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# A PMSG Wind with Power Factor Correction and PV Based Multiport High Voltage Gain Converter

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## ABSTRACT

Single source boost converter may not be able to give power continuously if generated voltage is less. Since PV power is not available all times, one or more sources are proposed to reduce the effect of this condition. This paper presents a hybrid photovoltaic and PMSG wind based multiport dc-dc converter with high voltage gain and single switch based power factor correction rectifier. Perturb and observe algorithm is used to extract maximum power from PV source. The proposed single switch boost rectifier for PMSG based wind energy system ensures power factor correction in order to eliminate reactive power or loss component in power of the system which totally improves the power quality of the system. Further the proposed multiport dc-dc converter shows lesser harmonics in the output which is confirmed by measuring total harmonics distortion of converter current, THD is less in the range of 4%. More than one source is used in proposed multi port dc-dc converter to continuously supply reliable power. The proposed multi port dc-dc converter is simulated in MATLAB/Simulink environment and results are presented to verify merits of proposed converter.

**Keywords:** Permanent magnet synchronous generator (PMSG), Power factor correction (PFC), Total harmonic distortion (THD)

## INTRODUCTION

Single source renewable energy <sup>[1, 2]</sup> based boost converters cannot supply inverter or a drive if produced output from source is very less. Hence if more than one source is used for a converter operation of inverter is possible with either of the source. Multi-port power electronic converter has integrated one or more sources like solar with maximum power point tracking based boost converter and PMSG <sup>[3, 4]</sup> wind based three phase single switch power-factor-correction boost rectifier can improve power factor and achieve less total harmonic distortion (THD) power converter. <sup>[5]</sup> In proposed a

control system for permanent magnet synchronous generator based wind energy system. Multiport dc-dc converter with three inputs PV, battery, super capacitor for reliable operation. <sup>[6]</sup> The proposed a reactive power controller for power quality enhancement of wind energy conversion systems. Bidirectional multiport dc-dc converters are required for double side energy transfer applications such as energy storage systems including battery, super conducting energy storage systems <sup>[7]</sup>.

**Proposed multiport DC-DC converter:** Fig. 1. Shows overall block diagram of proposed multiport dc-dc converter fed induction motor drive. With multiport converter system the proposed drive can operate with the presence of either of input. A new multiport dc-dc converter is implemented for reliable dc power supply. PV is modeled using its single diode equivalent circuit and mathematical model of its characteristic equations. Perturb and observe algorithm is employed to extract maximum power from photo voltaic source. Permanent magnet synchronous generator based wind energy system is used as one more input to multiport system.

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In wind side a power factor corrected single switch three phase boost rectifier is introduced. Fig. 2. Shows the circuit diagram of proposed single switch based PFC boost rectifier.

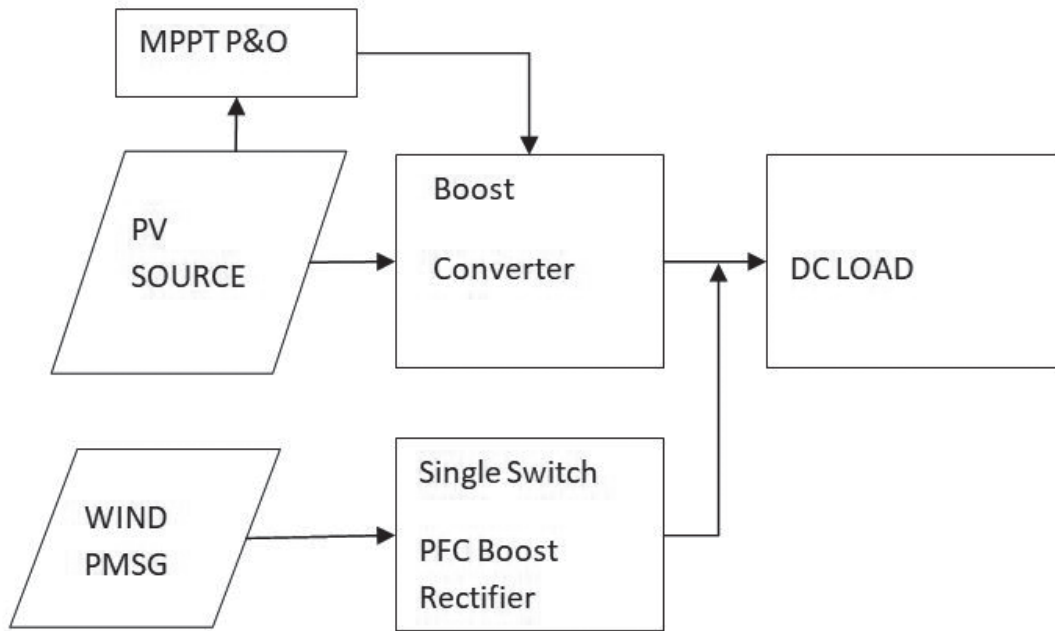


Fig. 1: Block Diagram of proposed multiport DC-DC converter

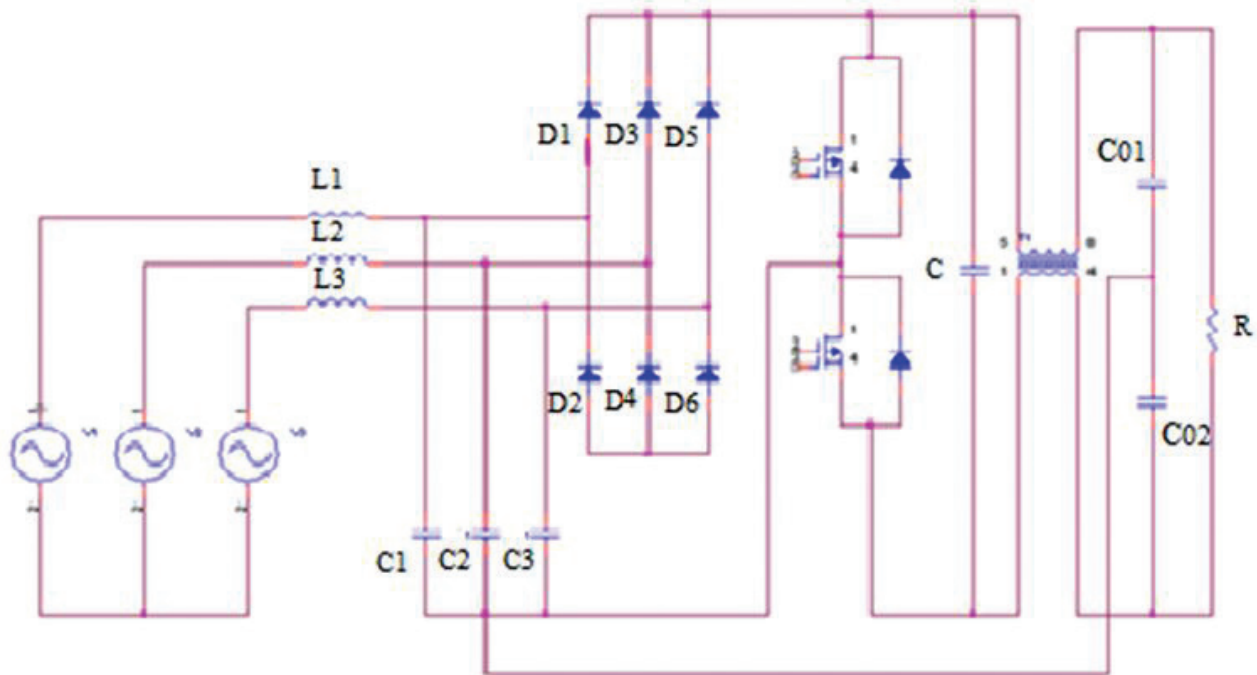
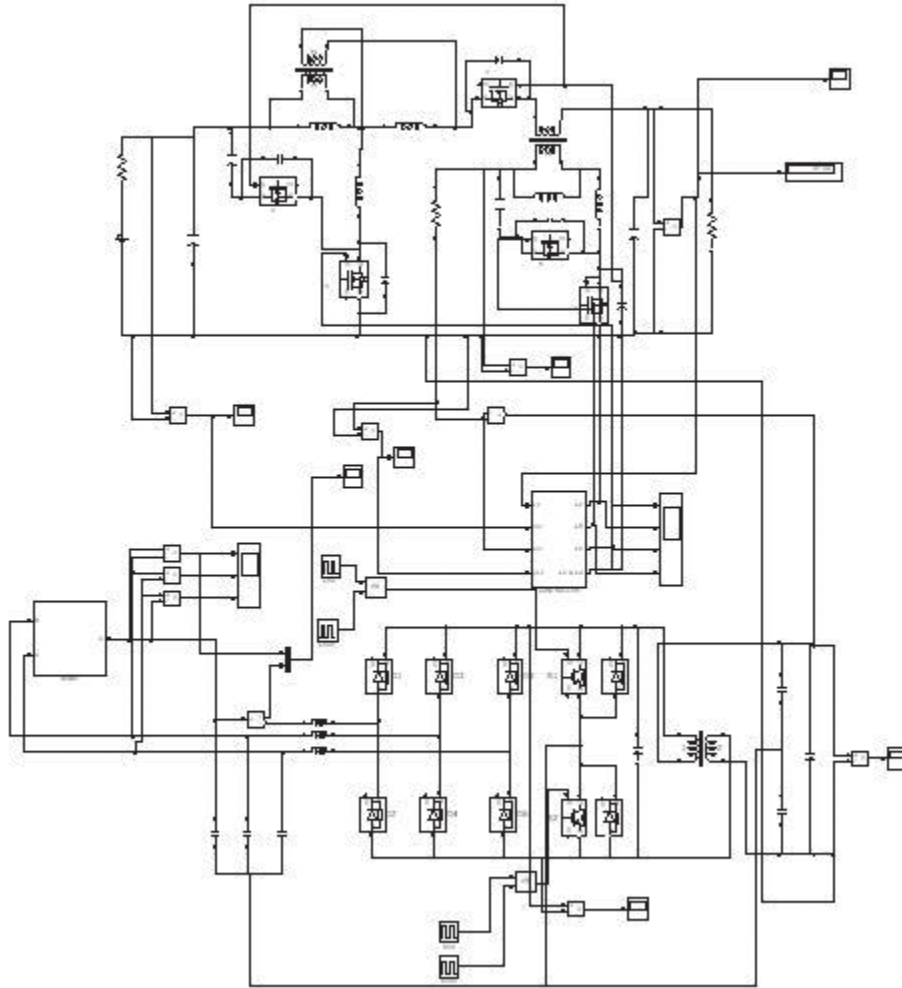


Fig. 2: Circuit Diagram of PFC rectifier for wind PMSG

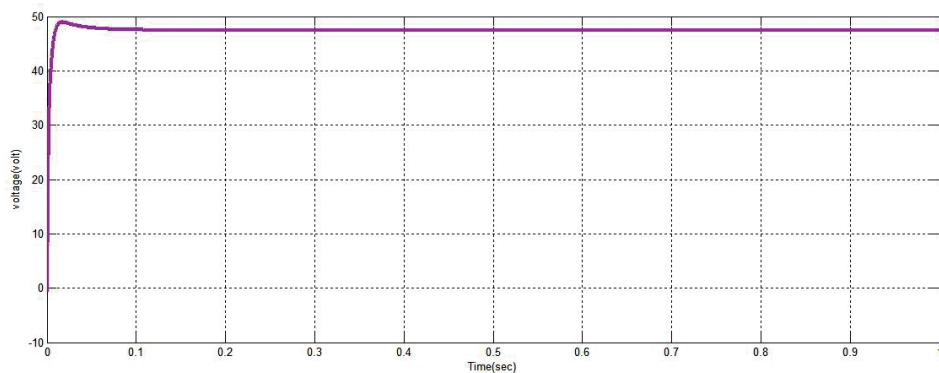
**Simulation Results and Discussion:** The proposed solar and PMSG wind based multiport port dc-dc converter is implemented in MATLAB/Simulink platform and results are presented here. Fig3. Shows simulation implemented circuit of proposed multiport dc-dc converter. Fig3. Shows PFC single switch boost rectifier circuit used for wind PMSG. Fig 4 shows Voltage performance of proposed multiport dc-dc converter, Fig 5 to 7 shows performance of proposed multiport dc-dc converter, PMSG wind output of single phase, power factor correction performance and total harmonic distortion values. Table1 shows simulation parameters of proposed circuit used in Simulink platform.



**Fig. 3: Simulation implementation of proposed multiport dc-dc converter**

**Table 1: Simulation parameters**

Resistance Rs	1k ohms
Inductance Ls	1m H
Capacitance (C)	22uF
Output Capacitor(C)	2200uF
Load resistor	10 ohms



**Fig. 4: Voltage performance of proposed multiport dc-dc converter**

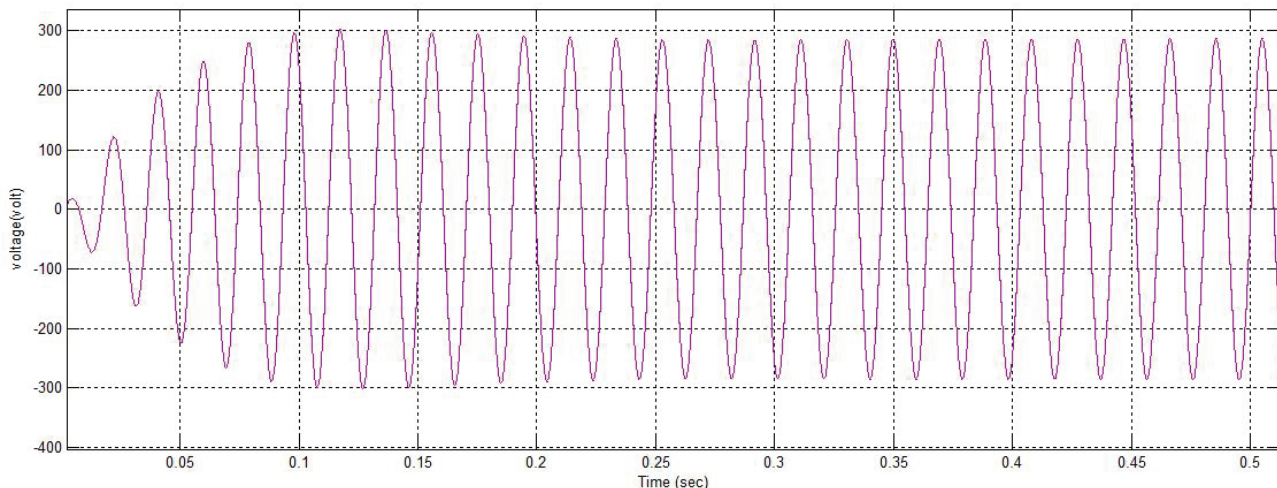


Fig. 5: PMSG wind output of single phase

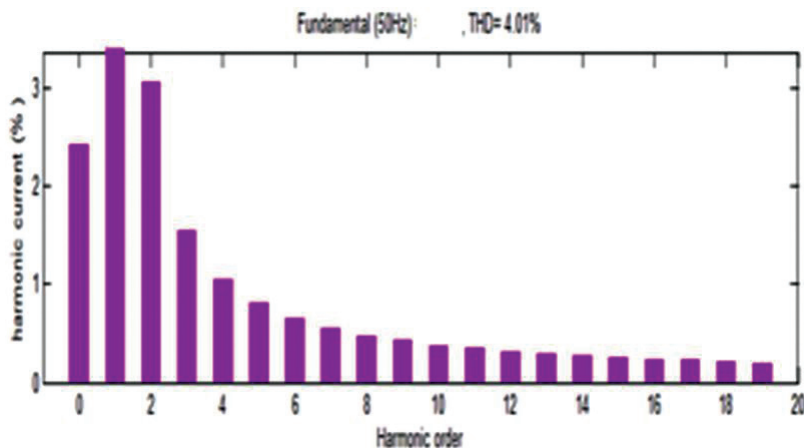


Fig. 6: THD performance of wind

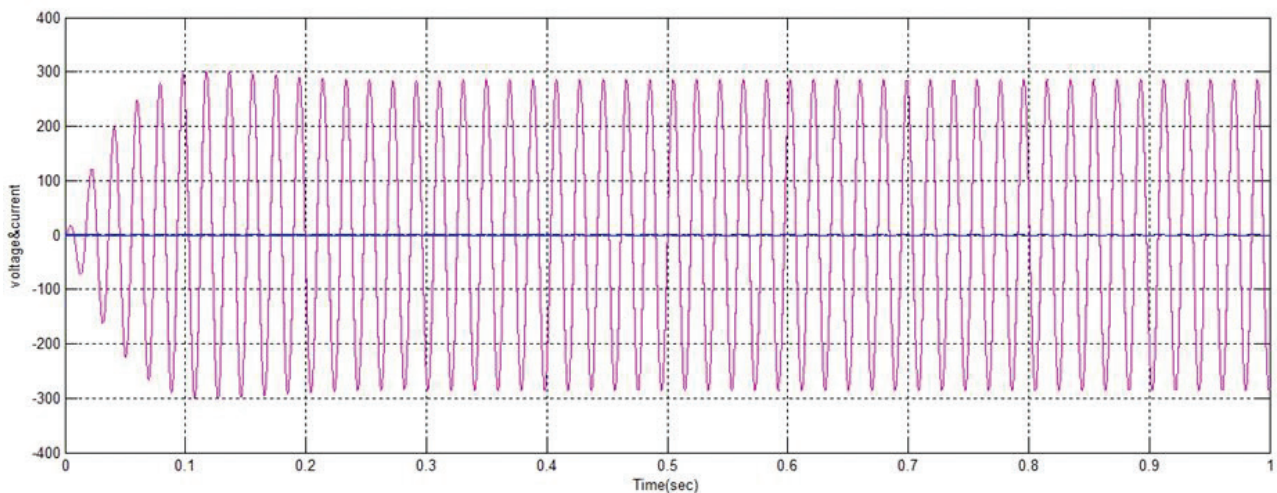


Fig. 7: PFC using single switch rectifier

**CONCLUSION**

The multi port photovoltaic boost converter with maximum power point tracking algorithm and PMSG

wind energy single switch power factor corrected boost rectifier has produced output voltage with high gain and improved power quality performance. The proposed multi port dc-dc converter is simulated in MATLAB/

Simulink environment and results shows that power factor is high near to unity and THD of the proposed converter is decreased to 4%. Achieved boost ratio of the proposed multi port converter is 1:5 with high power. This converter can be used as a power management device, allocating power to load if generation matches load and if excess power is available store it in some energy storage device.

**Ethical Clearance:** AMET University

**Source of Funding:** self

**Conflict of Interest:** Nil

### REFERENCES

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# A Power Electronic Converter for Tidal Turbine Generation Using DC Generators

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## ABSTRACT

In general tidal power generation involves more than one turbine, normally a marine system involves a multi generator system. Single source boost converter may not be able to give power continuously if generated voltage is less. Since generated power from turbine is not available all times, one or more sources are proposed to reduce the effect of this condition. This paper presents a hybrid tidal based PMSG and DC generator for multiport dc-dc converter with high voltage gain and single switch based power factor correction rectifier. The proposed single switch boost rectifier for PMSG based wind energy system ensures power factor correction in order to eliminate reactive power or loss component in power of the system which totally improves the power quality of the system. Further the proposed multiport dc-dc converter shows lesser harmonics in the output which is confirmed by measuring total harmonics distortion of converter current, THD is less in the range of 4%. More than one source is used in proposed multi port dc-dc converter to continuously supply reliable power. The proposed multi port dc-dc converter is simulated in MATLAB/Simulink environment and results are presented to verify merits of proposed converter.

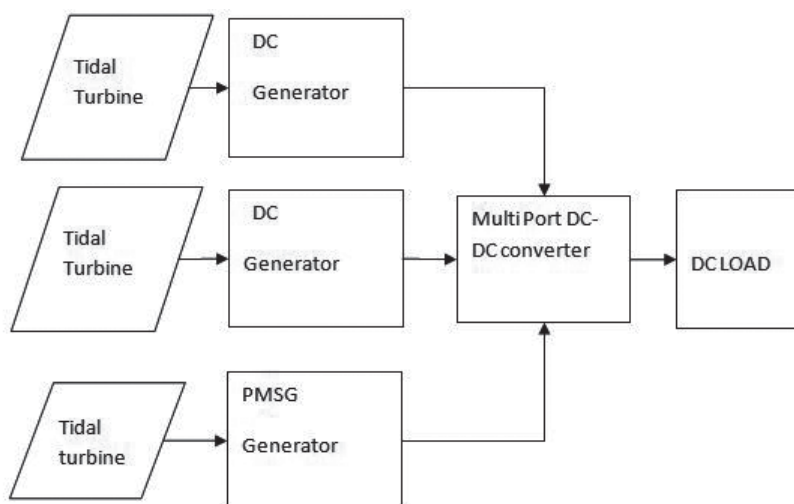
**Keywords:** DC SHUNT generator, Permanent magnet synchronous generator (PMSG), Power factor correction (PFC), Total harmonic distortion (THD)

## INTRODUCTION

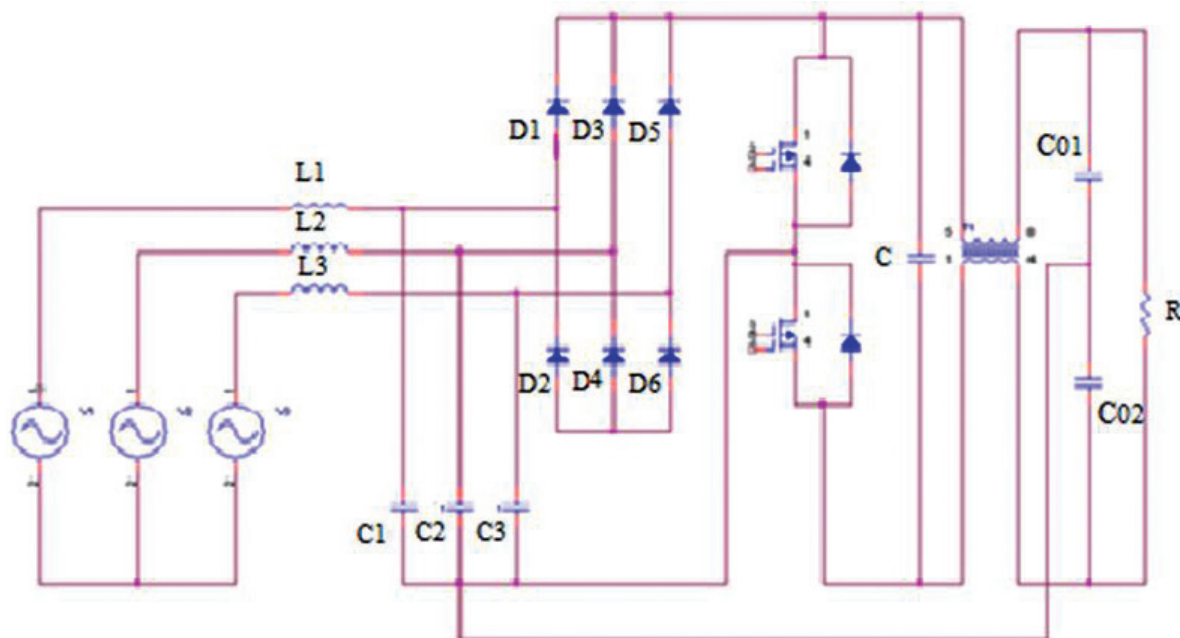
Single source renewable energy based boost converters cannot supply inverter or a drive if produced output from source is very less. Hence if more than one source is used for a converter operation of inverter is possible with either of the source. Multi-port power electronic converter has integrated one or more sources like solar with maximum power point tracking based boost converter and PMSG wind based three phase single switch power-factor-correction boost rectifier can improve power factor and achieve less total harmonic distortion (THD) power converter. <sup>[1]</sup> In proposed a control system for permanent magnet synchronous generator based wind energy system. <sup>[2]</sup> In presented a PFC rectifier for PMSG based wind system. Multiport dc-dc converter with three inputs PV, battery, super capacitor for reliable operation <sup>[3-5]</sup>. <sup>[6]</sup> Discussed the high

efficiency renewable PV inverter topology. A reactive power controller for power quality enhancement of wind energy conversion systems. Bidirectional multiport dc-dc converters are required for double side energy transfer applications such as energy storage systems including battery, super conducting energy storage systems. Optimization techniques based Solar panel crack detection is analyzed <sup>[7]</sup>.

**Proposed multiport DC-DC converter:** Fig. 1. Shows overall block diagram of proposed multiport dc-dc converter fed from multiple tidal turbine at different altitude coupled with DC generator and PMSG. With multiport converter system the proposed drive can operate with the presence of either of input. A new multiport dc-dc converter is implemented for reliable dc power supply<sup>[8]</sup>.



**Fig. 1: Block Diagram of proposed tidal power generation based multiport DC-DC converter**



**Fig. 2: Circuit Diagram of PFC rectifier for tidal fed PMSG**

Permanent magnet synchronous generator based tidal energy system is used as one more input to multiport system. In PMSG side a power factor corrected single switch three phase boost rectifier is introduced. Fig2. Shows the circuit diagram of proposed single switch based PFC boost rectifier for PMSG coupled with tidal turbine. Two tidal turbines is fed to a dc generator which are level increased using a normal boost converter. Another tidal turbine coupled with a permanent magnet synchronous generator is converted to DC using a power factor corrected single switch boost rectifier linked with the same DC link of multiport converter.

**SIMULATION RESULTS AND DISCUSSION**

The proposed solar and PMSG wind based multiport port dc-dc converter is implemented in MATLAB/ Simulink platform and results are presented here. Fig3. Shows simulation implemented circuit of proposed multiport dc-dc converter. Fig3. Shows PFC single switch boost rectifier circuit used for wind PMSG. Fig4 shows Voltage performance of proposed multiport dc-dc converter. Fig 5 to 7 shows performance of proposed multiport dc-dc converter, PMSG wind output of single phase, power factor correction performance and total harmonic distortion values. Table1 shows simulation parameters of proposed circuit used in Simulink platform.

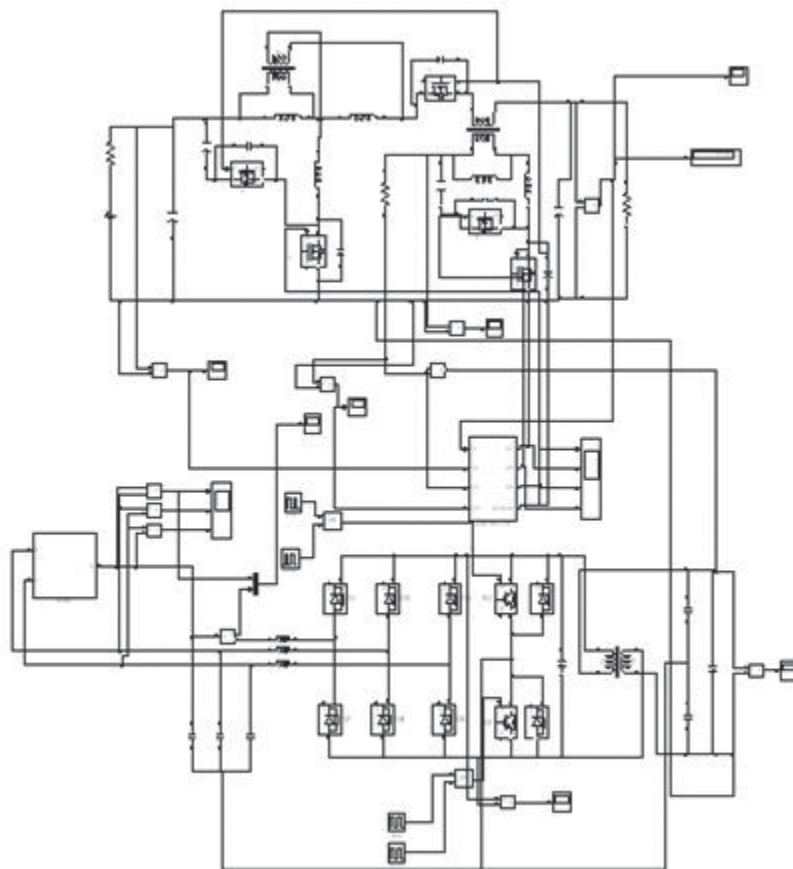


Fig. 3: Simulation implementation of proposed multiport dc-dc converter

Table 1: Simulation parameters

Resistance $R_s$	100 ohm
Inductance $L_s$	120m H
Capacitance ( )	1uF
Output Capacitor( )	100uF
Load resistor	100 ohms

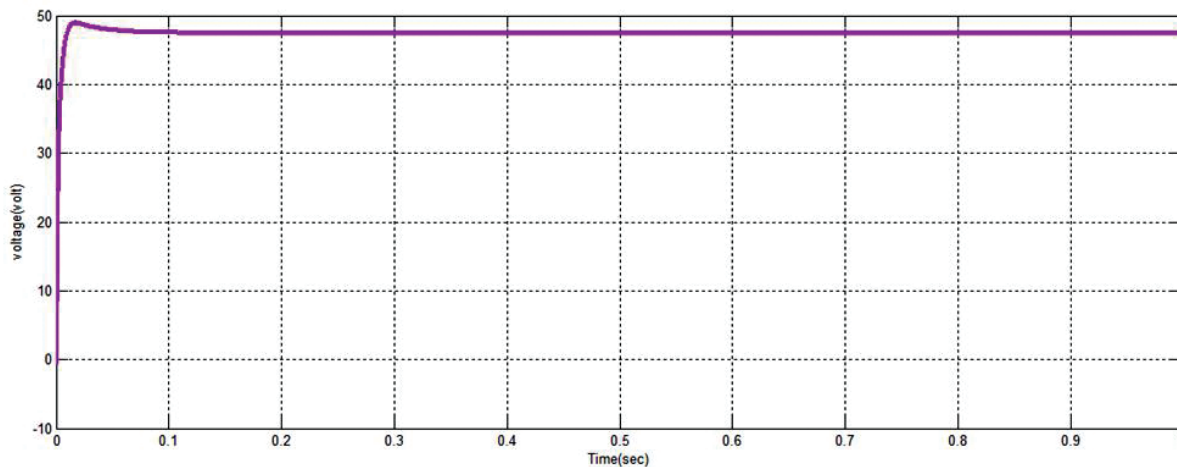
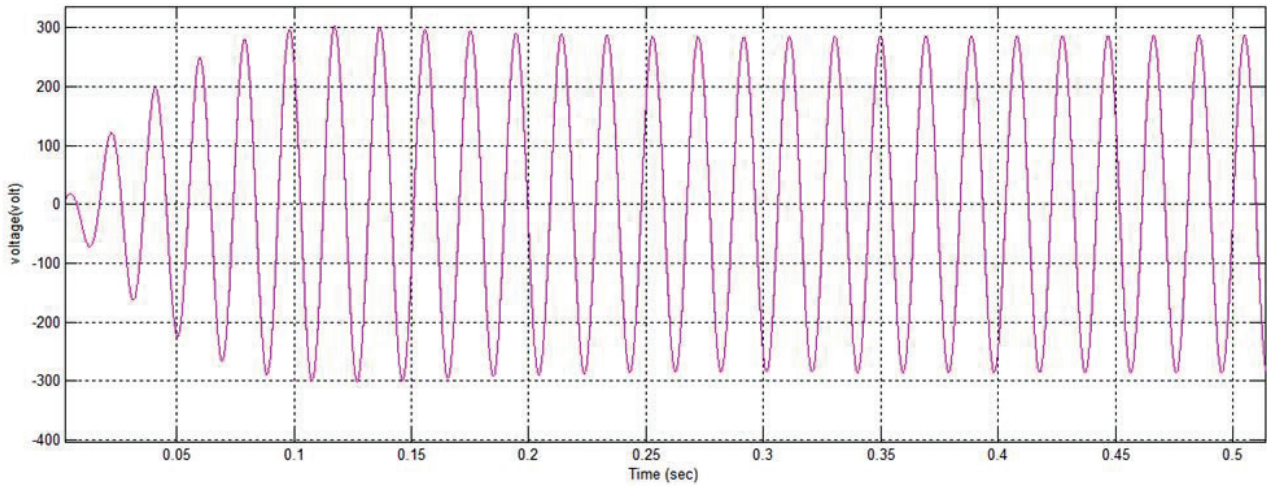
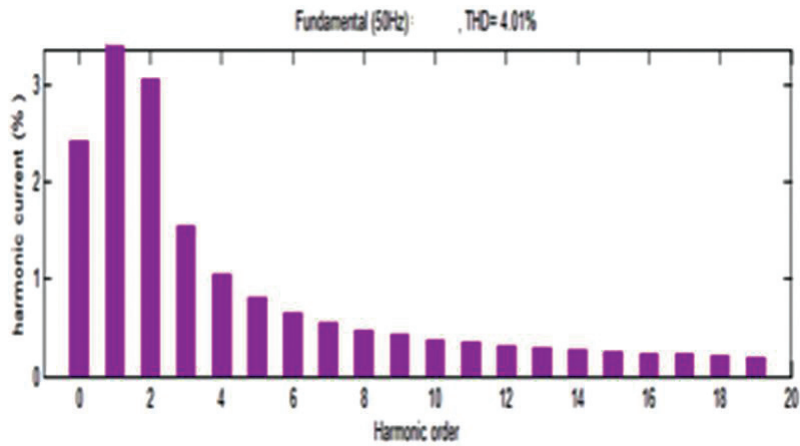


Fig. 4: Voltage performance of proposed tidal power generation fed multiport dc-dc converter

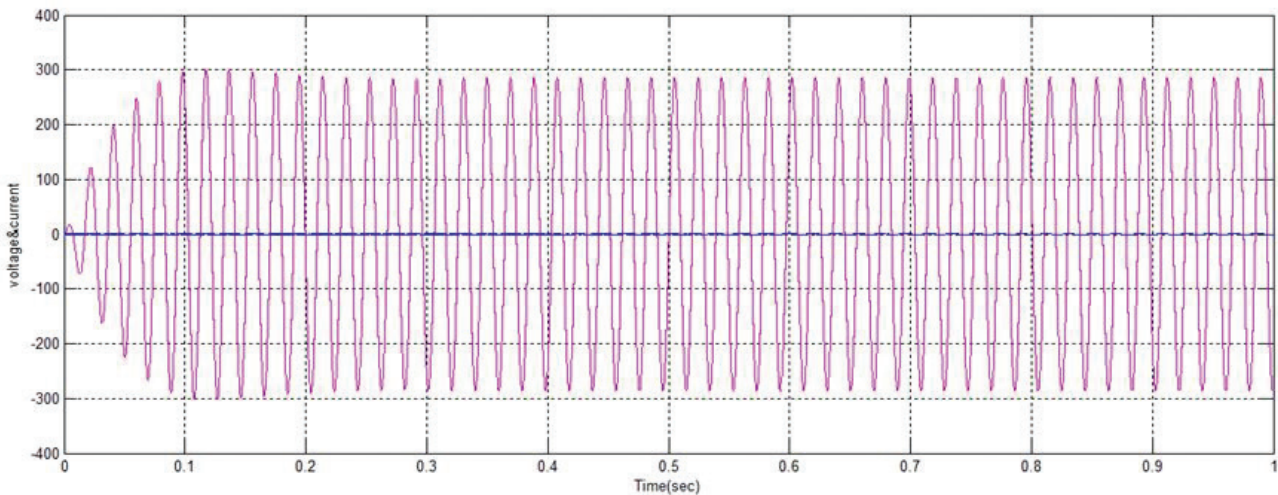




**Fig. 5: PMSG voltage output of single phase**



**Fig. 6: THD performance of PMSG**



**Fig. 7: PFC using single switch rectifier**

**CONCLUSION**

The multi port boost converter and PMSG based single switch power factor corrected boost rectifier has

produced output voltage with high gain and improved power quality performance. The proposed multi port dc-dc converter is simulated in MATLAB/Simulink environment and results shows that power factor is high

near to unity and THD of the proposed converter is decreased to 4%. Achieved boost ratio of the proposed multi port converter is 1:5 with high power. This converter can be used as a power management device, allocating power to load if generation matches load and if excess power is available store it in some energy storage device.

**Ethical Clearance:** AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Addition of Glass Fibre and Steel Fibre in Concrete to Increase the Stability

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## ABSTRACT

The recent introducing of fiber reinforcement concrete in the field of civil engineering. This product (concrete) has an advantage of being lightweight and reduces the cost, it also economy to the construction. The researchers are going all around the world to develop the performance of the glass fiber adding concrete and with other admixtures up to the certain extent. The some of the admixtures which been used like glass, steel, carbon, etc., are mostly wide in durability, shrinkage, strength, impact, cavitations, and the serviceability of concrete. The present job is to build up of information about the glass fiber and steel fiber in the concrete.

**Keywords:** glass fiber, steel fiber, concrete, strength.

## INTRODUCTION

**Glass Fiber Reinforced Concrete:** Glass fiber is made up of more than separate filaments, which are bonded up lightly make up a stand. In normal concrete, the conventional mixing techniques will not be possible to mix more than the 2% of the fibre in a length of 25mm. Table 1 displays the material details.

**Table 1: Input Study material**

S. No.	Properties Of Glass Fiber	
1.	specific gravity	2.68
2.	elastic modulus(Gpa)	72
3.	tensile strength(Mpa)	1700
4.	diameter(micron)	14
5.	length(mm)	12
6.	number of fiber (million/Kg)	235

This paper also explained in, Fabrication of CuO nanoparticles for structural, optical and dielectric analysis using chemical precipitation method <sup>[1]</sup>. Structural, morphological, optical and electrical properties of nickel sulfide thin films are explained <sup>[2]</sup>. Glass fiber reinforced concrete composites–strength and behavior studies are included<sup>[3]</sup>.

**Steel Fiber Reinforced Concrete:** Various steel fiber ports are accessible as support. Round steel cord the utilized sort are created by slicing round wire into the

short length. The run of the mill measurement lies in the scope of 0.25 to 0.75mm. Steel strands having a rectangular c/s are delivered by sitting the sheets around 0.25mm thick. The fiber produced using mellow steel drawn wire. Fitting in with IS: 280-1976 with the width of wire fluctuating from 0.3 to 0.5mm has been essentially utilized as a part of India <sup>[4, 5]</sup>. Round steel filaments are created by cutting or hacking the cable, level sheet strands having a run of the mill c/s going from 0.15 to 0.41mm in thickness and 0.25 to 0.90mm in width are delivered by sitting level sheets. Distorted fiber, which is in exactly limited with water-solvent paste as a package are additionally accessible. Since individual filaments tend to group together, their uniform appropriation in the network is frequently troublesome <sup>[6]</sup>. This might stay away from by including strands groups, which isolate amid the blending procedure.

Studies on glass fiber reinforced concrete composites–strength and behavior then investigations on synthesis, structural, surface morphological, optical, and thermal properties of copper oxide nanofluids<sup>[7]</sup>.

Steel and aroused steel strands don't erode in chloride fixation that more prominent than 2 percent by weight. Also, at significantly more prominent chloride particles, dissolve extricated fiber does not consume. Steel fiber strengthened cement gives better resistance than splitting and break spread because of expanded elasticity in stable structures <sup>[8]</sup>.

### COMPRESSIVE STRENGTH

The average compressive quality for 3D square at various rates (0%, 1.5%, 1.8% and 2.0%) at age 7, 14, and 28 days, it Can be noticed that, solid quality contrast and control concrete. The Fig 1 demonstrates the malleable disappointment of 3D square examples. The graphical portrayal shows the compressive quality of glass fiber and steel fiber. Fig 2 explores the comparison of compressive strength of cubes.



Fig. 1: compressive test

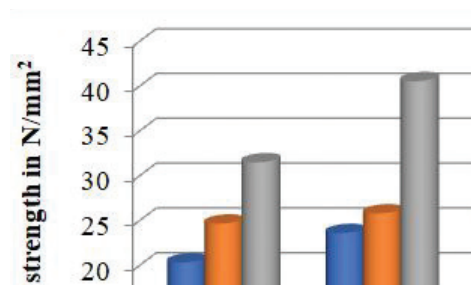


Fig. 2: comparison of compressive strength of cubes

### SPLIT TENSILE STRENGTH

The average split Tensile quality for chamber at various rates (0%, 1.5%, 1.8% and 2.0%) at age 7,14 and 28 days, it Can be noticed that, solid quality contrast and control concrete in Fig 3. Table 2 explores test results cylinders for split tensile strength.



Fig. 3: comparisons of split tensile strength of cylinders

Table 2: Test Results Cylinders for Split Tensile Strength

Sl. No.	Curing Days	Average Split Tensile Strength Inn/Mm <sup>2</sup>			
		Control Concrete	Glass Fibre & Steel Fibre Concrete		
			1.5%	1.8%	2.0%
1.	7	2.5480	2.41	2.54	2.89
2.	14	2.7391	2.61	2.78	3.15
3.	28	2.9550	3.29	3.32	3.54

### FLEXURAL STRENGTH

The average flexural strength of the beam at different percentages (0%, 1.5%, 1.8% and 2.0%) at age 7, 28 days, it can be noted that concrete strength compares with control concrete. The graphical representation shows the flexural strength of glass fiber & steel fiber. Figure 5 explains the comparisons of flexural strength of beams. Table 3 displays the test results beam for flexural strength.



Fig. 5: comparisons of flexural strength of beams

**Table: 3 Test Results Beam For Flexural Strength**

Sl. No.	Curing Days	Average Flexural Strength Inn/Mm <sup>2</sup>			
		Control Concrete	Glass Fibre & Steel Fibre Concrete		
			1.5%	1.8%	2.0%
1.	7	3.46	2.78	2.85	3.05
2.	14	4.28	3.29	4.32	4.52
3.	28	5.86	5.61	6.53	6.81

**CONCLUSION**

The concrete was prepared for the M20 grade concrete with the addition of glass fiber & steel fiber with various percentages of 0%, 1.5%, 1.8% and 2.0%. The specimens were cast for 7days, 14 days and 28 days then tested. The results are presented below.

- The maximum flexural strength for the addition of glass and steel fiber be achieved by 2.0% is found to be greater than the conventional concrete.
- It achieved maximum compressive strength when there is an addition of glass and steel fiber (2.0%).
- So the maximum percentage of addition of glass fiber & steel fiber is 2.0%.

**Ethical Clearance:** AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Concept on Internet of Things (IoT) sensors based Non-Destructive Evaluation Technique (NDE)

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## ABSTRACT

Till quite recently, in-service defect monitoring of Industrial Equipments is being accomplished by tedious manual methodologies for utilizing the conventional or Non-Destructive techniques for defects monitoring. There have been efforts in the recent past to make use of mini mobile robots with NDE techniques for defect monitoring in the inspection of pipes with reasonable success. In this context, this paper proposes a new development methodology of conceptual Internet of Things (IoT) sensors based Non-Destructive Evaluation Technique (NDE) based on Ultrasonic for in-service defect monitoring of Industrial Equipments. The underlying philosophy chosen is 'integrating an ultrasonic Non-Destructive Evaluation sensor packaged with IoT based sensor'. During the run time, the integrity of material will be done. Non-Destructive testing allows measurement of material properties without inflicting any damage to the material in process. An IoT with wireless network coupled with NDE facilitates the mutual effort to monitor a certain aspect without the use of valuable fixed wired circuits. A typical system architecture of a 'paired module' comprising of IoT sensor and NDE sensor packaged to monitor the defect status conditions of the pipelines is envisaged. A specific study is elaborated to monitor the thickness of a in-service pipeline used in Industrial Equipment. This concept methodology aims to work as an alternate to the existing technologies in similar context while providing enormous advantages over the existing methods.

**Keywords:** *In-service inspection, Non-Destructive Evaluation (NDE), Ultrasonic, Internet of Things (IoT)*

## INTRODUCTION

In industries, Non-Destructive testing and Non-Destructive Evaluation are very important aspects for defect monitoring, defect quantification, analysis and mitigation. This covers a large number of industrial activities, with new NDT methods and applications being continuously evolved<sup>[1]</sup>. Non-Destructive Testing methods are usually applied in industries where a failure of component would cause appreciable hazard or economic liability in transportation, building structures, piping's and hoisting equipments<sup>[2]</sup>. Weldment defects can be tested using conventional and NDT techniques such as ultrasonic testing<sup>[3]</sup>. There are numerous fundamental issues related to the practical implementation of

Ultrasonic NDT techniques in an industrial environment which need to be tackled<sup>[4]</sup>. In the case of in-service inspection in industries, after the manual inspections for a period, robotic inspections using mini robots are catching up. This aspect is well explained in the Robotic NDT inspection<sup>[5-6]</sup>. The property of Ultrasound is the capability to provide a perfect quantitative measurement this property will have major advantage. This means that the thickness measurement can be determined reliably with high precision. The available accuracy regarding depth measurement for the latest generation of tools is around  $\pm 0.4$  to  $0.5$  mm. The highest possible declaration that is arrived at today is  $0.06$  mm. usually thresholds for depth measurement of metal loss or cracks are set at  $1$  mm, however lower thresholds are possible

At this juncture, a novel concept is contemplated so as to conceive of in-service inspection in which even moving parts such as mini robots need not be deployed. The IoT sensor coupled with NDE sensor is the result of this thought process. The IoT, 'Internet of Things' could do anything from controlling appliances slightly. The

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IoT concept with its simplest format alone is proposed with NDE sensor packaged together. Such kind of activity is reported on Ultrasonic Non-Destructive Testing (NDT) using Wireless Sensor Networks. The philosophy of Wireless Sensor Network along with built in sensor intelligence manifests itself as IoT which is exploited in our proposed IoT-NDE based application.

The proposed application configures the IoT sensor which takes on the signal from NDE sensor which is packaged together with IoT module and sends the vital parameters on the defect analysis to a distant location at a considered distance of about (say) 100.

**Ultrasonic based NDE sensor for defect monitoring:**

Non-destructive testing and valuation is widely used technique to validate or check materials without causing damage to the material under testing. Ultrasound-waves are mostly used in this technique as an ultrasound wave exhibits different behaviors in several material properties. Sound waves outside the hearing of human threshold represent ultrasounds, which typically starts from 18 KHz.. When an ultrasound signal moves from one material medium into another different medium, a portion of the signal-energy passes through to the other medium, while the remaining energy is reflected back. By analyzing the speed of ultrasound signals in various material densities, and by quantifying the properties of the reflected signal, such as time-difference-of-arrival (TDOA) and signal intensity, we can calculate information of volume, thickness, number of various mediums, temperature, and more of materials.

Ultrasonic testing is not been disturbing as applied to the outside of a pipe or vessel in industrial equipment. Ultrasonic transducers or probes need to be applied through these contacts with the exterior surface of the pipe or vessel. This may involve scaffolding, excavation and stripping coatings or insulation. This is achieved in the real world by lighter mobile ultrasonic equipment with the help of a professional inspector. It is an accurate and relatively low cost non-destructive examination (NDE) method to deploy in most of the times. However, the operator has to be subjected to potentially dangerous environments and the accuracy and repeatability of ultrasonic measurements depend on the operator. The measurements are only performed periodically, taking a snap-shot of the plant condition.

A new approach of ‘installed ultrasonic sensors’ is emerging to challenge the manual UT (Ultrasonic Testing)

inspections and existing corrosion-rate monitoring solutions. This is due to their ability for improved data quality, onetime, non-invasive installation, and their ability to operate remotely without human interaction. As with UT thickness gauging, the resolving is based on relatively simple ultrasonic principles.

A transducer that can convert electrical energy to high-frequency acoustic or ultrasonic energy and vice-versa is semi-permanently attached to the surface of the object or asset under test. The transit time between the initial electrical-excitation pulse and return echoes (or between echoes) is used to calculate wall thickness.

Though the in-situ sensor solution is similar to manual thickness gauging, it is fundamentally different as the transducers and instrumentation are deployed/ installed semi-permanently.

This aspect has advantages such as i) instrumentation and probes can be accessed from a distance ii) data can be reviewed from a convenient access point for the manual data collection option or can be accessed remotely iii) Operator-to-operator, probe-to-probe, and instrument-to-instrument, variability is eliminated. iv) Data can be acquired on a more frequent basis for automated systems allowing for more frequent measurement aiding statistical data analysis. v) by deploying an integration temperature measurement device, acoustic velocity due to temperature variation can be automatically removed. vi) Wired and/or wireless installed sensor systems can make use of various forms of data backup, including the intranet, industrial wireless networks such as 802.15.4, (wireless HART, ISA100 or ZigBee), and satellite or cellular networks facilitating real-time data availability.

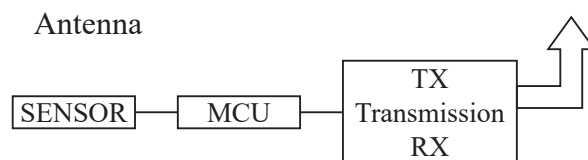
The paper also is described in, Design of optical sensor for detection of brininess of water <sup>[6]</sup> Application of machine learning for real-time evaluation of salinity (or TDS) in drinking water using photonic sensors Analysis on the structural, spectroscopic, and dielectric properties of borate glass are done.

**Ultrasonic sensor as a mini-packaged module for deploying in pipeline:**

The NDE technique proposed being ultrasonic sensor based is aimed to be packaged so as to fit in a pipeline for in-service inspection. The commercially available ultrasound-based NDT equipment is too-large and power-intensive. This is due to the fact that this equipment is displaying graphically

measured data in real-time and requires high sampling analog to digital converted (ADCs). But this process is not required as the IoT based sensor is designed to receive the raw data only the NDE sensor where as the IoT sensor using its intelligence taps only significant data for wireless transmission to a remote location. Therefore the only required part of the NDE system is the Ultrasound front-end generating Ultrasound signal and its timely reception. This significantly reduces power consumption and size of an IoT based NDE system. Further the continuous monitoring for a particular period of time, while the operation is a mini package ideally suitable. Efforts are made to choose the micro components and the interfaces for manufacturing the integrated compact module.

**IoT sensor concept for parameter acquisition and transmission:** The IoT is a network of sensors where data is exchanged, using different connectivity protocols, with systems [7, 8]. The transferring of data's can be done in two different ways between sensors and systems. The IoT in a general sense depicts a network topology comprising of simple nodes that collect and transmit a limited amount of data to a central controller or gateway which provides connectivity to the Internet and cloud services [9]. In the present context of the IoT based NDE for in-service defect monitoring in Industrial applications, the IoT manifestation is consciously abridged in such a manner that NDE acquired data is fed to IoT sensor wherein the useful significant data is handpicked for further transmission to the processor kept at a remote distance. Having said this, it becomes a proposition of building the IoT sensor model by designing the relevant configuration of data acquisition and wireless connectivity with associated software protocols. The aspects of sensor hierarchy & sensor independent intelligence are taken care. The most important aspect of this IoT sensor model is that it has to be extremely compact and has to dovetail with NDE sensor as a single package which can be suitably placed in the pipeline. Such modules can be designed so as to fix at different strategic locations in the pipelines for defect monitoring and transmission of data using NDE techniques. The compactness requirements dictate the nodes and gateways to consume minimum power and they should provide consistent and stable network connection and extend wireless connectivity range as far as possible. A typical IoT configuration is show below in Figure 1



**Figure 1: Schematic diagram of A typical IoT configuration**

The starting point of IoT is the thing itself. This thing has a low power processor, some sort of embedded operating system and a way of communication (usually wirelessly) using suitable communication protocols.

The main entity of IoT systems is a processor unit or microcontroller (MCU) that processes data and runs software stacks interfaced to a wireless device for connectivity. Requirements for both the MCU and wireless device are specific to the end application and system requirements. Advanced IoT sensor nodes consolidate sensor functions and use an 8-bit MCU or a 32-bit device to run a small radio frequency (RF) protocol stack. These devices are typically battery powered and connected to gateways to take care of heavier processing and data transmission.

The things may connect directly to the neighboring things or an Internet gateway device. The subsequent level is 'ingestion tier' – software & infrastructure responsible for managing things and updating firmware. Then comes 'analytic tier', takes organized data & processes it. Finally 'end-user' tier comes where actual application.

Sensor Nodes are designed typically to transfer small amounts of data and often have to operate on batteries for several years. The devices must also be portable, reliably connected and able to operate under varied environmental conditions regardless of RF interference or physical barriers. Because these devices are part of networks, the setup of networks, integration of sensor data and display of information must also be considered. The combined selection of the suitable MCU and wireless or RF connectivity for these devices as well as development tools and software stacks for application development are critical to their successful design.

The complete process of IoT-NDE implementation involves the phases of - Selecting a Microcontroller (MCU), Selecting the Appropriate Wireless and RF Connectivity Solution, Simplifying Design with Integrated Components, Meeting Low Power Requirements, Accelerating Software Development.



The connected “things” send and receive data through the network relating to a various physical characteristics—temperature, moisture level, pulse rate, light level, velocity or revolutions per minute—as well as more complex data such as maintenance requirements, sounds, and static or moving images

A software system designed intelligently manages the things and the networks they use, organizes and stores the vast amounts of data they generate, and processes it and presents it for end users.

**IoT based NDE application—A case study:** The IoT sensors coupled with Ultrasonic sensors are modeled and simulated to start with[9,10]. Suitable locations for in-situ placement in the in-service pipe line will be analyzed and finalized. The sensor network will be studied for Network connectivity. Each sensor suit will be checked for its efficacy in detecting corrosion and weldment defect will be studied and suitable design modification of the parameters will be effected. Subsequently software protocols will be developed for transporting data and interconnecting them and feed a common node for analysis and interpretation. In the process the simulation model and the physical model both will be achieved.

**IOT- NDE deployment model for pipe inspection:**

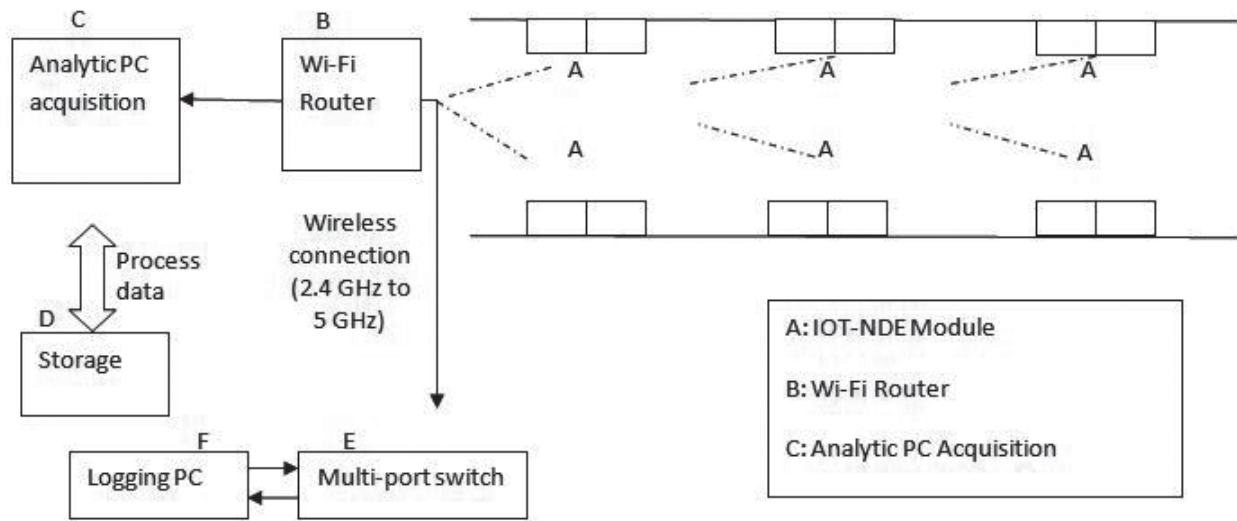


Figure 3: IOT-NDE deployment model

**CONCLUSION**

Ultrasonic testing wherein ultrasonic transducers or probes need to be applied in direct contact with the outer surface of the pipe or vessel in industrial equipment. In conventional method there are a few shortcomings namely testing involves scaffolding, excavation and

The ultimate aim is to design and develop IoT sensors coupled with NDE ultrasonic sensors for in-situ deployment in in-service inspection lines for detecting weldment defects, cracks and incipient corrosion and to develop suitable interfaces, software protocols for connectivity to remote location for monitoring. Figure 2 & 3 explores Schematic of IOT-NDE paired module.

The Ultrasonic Gauge with the Integrated IoT system measures different parameters of the pipeline studies various properties of them and transmits the information collected normally but when there is any crack or any unexpected phenomenon found it will transmit data citing the real information for decision making.

**DISCUSSION**

**An IOT-NDE ‘paired’ module: A schematic:**



Figure 2: Schematic of IOT-NDE paired module

IOT consists MCU, embedded software

stripping coatings or insulation. Though, it a low cost NDE method, the cost of accessing the structure often that exceeds the basic cost of inspection. In addition, a professional inspector is generally required to operate the ultrasonic sensor. In addition, ultrasonic testing sometimes requires personnel be exposed to potentially hazardous environments. The accuracy and repeatability

of ultrasonic range will be operator-dependent and it is known that the probability-of-detection (POD) is poor. Finally, the measurements are performed periodically; the snapshot is taken according to the condition of the plant. In recent times mini robots are increasingly getting deployed with NDE sensors for defect monitoring. These enumerated problems in all the above methods are overcome in this paper wherein the ‘conceptual model’ of IoT-NDE based system is described. Further the paper brings out a paradigm shift in defect detection wherein the practice of mobile instrumentation is replaced with in-situ methodology using IoT-NDE as a technologically advanced solution.

In summary, an IoT-NDE based system for in-service inspection of pipelines in industrial applications is proposed, with the technical details of basic NDE using ultrasonics, basic concepts of IoT suited to this situation and the two as an integrated module. An illustration is shown of its conceptual operation and finally compared with the existing methods for its effectiveness and progressive approach.

**Ethical Clearance:** Taken from AMET University

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# An Empirical Study of Students' English Performances in School

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## ABSTRACT

As the world is ending up noticeably more worldwide, English as a typical language of the world is winding up noticeably more critical in different fields. About every one of the colleges have opened English courses; be that as it may, there are numerous understudies, regardless of whether have exceptionally poor or great English execution in school, willing to burn through cash in taking an interest in English preparing outside of school. This paper is intended to investigate the connection between students' English exhibitions in school and inspirations to take an interest in English learning outside of school by observational techniques. The outcomes appear: the inspirations contain advancement, enthusiasm, appearing, to travel to another country, circumstances, to acquire work, and to escape from reality; among which understudies at various levels of execution have distinctive inspirations on enthusiasm, to escape from reality, and circumstances.

**Keywords:** *Students'; English learning; motivation; English performance.*

## INTRODUCTION

English as a typical language of the world is winding up plainly more critical in different fields, and an ever increasing number of individuals include themselves in the pattern of learning English <sup>[1]</sup>. Almost every level of school has opened English courses. Colleges likewise focus on English instruction. At colleges, in the course setting, from essential to unique, many courses with various accentuations have been opened <sup>[2]</sup>; about instructors, the greater part of colleges have utilized remote educators; and numerous colleges have English relationship to hold English exercises frequently <sup>[3]</sup>. Be that as it may, teaching in such endeavors, there are numerous understudies willing to burn through cash in partaking in English learning outside of school <sup>[4]</sup>. Through chatted with them, we found that their execution in English in school differed broadly. A few understudies are exceptionally well, yet some are extremely poor.

To clear these issues will help colleges to enhance English instructing technique, will likewise assist English preparing enterprises with setting up courses more focused on and to set down promoting methodologies <sup>[5]</sup>. understudies' inspiration of reimbursing one's family and guardians, looking for information, landing a position and carrying on with an existence, seeking after execution, serving for society and inactive inspiration <sup>[6-7]</sup>. Students as goal for research, and the outcomes demonstrated that innate premium, execution based, setting based,

abroad based, socially mindful, self-awareness and data media-persuaded are the primary inspirations of English learning. In our past review, we have investigated the inspirations of colleges' understudies to partake in English learning outside of school.

## PROPOSED SYSTEM

A survey was made to gather information from students who were partaking in English learning outside of school. This review is a reaching out of our past review; along these lines, we utilized the estimation scales which we investigated beforehand for reference. The estimation scales portrayed 28 factors and requested respondents to judge the criticalness of these elements as per their own particular insight of taking an interest in English preparing outside of school. All things embraced 7-point Likert scale, among which 1 signifies "unequivocally unimportant", 7 signifies "emphatically important". Moreover, we utilized great, great, direct, poor and extremely poor five levels to coordinate ask respondents English execution in school.

Students were the examination goal of this review. We gathered the examples in the classroom of English preparing outside of school by disseminating 300 polls taking all things together. At long last, 269 duplicates were returned, among which 230 were compelling.

Keeping in mind the end goal to express the structure of the first poll with less factors and keep up most data given by the first information, we embraced SPSS13.0 to break down the 28 factors by utilizing main parts of element examination. Bartlett Test of Sphericity Sig. = 0.000. KMO Measure of Sampling Adequacy = 0.761. The outcome uncovered seven variables that clarified 73.729% of the aggregate variety. The loadings of every one of these variables were higher than 0.59. As indicated by the included data, we named these seven components as: advancement, enthusiasm, appearing, to travel to another country, circumstances, to acquire business, and to escape from reality (Tab.1).

“Advancement” calculate, basically alludes to the inspiration of cooperation in extracurricular English preparing is better for the future improvement, for example, the overhauling of English in school execution, to perceive a few companions to grow human circle, et cetera. It incorporates factors from Q6-Q13.

“Interest” calculate, primarily alludes to the inspiration of interest in extracurricular English preparing is to meet claim love in different parts of English, for Descriptive Statistics and Results of Factor illustration, similar to English dialect itself, et cetera. It incorporates factors from Q1-Q5.

## DISCUSSION ABOUT THE SURVEY

“Appearing” figure, principally alludes to the inspiration of interest in extracurricular English preparing

is to meet its own execution, highlighting their own needs, for example, through enhance English outcomes to get acknowledgment from instructors and envy from colleagues. It incorporates factors from Q17-Q20.

“To travel to another country” figure, predominantly alludes to the inspiration of interest in extracurricular English preparing is to travel to another country, for example, through investment in preparing to discover chances to travel to another country, enhance English to acquire capabilities to travel to another country. It incorporates factors from Q26-Q28.

“Circumstances” elements, principally alludes to the inspiration of cooperation in extracurricular English preparing in light of not happy with English training in school, for example, don’t care for school English educators. It incorporates factors from Q21-Q23.

“To acquire business” calculate, primarily alludes to the inspiration of investment in extracurricular English preparing plans to better get ready for work, for example, through cooperation in selection test to enhance their own particular capabilities, to establish the framework for future improvement. It incorporates factors from Q14-Q16. Table 1 displays results of factor analysis

“To escape from reality” consider, chiefly alludes to the inspiration of investment in extracurricular English preparing is to keep away from offensive or generalization of grounds life. It incorporates factors Q24, Q25.

**Table 1: Results of Factor Analysis**

Observable Indicators	Load- ing	Comm- unities	Alp- ha	Observable Indicators	Load- ing	Comm- unities	Alp- ha	
Q1.enjoy English itself	0.843	0.778	0.888	Q17. to obtain recognitions from teachers and classmates	0.861	0.797	0.830	
Q2.like to learn language	0.907	0.880		Q18.to avoid being despise	0.740	0.741		
Q3.like English songs/ movies	0.730	0.657		Q19.to maintain or improve own status in school	0.809	0.753		
Q4.interest in people and cultures in English-speaking countries	0.793	0.756		Q20.to show off to friends	0.764	0.653		
Q5. to acquire interested knowledge	0.732	0.699		Q21. dislike school English teacher	0.807	0.743		
Q6. to Improve English ability	0.601	0.552		Q22.bad English textbook in school	0.933	0.889		
Q7. to recognize some friends	0.595	0.532		Q23. low English courses quality in school	0.809	0.738		0.861
Q8. not to lag behind others	0.524	0.582		Q24.to out of unpleasant school life	0.866	0.812		
Q9.to expand knowledge	0.709	0.747		Q25. to change the rigid lifestyle of school	0.791	0.764		0.740
Q10. to reinforce school learning	0.588	0.663		Q26. Looking for overseas study / work opportunities	0.834	0.781		
Q11. to further study other courses	0.690	0.597		Q27.to experience overseas culture	0.879	0.849		
Q12. English is important in today's society as communication tools	0.520	0.788		Q28. to prepare for go abroad in the future	0.905	0.859		0.901
Q13. to enrich after-class life	0.742	0.767						
Q14.to help entrance examination	0.826	0.782	0.870					
Q15. to obtain a certificate	0.849	0.815	0.831					
Q16. to help finding a good job	0.709	0.734						

## CONCLUSION

Advancement, enthusiasm, appearing, to travel to another country, circumstances, to acquire business, and to escape from the truth are seven inspiration components. Understudies at various levels of execution have diverse inspirations on enthusiasm, to escape from reality, and circumstances. Understudies at various levels of execution have diverse premium inspiration, and understudies with great execution contrast with understudies with poor execution out of more prominent premium inspiration to take an interest in English learning outside of school. With respect to the “premium”, premium is the best instructor; the understudies, who have solid enthusiasm for English, have put more vitality on English realizing which make them have great English execution. It might be likewise a direct result of this; they are not content with school instruction, and take part in the outside of school English preparing to meet that intrigue.

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# English Language Supports for Technology Learners

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## ABSTRACT

Understudies in their utilization of PC based materials (CbMs) past the classroom, incorporating into Self Access Centers (SACs). Polls and semi-organized meetings in center gatherings and coordinated were used to assemble data. The information recommends that understudies made standard and broad utilization of an extensive variety of materials in both their local dialect and the English dialect. Understudies perceived the significance of getting to and transmitting data in the English dialect. They seemed to make extensive utilization of CbMs for presentation to and the oblivious procurement of the English dialect, especially past a SAC. Where cognizant learning of English was accounted for the part of SACs has all the earmarks of being profoundly noteworthy. The paper finishes up by suggesting that we have to go past conventional systems of PC helped dialect learning (CALL) for comprehension and examining the part of innovation in dialect instructional method and that the term versatile helped dialect utilize (MALU) might be more suitable.

**Keywords:** *Self Access Centers (SACs), Dialect learning, local dialect, English dialect*

## INTRODUCTION

This venture looks at the practices and view of non-local grown-up understudy speakers of English (NNS) taking a shot at CbMs in self-think about settings in their own particular nations. With reference to Thai and Arabic college understudies it asks the accompanying inquiries: Which CbMs do such understudies get to and why? What exactly degree do they see such CbMs as helping with their dialect contemplates? Where access to material is accessible anyplace and at whatever time, where do understudies like to work and why? What e-education aptitudes are utilized? Whatever degree do understudies make utilization of person to person communication locales in English? Do they see PC interceded correspondence (CMC) as affecting the kind of dialect that they utilize? What are the arrangement ramifications of the responses to these inquiries for the advancement and heading of SACs? Besides, what are the suggestions for the hypothesis and routine with regards to CALL today? In noting these inquiries, the venture addresses some critical issues of data and correspondence innovation and new advances, and parts of educator instruction, preparing and intercultural correspondence, and the social, monetary and political parts of English.

## LITERATURE SURVEY

The estimation of learner self-sufficiency in dialect learning is for quite some time built up and all around recorded and for the motivations behind this review we should take an expansive meaning of learner independence to incorporate any self-coordinated practice as well as utilization of the English dialect. Self-instruction in Language Learning is explained by <sup>[1]</sup>. The connection amongst CbMs and self-ruling learning in SACs is additionally entrenched; remarks that: 'The notoriety of learner self-governance might be in any event incompletely identified with the ascent of PC innovation and the developing significance of PCs in dialect learning conditions around the world'. Collecting and Interpreting Qualitative Materials are described by <sup>[2]</sup>. Moreover, watch that 'adaptable, self-sufficient, deep rooted learning is basic to achievement in the period of data'. For a long time now most productions worried with setting up and overseeing SACs incorporate some discourse on the part of PCs, and today it is troublesome, if not unimaginable, to consider SACs without them. Learner Autonomy and Language and the Internet are discussed by <sup>[3]</sup><sup>[4]</sup>.

The connections between CbMs, SACs and learner self-sufficiency too settled but then dangerous

‘... in that there is little in the writing which inspects what understudies really do in such focuses and why; experimental information on the practices and view of learners is discernibly missing ...’ These reviews have analyzed dialect learners’ discernments, practices and techniques when chipping away at a scope of CbMs in SACs and other self-examine settings, for example, the home. Teaching and Researching Computer assisted Language Learning is described by [5]. Various critical issues for instructional method and approach have emerged out of this work. Understudies multitask and utilize both their local dialect (L1) and the English dialect (L2) when dealing with an assortment of CbMs and ‘this undermines what may be described as a conventional perspective of dialect realizing which tends to push an individual movement which is finished in the objective dialect’. CALL – past, present and future is discussed by [6]. The part of CbMs is critical, however ‘... it would be a mix up for experts and other asset suppliers to carelessly take after the digitalised medium course to everything the potential open doors offered by a mixed approach which consolidates both digitalised and paper-based materials ought not be neglected and the suggestions for SAC configuration should be tended to’. Observational techniques are described by [7-8].

### DISCUSSION ABOUT THE SURVEY

**CbMs and PbMs:** While conventional instructional exercise CALL CbMs keep on being one characterizing trademark inside the field, especially with regards to SACs, they don’t and ought not of themselves characterize such focuses: there is something else entirely to SACs than CbMs. Similarly, there is a whole other world to learner independence than the physical area of the SAC, a point which is emphasized by the ‘anyplace, whenever’ accessibility of CbMs. In any case, reactions from the Emirati understudies specifically propose that learner sees on which instructional exercise CbMs work and why (Q9) presumably should be all the more proactively assessed when preparing SACs. It is likewise certain that the customary perspective of CALL as CbMs that have an immediate educating or learning capacity are today however one a player in a substantially more extensive scope of CbM applications; there are rising patterns and improvements which indicate a more mind boggling picture. An understudy get to an extensive variety of CbMs of both a social and a scholarly nature at any one time and do as such from an assortment of conceivable spots

and, in doing as such, huge presentation to the English dialect is experienced. In dialect instructional method initially made the refinement between realizing which is seen as cognizant and procurement which conversely is oblivious: when connected to an electronic domain, oblivious obtaining is in all likelihood occurring through presentation to credible English from an assortment of CbMs. Such obtaining is ostensibly as critical in learner self-sufficiency as CbMs which energize coordinate routine with regards to the dialect. Plainly, both cognizant learning and oblivious introduction to genuine dialect help the independent learner, yet not really in a similar ways, and learning societies and also singular learning styles are probably going to be critical factors.

### CONCLUSIONS

This review has created a lot of quantitative and subjective information and our examination and exchanges have unavoidably centered on the most essential non specific matters emerging from this; nonetheless, we have absolutely not depleted every one of the issues. For sure, the informational collections from every organization may be conveniently used to additionally create, comprehend and define setting particular arrangement at institutional or national level, yet such specificity is basically past the dispatch here. By method for conclusion, thought of developing new conceivable structures for the field of CALL is viewed as together with a note of what has been accomplished in this review and recognizable proof of where further research may lead.

**Ethical Clearance:** Taken from AMET University committee

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# English Stress Gaining by Resident Speakers of Tibetan

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## ABSTRACT

Past reviews demonstrate that language contrasts cause comparing impacts on Second Language Acquisition. In view of the Corpus of Chinese, English, and Tibetan talked by Tibetan Speakers (CETTS), this review led English anxiety generation and discernment explores and break down the English anxiety obtaining by local speakers of Tibetan, to see if stretch position and syllable structures will influence their anxiety securing. By investigating 2,176 creations and 4,352 observation reaction by 17 subjects, and additionally receiving ANOVA examination and Mann-Whitney U test, this review discovers that: (1) The Tibetan gathering has a lower precision rate in English anxiety generation and discernment tests; in addition, not at all like Americans, local Tibetan speakers don't utilize the scope of F0 to acknowledge English anxiety. (2) Stress position influences push creation by the Tibetan gathering, however applies no impact to stress generation by the American gathering, and stress observation by both gatherings. (3) The tonal conveyance manage of Tibetan does not influence the obtaining of English anxiety. (4) Schwa has no factual effect in precision rate, yet can abbreviate the subjects' reaction time. Such discoveries will give observational information to more compelling educating of English to minority gatherings. List Terms: creation and observation, English anxiety procurement, push position, syllable structure.

**Keywords:** *Tibetan Speakers, ANOVA, English anxiety, syllable structure*

## INTRODUCTION

Past reviews have talked about English anxiety (thus alludes to as lexical worry) over its area and acoustic features(AF), and have methodically detailed that (1) the word class and syllable structure together choose English anxiety area (for instance, <sup>[1][2][3]</sup>); (2) English anxiety is acknowledged by four AFs, to be specific, syllable length (D), power (I), key recurrence (F0) and vowel quality (schwa) (for instance, <sup>[4][5][6][7][8]</sup>). In the previous 20 years, there is expanding thoughtfulness regarding the English anxiety procurement by L2 English speakers. <sup>[9,10]</sup> Demonstrates that albeit both local English and local mandarin Chinese speakers recognize English worry with about equivalent exactness, diverse inclinations for English anxiety designs exist: trochaic anxiety is favored by local English speakers, though Chinese speakers want to rhyming anxiety. finds that all subjects create introductory worry with bigger scope of F0 (R), higher mean F0 and more noteworthy I than definite anxiety, and last anxiety is delivered with longer D Ratio than starting anxiety. Tibetan incorporates three principle vernaculars: Ü-Tsang, Khams Tibetan, and Amdo Tibetan. In this review, Tibetan is alluded

to as Ü-Tsang, which incorporates four sorts of tone, specifically, abnormal state, high falling, low rising and low plunging.

## METHODS

**Participants:** Seventeen grown-up subjects were welcome to take an interest in the investigations, and isolated into two gatherings, in particular the Tibetan gathering and the American gathering, as per their first dialect (L1). In the Tibetan gathering there were 12 local speakers of Tibetan (NST) (seven guys and five females). All NST were understudies, matured 19-23, and had learned English for no less than five years. In the American gathering, there were five local.

**Stimuli for Speech Production:** Boosts for the generation examination were 128 pseudowords whose syllabic structures comply with Tibetan phonotactics. Such utilization of pseudowords couldn't just maintain a strategic distance from the nature impact that will blow up the scores, additionally permit a strict control Consistent to Tibetan phonotactics, four sorts of syllable were utilized to coin disyllabic pseudowords:

“CV”, “CVV”, “CVN” (N speaks to a nasal coda, for example, [m]) and “CVG” (G implies voiceless stop, for example, [p]). [t] was taken as the onset of all generation tokens to keep away from span deviation, the coda of syllable CVN was [m], the coda of syllable CVG is [p], and vowels utilized were [a], [i], [u]. We got [a:], [i:] and [u:] as rhyme “VV”, because of diphthong is uncommon in Tibetan dialect, which as a rule utilizes length to recognize meaning. With these sections used to make pseudo words, the four syllable structures were combined to yield 16 disyllabic word sorts, and 4 things were made for every sort of word sort. Absolutely, we got 64 pseudo words for the creation analyze.

### PROCEDURE

**Production and Perception Experiments:** Before starting the experiments, all subjects completed a short questionnaire on language background and personal information. Additionally, they participated in the production experiment first and perception experiment second. With the help of MATLAB, reading materials of the production experiment were randomly shown on the computer screen, with the intended stressed syllable in bold and the unstressed one in grey. Recordings of the production task were then saved as wav files for further evaluation and analysis. EPrime 2.0 was used to in the perception experiment to record RT upon the ending of each stimulus. Before the perception experiment, there was a short practice session with 10 practice trials. This experiment was divided into four blocks to ensure the reliability of results, three consisting of 64 trials and one consisting 74 trials. *Production Evaluation* Stress production was evaluated in the form of perceptual evaluation by employing EPrime 2.1. Totally, 3 English major students whose IELTS scores are above 7.5 were invited to complete a stress perception test which consisted of 190 pseudo words and English real words. Having finished this test with an accuracy rate above 95.00%, they completed the perceptual evaluation experiment, that is, evaluating subjects’ production recordings. Ten pseudo words produced by the phonetician were added in each subject’s production as filters, and the correctness of filters were recorded. Here in the present research, the correctness of filters was restricted above 95.00%, so that reliability of choices could be guaranteed. During the perceptual evaluation, each participant finished the production task

for all subjects in avoidance of different standards. If the stress location of a word was judged to be the same as the intended position, this word would be scored 1, otherwise, 0. All production recordings were evaluated three times to minimize deviation, and average scores were taken to evaluate the stress production by subjects.

## DATA ANALYSES, FINDINGS, RESULTS AND DISCUSSION

### Speech production

**Overall Differences between NST and NSA:** After 2,176 tokens from generation trial being judged three times, each subject gets a normal score and relating exactness rate. Comes about demonstrate that NSA has an evident higher normal air conditioning curacy rate than NST (98.75% vs.82.75%) by and large, in both introductory anxiety (98.75% versus 86.59%) and last anxiety (98.75% versus 78.78%), and in addition in a wide range of syllables (98.12% versus 82.81% in “CV”, 99.37% versus 87.24% in “CVV”, 98.75% versus 81.25% in “CVN” and 98.75% versus 79.69 %). More points of interest of such creation trouble are investigated by differentiating AFS amongst NST and NSA. For an examination of AF, we select 25% things of each subject arbitrarily, guaranteeing even sizes of various anxiety positions and diverse focused on syllables to stay away from the impact on AFs brought on by test distinction. Given that NST may experience issues in delivering vowels effectively, despite the fact that vowel quality (schwa) is an imperative prompt in the acknowledgment of stress, it’s questionable to be utilized as a part of judging stress. Also, has shown the significance of R amid stress acknowledgment, so D, I, F0 and R are utilized to gauge the anxiety generation. Information of four AFs are removed in Praat. Mean esteems are appeared in Figure 1.

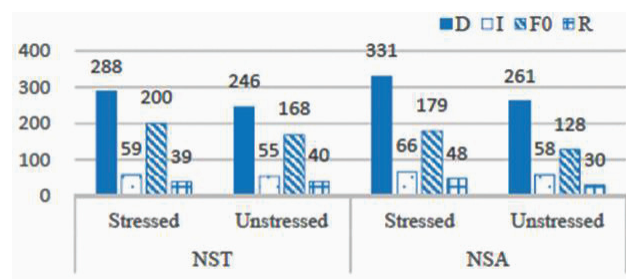


Figure 1: Means value of AFs

## Speech Perception

**Overall Analysis:** 4,352 anxiety area reactions of all subjects are broke down in this part. RT of right decisions is general substantially shorter than that of wrong decision (1,324ms versus 1,700ms), which ensures the unwavering quality of their decisions. Aftereffects of ANOVA investigation demonstrates a distinction amongst NST and NSA in their discernment examination’s general exactness rate principle impact of gathering:  $F(1,16) = 9.222, P = .008$  and NSA has a higher general precision rate than NST by 30.80% (98.03% versus 68.03%). Also, mean reaction time for NSA is considerably shorter than that of NST (658ms versus 1,719ms). Here we can securely make the determination that the NSA amass likewise perform superior to the NST bunch in the recognition analyze. Concerning the anxiety position, despite the fact that NST recognize last anxiety (66.34%, SD 14.26) superior to anything starting anxiety (69.73%, SD 13.68) with a slight shorter RT (1,698ms versus 1,740ms), Mann-Whitney U test shows that there is no anxiety position predisposition ( $Z = -1.020, P = 0.308$ ). Thus, despite the fact that NSA has a higher precision rate on beginning anxiety (89.22%, SD 9.37) than on definite anxiety (87.81%, SD 9.38) with a slight shorter RT (646ms V.S 671ms), ANOVA examination demonstrates there is no anxiety position inclination ( $F(1,9) = .056, P = .819$ ). In NST, the request of syllables as far as precision rate is “CVG” > “CVV” > “CVN” > “CV”, the request as far as RT is “CVV” < “CVG” < “CVN” < “CV”, however consequences of ANOVA investigation ( $F = .575, P = .635$ ) and ANOVA post-hoc test examination (LSD and Bonferroni) of exactness rate demonstrates that such contrast between syllable is not self-evident. In NSA, the exactness rate request is “CVN” (91.56%) > “CV” (87.81%) > “CVG” (87.50) > “CVV” (87.19 and ANOVA examination ( $F = 4.946, P = .013$ ) demonstrate a connection between precision rate and syllables. Consequences of ANOVA examination, a considerably higher exactness rate, and a substantially shorter RT (579ms versus 626ms, 711ms & 720ms) bolster an inclination for “CVN” in NSA. So there is no syllable predisposition in NST, yet an inclination for “CVN” in NSA. Figure 2 RT Ratios (%) of schwa effect.

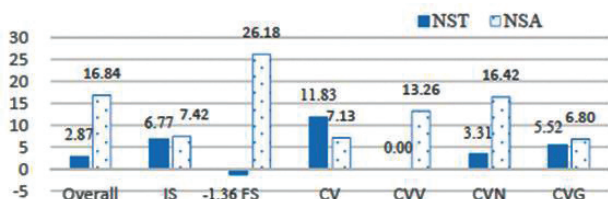


Fig. 2: RT Ratios (%) of schwa effect

Consequences of the recognition analyze propose that (1) NSA reactions more precisely and rapidly than NST. (2) There is no anxiety position predisposition for both gatherings and no syllable inclination in NST, yet NSA has an inclination for the syllable “CVN”. (3) Schwa can abbreviate RT for both gatherings, and such impact is more clear for NSA. (4) The schwa impact is prevalent in the last worry for NST and in both anxiety positions for NSA, and such impact fluctuates in various syllables.

## CONCLUSION

By leading creation and observation explores and breaking down outcomes from points of view of precision rate, AFs and RT, this review plans to research whether the anxiety position and the appropriation tenets of tones in Tibetan influence English anxiety securing by NST, and whether schwa can abbreviate reaction time. Significant discoveries are as per the following. Initially, NSA beats NST both underway test and recognition analyze. Both gatherings utilize F0, span and power to acknowledge stretch; be that as it may, the scope of F0 is the most vital signal for NSA, however is not utilized by NST amid stress acknowledgment. Furthermore, in spite of slight contrast in the aftereffects of various syllables, the tonal dispersion lead of Tibetan does not measurably influence the English anxiety creation and discernment. Thirdly, as far as stress position, just introductory anxiety inclination is seen underway by NST and no anxiety position predisposition in the observation explore. The position impact is more transcendent than stress impact for term and the scope of F0 in the generation try by NST. Finally, schwa can abbreviate reaction time for both gatherings, and such impact is more clear for NSA. Such discoveries will give exact information to more successful educating of English to minority gatherings. Additionally research can be led to see if the nonattendance of the focused on syllable in L1 influences English anxiety securing, and additionally the connection between stress generation capability and stress discernment capability.

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# A Development of Soft Skill in Tourism Industries

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## ABSTRACT

In the level universe of today, India needs to stand tall more than ever. The times of subjugation and underdevelopment should be over after such a large number of years of autonomy. Swami Vivekananda talked about India's profound prevalence over the West. The Silicon Valley perceived the virtuoso of Indian programming software engineer; the Call Centers compensated the English talking and persevering youth of India. However another approach to profit by the additions is endeavor the nation's History and Geography. There is on one hand the magnificence of Nature and after that there are lofty landmarks, the wonders of artisanship and age old customs of cooking and garments – delights that can take into account the visitor of each taste. The time has desired India to profit by its potential in Tourism the point of the present paper is to investigate how to improve the traveler enchant through delicate abilities preparing in the nation.

*Keywords: Swami Vivekananda, software engineer, Tourism, cooking and garments*

## INTRODUCTION

Tourism is the aggregate of wonders and connections emerging from the travel and remains of out-of-state people in so far as it doesn't prompt perpetual habitation and is not associated with any procuring movement. India has dependably lived by the mantra 'Atithi Devo Bhavah'. Residential tourism excessively thrived as old and youthful, rich and poor all attempted religious journeys, to far corners of the nation. The four dhams, the most hallowed of Hindu sanctuaries, are situated at four topographically restricted areas. Badrinath is in the lap of the Himalayas in the North, while Rameshwaram is in outrageous south. Dwarka lies in the West and inverse it is Jagannath Puri. So by goodness of need, even a normal Indian since antiquated circumstances till date, ventures to every part of the length and expansiveness of the nation<sup>[1][2]</sup>. Prior they moved in troops and family clerics invited them and dealt with the welfare of the old and the exhausted. The rich vendors of the towns gave intensely to build safe houses and hotels for the explorers. Sovereign Asoka took it as an imperial obligation to plant trees and assemble motels for the solace of the explorers.

**Travel through the ages:** Nourishment social occasion should be the soonest purpose behind travel. Exchange and business was likewise a solid main impetus taken

after by religious and academic interests. History additionally archives that men go to battle in wars and to fulfill their interest. Whatever the reason, from times immemorial, travel has held an interest for men. In old period, it was a greater amount of an oblivious, basic and non-formal action. Two awesome developments ever (a) the innovation of wheel which enhanced speed and therefore remove secured and (b) the creation of cash by Sumerians (Modern Iran and Iraq) which helped business exchange<sup>[3]</sup>. While go for exchange and business appears to have begun in different parts of the world at nearly around a similar time, the Indian convention of go for religions and training is maybe the most seasoned idea on the planet. The immense sages of the past resigned to the grand statures of the Himalayas or in profound wildernesses to ruminate in their mission for otherworldly edification. Buddha – the illuminated one – additionally chosen to share reality which he had found with the people groups of the world, and made a trip starting with one place then onto the next spreading the message of truth and peacefulness till he inhaled his last<sup>[4][5][6]</sup>. Lord Buddha left countless voyaged everywhere throughout the world after his inheritance of spreading reality. One of his most well known supporters was sovereign Ashoka, who sent ministers including his child Mahindra, little girl Sanghmitra and sister Charumati to Sri Lanka, which prompted the spread of Buddhism in all parts of Asia.

**Spa Tourism and formation of Seaside Resorts:** The Romans were most likely the main delight explorers on the planet. They made superb system of streets, transportation and correspondence framework to deal with the huge realm, which voyaged too. They went to see the sanctuaries in the Mediterranean region and the pyramids of Egypt and embraced trips to restorative showers called “Spas” and ocean side resorts. The word Spa is gotten from Waloon word “Espa” which implies wellspring and identifies with a town in Belgium.

Inland Spa has its starting point to the conviction that mineral water has corrective and recuperating properties and is useful for wellbeing both for drinking and drenching in it ( a hypothesis which specialists pushed). The Greek had ‘Asclepiad Sanctuaries’ for washing of wiped out people. The voyagers coming to Spa required certain preoccupation from their principle movement. Steadily, Spa focuses included the office of joy and excitement and subsequently the way of life of spa resort was conceived. Dramatic preparations, athletic rivalries, and different types of diversion turned into a piece of exercises at Spa resorts.

**Tourism Today:** Tourism is typically identified with ‘touring and going by outside spots for a few days’ to a typical man. Travel removes us from home turf and it gets vital because of travel related encounters. A Persian writer Sadi stated, “The advantages of travel are numerous; the freshness it conveys to the heart, the enjoyment of viewing new urban areas, the meeting of obscure companions and the learning of high conduct.” But, tourism is generally another marvel as discernable by its mass character from the travel. Tourism is related with development of individuals, an identifiable industry, an area of economy, administrations which should be accommodated explorers.

**Travel in India:** The convention of cordiality proceeds right up ‘til the present time in India. A normal traveler finds the locals accommodating, affable and neighborly. Be that as it may, throughout the years Tourism has risen as an industry. Prior to the retreat hit, Travel and Tourism was rising as the top income workers for some nations. It gives work to a huge number of individuals, specifically and in a roundabout way.

The Ministry of Tourism, Govt. of India propelled the “Atithi Devo Bhavah” battle under its aspiring project to draw in more number of travelers and the final

products say a lot about the advance. The idea is gone for limit working for specialist organizations and partners in the tourism division to make the travelers mindful of the advantages in India and the need to treat them with conventional care and most extreme affability.

**Soft Skills:** Delicate aptitudes is a sociological term for a man’s Emotional Intelligence Quotient, which alludes to the bunch of correspondence, lingual abilities, individual propensities, identity characteristics, social graces, invitingness, and good faith that check us. Delicate aptitudes supplement hard abilities (some portion of a man’s IQ), which are the specialized prerequisites of a vocation and numerous such comparative occupations.

Some center zones in delicate aptitudes are:

1. Proxemics
2. Kinesics
3. Paralanguage
4. Manners and Etiquette

## DISCUSSION ABOUT THE ARTICLE

**Proxemics:** The art of spaces between people. All people jump at the chance to have an individual space around them and interruption is not welcome. The western world has pretty much characterized the space that people get a kick out of the chance to have with others, contingent on their relationship.

**Kinesics:** The body says a lot regardless of the possibility that the mouth is noiseless. Terrorizing, intrigue, antagonistic vibe, warmth all can be spoken with non-verbal communication. Non-verbal communication fortifies our verbal correspondence and it is considerably more imperative in situations where the two gatherings don’t talk a similar dialect.

**Paralanguage:** With respect to the characteristics of discourse, the speaker ought to be careful about every one of the characteristics of discourse very separated from the words themselves. Paralanguage manages the discourse qualities like volume, rate of discourse, pitch, cadence, elocution and articulation. The western visitor to India is confounded by the commotion he experiences in India.

**Manners and Etiquette:** At the point when a remote traveler visits another nation, he doesn’t want to discover his very own copy nation or progress. The host

should keep up and grandstand his own way of life, and conventions. However some normal kindnesses, some decorum, some regard towards the nonnative would go far in winning the pleasure of the client.

### CONCLUSION

There is necessity of preparing in delicate aptitudes at the grass root level like cab drivers, watchmen, police work force and so on. Understudies experiencing tourism courses must be offered presentation to genuine or genuine like condition to create them. Around there we could create sight and sound lab in the form of MYCIN (a choice emotionally supportive network for specialists in view of manmade brainpower). Understudies are given more presentation to hypothetical sources of info like tourism ideas, promoting, HR, history and less introduction to delicate expertise modules as noticeable from the syllabus of significant colleges and govt. initiates in the nation. Tourism foundations don't have a different module for delicate abilities. It is dealt with as a piece of dialect. Understudies are generally not mindful about conduct and decorum related issues, diverse crevices amongst India and western, Asian or other piece of the world. As tourism understudies can't learn numerous dialects in brief timeframe, there must be more accentuation on non-verbal correspondence. So they could bargain prudently with the vacationers.

Accordingly it is reasoned that there is necessity of delicate aptitudes in the tourism. At present there is hole in arranging stage and execution organize.

**Ethical Clearance:** Taken from AMET University committee

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# Intelligent Web-based English e-Learning Tutor with Data Mining Technique

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## ABSTRACT

With the transmission of instructive information mining field, it is in effect progressively associated with various research ranges, for example, versatile and smart electronic mentors, savvy instructive applications and other pleasing on the web instructive information mining frameworks. The utilizations of instructive information mining consider the framework scholarly perspectives, the scholastic foundation, and the learner's order. This paper proposes another versatile e-learning framework. The proposed framework incorporates an outstanding canny electronic English e-learning mentor with information mining procedures. Likewise, the information mining strategies are utilized as a part of request to bunch understudies' learning styles as per Jackson's learning styles. A definitive objective of the proposed framework is to decide the best showing pattern for every learner. The proposed system can be made available through the web everywhere as well as Every Time (EWET). It also offers adaptive facilities such as learning videos, adaptive presentations, and quizzes for the students. Moreover, it helps both teachers and students to follow the best learning process and achieve the highest academic rates. The results show that the highest student's achievement pattern is the pattern (Speaking – Reading- Grammar - Writing) with score of at least 87.4%.

**Keywords:** *Educational data mining, k-nearest neighbor, Adaptive Learning, E-learning, Jackson's Model.*

## INTRODUCTION

Data mining field utilizes numerous strategies to separate the required concealed information and concealed examples from huge information. Information mining is utilized as a part of e-learning frameworks to find concealed information, principles, and tests through the way toward dissecting accessible data that can greatly affect the instructive research<sup>[1, 2]</sup>. Instructive information mining is viewed as a rousing subject that creates methods to perceive particular information that will upgrade the instructive procedure of learning. By utilizing those methods, a superior comprehension is accomplished.

The e-learning system is a dynamic learning environment that uses the Internet to make the learning process more efficient by providing learners with available resources and services. Currently, intelligent learning systems are one of the most important topics in the field of education<sup>[4, 5]</sup>. Therefore, an e-learning system can be intelligent or non-intelligent systematic. The non-intelligent system presents a static style in learning for all types of students.

Grouping procedure can be considered as the most utilized method in information mining. It utilizes an accumulation of tests regularly called the preparation information that are pre-grouped keeping in mind the end goal to make and develop a model that is helpful in arranging the entire populace on the loose. The characterization procedure incorporates gaining from the preparation information and after that arranging the entire populace<sup>[6, 7]</sup>. In the instructive frameworks, order strategy is utilized to depict a gathering of learner's qualities and properties. There are numerous goals accomplished in the learning condition through utilizing characterization, for example, recognizing the learner who requires more inspiration and consequently anticipating the level of learner's mindset and knowledge with a specific end goal to offer for him an extraordinary course and to group him as per his learning style<sup>[8]</sup>.

## RELATED WORK

A lot of researches and studies have been held in the field of data mining. The techniques of data mining are used to improve and enhance the process of learning, as well as



toutilize the benefits provided by e-learning systems. These techniques also used to find poor academic students in order to help them to acquire better performance [11]. Since 1980, thee-learning systems have been applied and many researchers developed their own approaches and the rest of this section summarizes few of them. In other research, EDM was used in the field of prediction to try to discover students' performance, dropout, etc. For example, in 2015 Thakar et al. summarized that all previous researches find out an important area in the educational field and the use of prediction with data mining will obtain a lot of benefits; such as finding a set of weak students, predicting students' dropout, evaluating collaborative activities etc. In2015, Vahdat et.al [3] focused on the possibility of predicting students' performance based on their characteristics and behavior. Furthermore, [9, 10] presented an approach that classified students to predict their final grades based on some features elicited from an educational web-based system.

and the system administrator. In the client layer, clients can open the Adaptive English E-learning web-based tutor Every Where as well as Every Time (EWET).

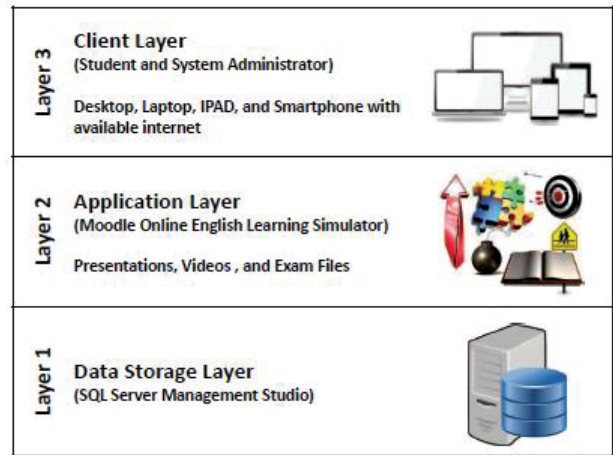


Figure 1: The proposed adaptive e-learning web-based tutor architecture

SYSTEM DESIGN AND OPERATION

The adaptive English E-learning web-based tutor is an adaptive online system targets third class students. It can define the learner style, the suitable content for learning and an adaptive presentation technique. The system updated automatically according to the learner characteristic and behavior. Adaptive E-learning web-based tutor architecture consists of three main layers as shown in Figure 1. Where the first layer is the database layer in which all the behaviors of the student were saved. The second layer is the application layer contains the learning videos, adaptive presentations as well as quizzes. The last layer is the client layer that includes the students

Our proposed Adaptive E-learning electronic mentor segments are depicted in the following subsections. Besides, Figure 2 demonstrates the flowchart of our proposed framework in which the understudies at first take the pre-poll (Jackson's learning style profiler) then the understudies will be bunched into five principle groups as indicated by their outcomes in the prequestionnaire. The framework will comprise from five bunches; Emotionally Intelligent Achievers understudies, Goal Oriented Achievers understudies, Sensation Seeking understudies, Conscientious Achievers understudies, and Deep Learning Achievers understudies.

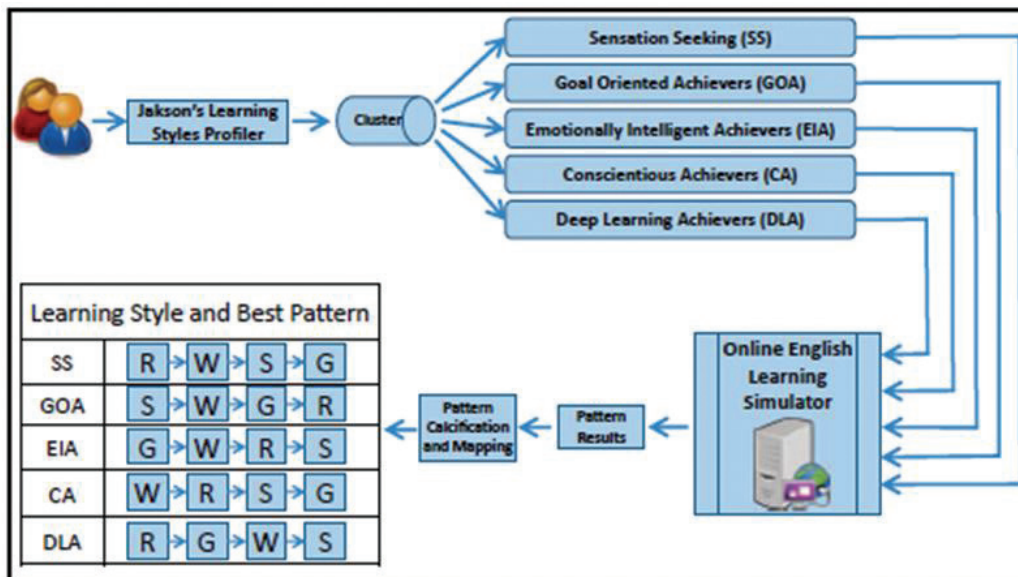


Figure 2: The flowchart of the proposed adaptive e-learning web based tutor

## RESULT AND DISCUSSION

In this research, five Jordanians' schools were visited by the research team in order to implement our approach and collecting the data from students. The total number of participants' students is 314 students with both genders. All of them with the same age. This data was trained into the Rapid miner as training set and then

divided using cross-validation into training and testing set. We conducted two experiments as follows. This experiment aims to check which pattern was the most chosen pattern by the students. Figure 3 shows the Rapid minor results for analyzing student's behavioral patterns. The experimental results shows the pattern (Speaking - Reading -Grammar - Writing) is the most chosen pattern by the students

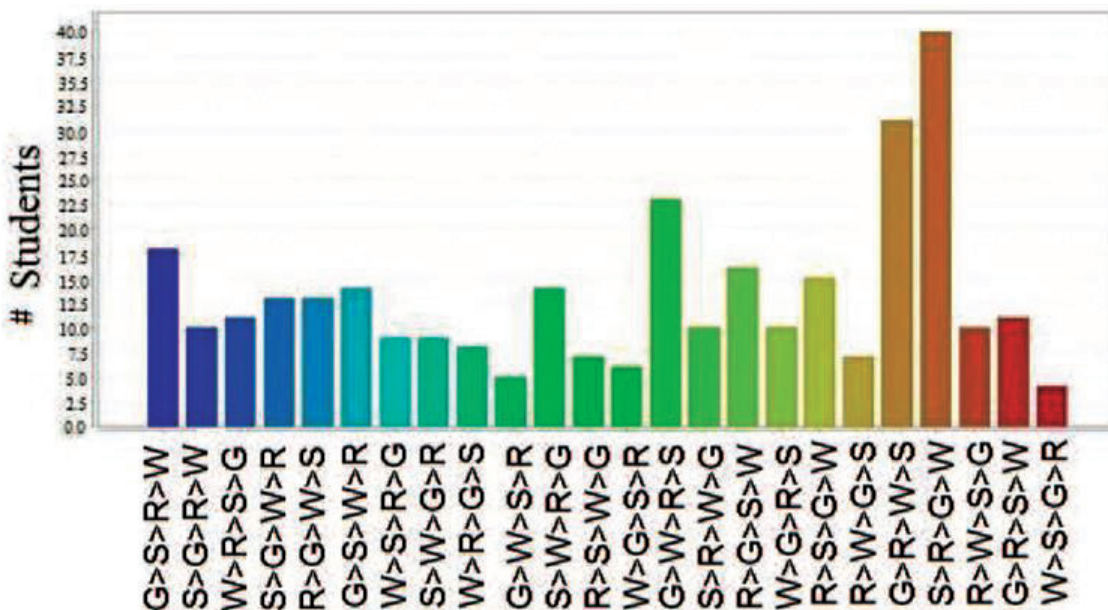


Figure 3: Patterns Analysis Vs number of students

## CONCLUSION

Numerous Data Mining procedures can be utilized to upgrade the learning and instructing forms. In this paper, we proposed an Adaptive E-learning English electronic guide that offers numerous instructive offices, for example, recordings, introductions, and tests to give the understudy a versatile and alluring learning situations. Speaking, Grammar, Writing, and Reading are the fundamental four stages in our mentor. These four stages result in 24 designs as indicated by the likelihood rules. Another piece of our proposed framework was the online electronic pre-poll that models every understudy's learning style as per pre-characterized Jackson learning styles. Toward the end, a classifier arranges each learning-style-understudy bunch with the best example. Two examinations were done, the first to discover the most well known example by the understudies and that was the example (talking - perusing - punctuation - composing). To finish up, our proposed Adaptive E-learning English online coach can

help both educators and understudies to take after the best learning process and accomplish the most elevated scholastic evaluations.

**Ethical Clearance:** Taken from AMET University

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# Preparing College Understudies Complete Qualities by English Class Lectures

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## ABSTRACT

Output Hypothesis and College English Curriculum Requirements, brings English discourse exercises into the class, and affirms its capability on the understudies' English application capacities and its advancing an incentive by 2-year tests. What's more, it breaks down the current issues in the address substance, oral expression, stance and flexibility, and so on. At last, it reaches an inference that understudies' complete qualities can likewise be prepared by English class lectures, for example, English capability, social mindfulness, mental quality, theory and development abilities, and stylish judgment and so forth.

**Keywords:** *English Class Lectures, Complete Qualities.*

## INTRODUCTION

Output Hypothesis, focused on the yield's capacity to develop and enhance the language generation capacities<sup>[1]</sup>. Notwithstanding the info dialect, the yield dialect assumed a vital part in enhancing relational abilities of learners. He called attention to that the yield ought to be attempting to accomplish something over their present level of practice<sup>[2]</sup>. Since the yield of the procedure can urge understudies to effectively look for a reasonable shape to express them, when they meet a few troubles to express, they will try endeavors to attempt, in the process they could attempt to total up some new guidelines and lessons from the criticism and at last make a steadier framework<sup>[3][4]</sup>.

College English Curriculum Requirements calls attention to that English teaching goal is to build up understudies' English language capability<sup>[5]</sup>, particularly tuning in and talking aptitudes with the goal that they can convey in English successfully in their future review, work and social collaborations, in the interim to upgrade their independence capacity, enhance their general social quality to address issues of social improvement and universal correspondence<sup>[6]</sup>.

Understudies have learned English for no less than six years before they enter the college, yet by and large their tuning in and talking capacities are powerless, which requires an appropriate situation for them to hone in the restricted class time<sup>[7]</sup>. The exploration gather

brings English discourse exercises into the class in light of Output Hypothesis and College English Curriculum Requirements. The understudies hone their oral English by addresses in classes<sup>[8]</sup>.

## PROPOSED SYSTEM

English speech is a vital correspondence aptitude in a worldwide, diverse setting, is the exemplification of far reaching education, yet what sort of capacities and qualities can be upgraded through deliberate preparing.

English lectures can enhance the understudies' far reaching application capacities. Swain trusts that the ways toward get ready for a discourse bosses the sentences' structure, vocabulary and slowly reinforce the feeling of dialect, to advance utilizing dialect unreservedly. At the point when English learners communicate in English, their mind must be dynamic in utilizing learned dialect information, attempt to make sense of the down to earth use of linguistic use rules, consider suitable words and check the suitability of the announcement. Amid the way toward setting up the discourse, understudies must ponder over and over to convey what needs be with the educated learning. The English open discourse course is to prepare understudies' complete application capacities, to improve the scholarly general abilities. It consolidates the information, intrigue and test in one, so that understudies' abilities of perusing, composing, talking and listening can be additionally moved forward.

Speeches go for passing on data, influence, physical and mental delight by an expansive number of learning, social proficiency, such wide social mindfulness as study, accumulation, capacity of handling an assortment of logical and social information and data. Notwithstanding the reason for the discourse, the speaker dependably require a considerable measure of data to enhance the substance of discourse, with a strong hypothetical and persuading illustrations and information to demonstrate or negate a specific perspective. To do this we should survey, unite, compose, and channel what we have realized, and contemplate, ace, gather and develop the new learning via looking data, going to specialists, and polls. Also, understudies need feeling of social contrasts and social assorted qualities, ought to know the social or sub-social components of all districts on the planet, countries, races and associations, even the social or sub social elements of the crowd, and their esteems, convictions and mind propensities.

The most physiological reaction of the pressure is self observation, the gathering of people can't see it, particularly the speaker grins however much as could reasonably be expected when giving discourse, all the more particularly when he trades with more eye and enthusiastic contact. Open discourse makes learners not so much refutation but rather more conviction about themselves. In the event that overlooking the following sentences, attempt to control feelings and acclimate to cure, the gathering of people will likely come to tune in to your thoughts. Instructors can enable understudies to comprehend discourse brain science to well, which will help facilitate the dread about the discourse and fortify the use of suitable techniques. In an amicable environment, understudies more than once state sees, express focuses and emotions, make inquiries, and get instructors and other understudies' certain reaction, and bit by bit build up a decent mental nature of speech.

English open talking abilities preparing will without a doubt help the arrangement of basic speculation propensities and the advancement of basic limits. From the point of view of the discourse, understudies must contemplate questions while setting up a discourse: what subjects are vital, intriguing and new? Which themes have been examined over and again, how to be novel and new? What are certainties or feelings when gathering materials? What are plausible contentions? Which is all the more persuading? How to make the article's

reasoning clear and rationale close? How to make it without a proviso from various points and at various levels? What issues would be raised by the individuals who hold diverse perspectives? By what means would it be advisable for me to react? These are reflections, examination, thinking and judging from the basic deduction handle. In the meantime, English discourse can enable understudies to practice basic considering, intentionally utilize clear, exact, institutionalized dialect for expression and banter about, and advance their creative capacity.

## RESULT AND DISCUSSIONS

**Presentation aesthetic abilities incorporate two viewpoints:** speakers make style as per the stylish laws; the gathering of people acknowledges feel as indicated by tasteful criteria. Just the understudies realize what sort of discourse is fruitful, they are probably going to take after the laws to make the introduction excellence and welcome it. To stir the gathering of people's observation and quest for the great and excellent, every pleasant introduction is lovely talks. The talks can be partitioned into verbal discourse and nonverbal one. Verbal discourse incorporates substance, dialect and voice; non-verbal discourse states of mind, visual-guides things and characters. For the speakers, they are first to be seen and not be heard by the group of onlookers, so fair dress, liberal way, being quiet and brimming with vitality, eye contact with the gathering of people, are required. Notwithstanding essential aptitudes the speaker must have a right viewpoint about the world, life and esteem, an expansive global point of view and honorable patriotism, great social profound quality, proficient morals and scholarly uprightness, broad information, the longing and capacity to concentrate advance learning. These variables impact all the time even decide the speakers' inspiration, discourse arrangement and usage handle, the methods and a definitive reason.

## CONCLUSION

English speaking exercises fill the missing holes in speech class; give open talking stages and preparing open doors for all understudies. Other than general English capability, such understudies' qualities as social mindfulness, mental quality, theoretical and imaginative capacity, and style are prepared, which lays great general qualities for understudies entering society.

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**Conflict of Interest:** Nil

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# Ship Position Tracking Scheme Based on Distributed Multi-sensor Data Fusion

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## ABSTRACT

The aim is to determine the actual position of the ship which moves dynamically in the sea to avoid the stumbling block or hindrance which causes the ships damage. The location detection system is used to give the location information with accurate. Based on the multi-sensor data fusion techniques the location of the ship can be identified efficiently. Joining the Kalman filter technique, the synchronize transformation technique; the time configuration method and the track correlation is performed by optimal fusion method. Usage of multiple sensor data technique outperforms the methods based on a single ultrasonic sensor.

**Keywords:** Data Fusion, Ship position tracking, Multiple-sensor, Kalman filter technique.

## INTRODUCTION

Dispersed multi-sensor information combination (DMSDF) has been created to take care of an assorted arrangement of issues that offer some basic qualities [1-2]. The objective attaching direction estimation issue has been a productive region of multi-sensor applications [3]. Numerous issues have been settled, yet new and differentiated applications still test frameworks engineers [4]. Issues identified with multi-sensor combination incorporate information affiliation and administration, sensor instability, information activity, commotion separating, making expectations and dynamic framework demonstrating. They emerge from the natural vulnerabilities in the tangible data brought on by gadget imprecision, as well as commotion sources inside the framework and the sensors [5]. As of late, there has been expanding accentuation on utilizing conveyed multi-sensor information hotspots for different applications, e.g., outlining circulated frameworks, fusing situation based plan approaches, abnormal state data combination (HLIF), following, grouping and circumstance evaluation. Having the capacity to manage these vulnerabilities, DMSDF has turned into an essential technique to enhance the execution of target following and recognizing frameworks when different sensors are accessible. Also, contrasted and single sensor based techniques, DMSDF joins information from numerous sensors and in this manner can perform inductions all

the more proficiently and precisely<sup>[6]</sup>. Based on the properties the target zone is detected by DMSDF. Leggings proposed structures for conveyed information combination and calculations for target following. Their structure can be seen as conveyed expansions of straight and nonlinear estimation hypotheses. The DMSDF is for the most part utilized for divergent (sensors with various watched outlines). Search and Rescue (SAR) and Moving Target Identifier (MTI) are used for wide zone observation applications. MTI be that as it may, while having the capacity to identify and track a protest from a long separation the radar based frameworks endure a few hindrances, for example, high clamour, solid mess impedance and high cost for both equipment and programming. In addition, the exactness of the separation estimation is deficient for applications including indoor situating. So also, the going exactness of a differential global position system ranges (DGPS) upto 3-5m which doesn't provide the requirement for indoor applications. Ultrasonic sensors in the system are used to find the obstacle distance by sending signal in different environment and electromagnetic fields are straightforward. Besides, frameworks in view of the ultrasonic sensors enhance the accuracy that now extends from decimetres to centimetres. Be that as it may, when a ship is at sail in the ocean, it is influenced by natural variables, for example, winds, waves and streams. The ship has six degrees of view point including gush, sway, hurl, move, yaw and bow. This activity is carried out

by low and high repetition part . A Secure & Efficient Audit Service Outsourcing method designed to prevent the fraudulence of prover<sup>[7]</sup>. An efficient mechanism on probabilistic queries and periodic verification is proposed to reduce the audit costs per verification and implement abnormal detection timely. In implemented an approximation automated structure, called Filtered Wall (FW), to filter disposed of substance from OSN client substances<sup>[8]</sup>. The goal of paper is to utilize efficient classification procedure to stay away from overpowered by unsuccessful messages. In OSNs, content filtering can also be abused for a unique, more reactive. The method layout of a structure provides adaptable substance based content filtering for OSNs, in light of ML methodology

### PROPOSED SYSTEM

The objective is to develop the precision of ship's indoor location and their target tracking. Location of ship and its sophistication in marine is identified by using GPS and ultrasonic sensor is proposed. A problem of time configuration, extraction and its spatial association is tracked by distributed fusion model is proposed. Signal quality is improved by Kalman Filter (KF) multi-sensor signal pre-processing.

**Data Fusion Models:** Using Joint Directors of Research facilities (JDL) and Waterfall Combination Forms (WFFP) the multi-sensor data combination system is mentioned in the reviewed paper. The JDL model is used to record the information in database by database-administration system which gives data for future. The WFFP has six levels of handling and a few likenesses with the JDL demonstrate. The benefit of the WFFP model is the straightforwardness in comprehension and applying. The new data after the choice of waterfall model can't successfully utilized as a part of different connections. The astute circuit demonstrate does not contain the administration necessities information base and framework information.

In order to implement the target tracking for ship ultrasonic sensor is used. Each confined ultrasonic sensor is used to course the signal and the local track estimations are done and the disseminated. Accuracy of the Multi Sensor Data Fusion is obtained by kalman filter method to pre-process the signal, Time varying linear control systems with N ultrasonic sensors. The ship pathway and its tracking data is monitored by distributed multi-sensor target strategy. The Figure 1 shows Multi-

sensor Data Fusion Model. It consists of Main layer and secondary layer.

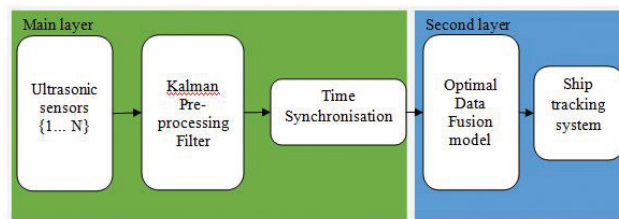


Figure 1: Multi-sensor Data Fusion Model

**The Main layer:** the flag pre-processing layer: the flag layer information connection is based on the state of forecast and estimation. (e.g., gathering of the data systems, the wiping out exceptions and the objective information transportation handling). With the sensor result taken from the forecast the main layer has settled to parallel arrangement. Therefore, each measuring framework has the measured information continuously and requires a bound together inspecting recurrence to be utilized as a part of the particular calculation. Going to the development part it takes time for analyzing and implementation in real time product. The routing arrangement to the multi-sensor information would be the source of information's parallel combination. The time synchronization should be focussed before the performance of the ongoing information.

**The second layer:** the ideal combination layer: In this section it will combine the sensors with data fusion algorithm for tracking the ship based on the timing.

### DISCUSSION

The data delivery rate is defined as the ratio of successful packets or information delivered to the packets sent. It can be measured with the packets received at the receiver side.

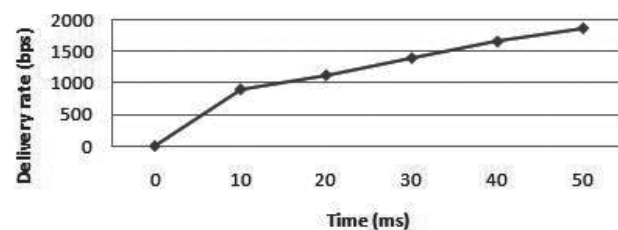


Figure 2: Delivery rate for MSDF

The delivery rate of the packet for multi sensor data fusion network with kalman filtering is shown in the Figure 2.



## CONCLUSION

Ship track signal location using ultrasonic sensors getting input signal with data fusion algorithm. The proposed technique is used to improve the quality of ships moving path. It is appropriate to single ship tracking with multi-sensor. The MSDF optimized and Kalman filtering theory with the combination used for tracking movement and position.

**Ethical Clearance:** Taken from AMET University University

**Source of Funding:** Self

**Conflict of Interest:** nil

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# Spontaneous Exposure of Aquatic Smooth on Turfsvia IOT

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## ABSTRACT

In Agriculture area where farmers won't keep on watch their fields are filled with water all the time. They start the pump to fill water to the fields and leave until with a calculation of hour basis. But, in short time the fields are full and the crops are ready to get excess of water. Too much of water make the crops sick and fall soon. Our proposed work, designing a IOT based board to control the water level on the field with the help of water level sensor and automatic walls which block water as well as drop water when it exceed level. Motor pump connected to the board where it senses level of water sensor and send a message back to the motor to turn off. It doesn't need any manual operation to switch off your motor when fields are filled. Once motor is ON, the water started to flow on fields and walls will block if water is enough for the fields. These lead us to avoid unwanted crop damage on an aquatic area with spontaneous discovery of smooth over fields.

**Keywords:** Agriculture, farmers, crops, water level sensor.

## INTRODUCTION

Agriculture is a blooming nature of India where every state manages some sort of variety in farming with different food items. State wise survey takes every crop like wheat, paddy, sugarcane etc., are cultivating for a set of period where it moves on to cut after crops grown efficiently. Not all the time same crop going to cultivate, each set of season wise the crops are cultivated with difference on state wise [1]. Tamilnadu will not provide the same way of Kerala farming like tea, coffee leaves on large scale. Rice production is also differs from one state to another where the size and quality will not be the same on market.

When it comes to farming, the crop level management is necessary to take care of each crop on a right time season with correct feed of materials to grow and on time watering is also necessary for managing different variety of crops [2-3]. Water management is difficult to split the works, where farmers cultivate different crops on different fields. Watering crops on the same time cause sick where some crop need little amount of water and another needs more. But, managing manually takes lot of time to be spend to check the level of water on each fields and managing it with cutting some space on fields to take out some water.

Now days, technology emerged on market on different areas even in agriculture. So this management and all going to be done automatically with variety of sensors where it check the soil status using soil sensor

whether it is dry or moisture<sup>[4]</sup>. Even with vibration sensor, the theft detection on motor room is monitored and alternate solution of intimation is passed to owner of farm. So, it will be helpful for entire agriculture field without any manual progressing on watering and making some authentication<sup>[5]</sup>.

## PROPOSED WORK

Our implementation, designing a sensor based automation watering system to control flow of water on various fields and checking the level of sensors whether this field is enough. When the motor is ON to fill the water on fields, the sensor inserted in fields check the level of water. If the water level reach its limit, automatically a wall will close the field and drops water on to another fields, when it reaches all fields with enough water. Automatically intimation is passed to the motor switch with a signal of ON or OFF helps better farming on a smart way without any manual monitoring of work during watering fields.

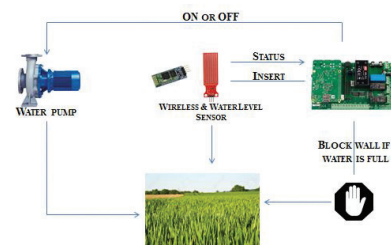


Figure 1: Proposed System Architecture

In Figure 1, the detailed view our implementation is explained. Here, first the water pump is on to fill water on to the fields. Second, kit is inserted with water level sensor and wireless sensor to send intimation back to the kit. Then, the sensor check level of water on each field and send a message back to kit. Where kit receives signal and process action whether to turn off motor or block water for that filled. Each time a field is checked whether it is enough water or need to pass water from that field to another with status action. Sensor analyzes each level and keeps on forwarding the information back to the main board to further proceeding.

With the help of IOT board the process is completely automatic, there is no need of manual monitoring of water proceeding to the filed by calculating hour basis. Just turn on the motor as well as main board to keep on check the status of files simultaneously without any interference.

### RESULT AND DISSCUSSION

In this methodology we compare the old days of watering standards and current technology update on the domain to initialize a legal way for future work. Manual standards with automatic board functionality increase the standard of improvisation on agriculture areas. Figure 2 explores the Comparison of Manual and Automatic process.

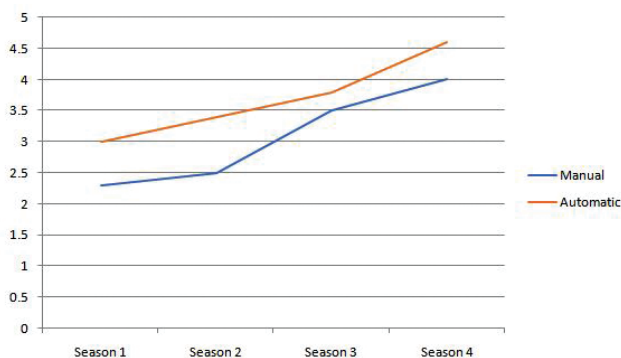


Figure 2: Comparisons of Manual and Automatic

### CONCLUSION

Finally, manual operations are kept on monitoring with a human being to complete functionalities. IOT based automation watering of crop fields proven with better functionalities without any damage to crops on water level high basis. Improvised method with excess amount of water is blocked and moved on to other fields increased ability to discovering areas.

Ethical Clearance: Taken from AMET University

Source of Funding: Self

Conflict of Interest: Nil

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# Target Recognition for Marine Search using Neural Network

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## ABSTRACT

Detection of objects of interest and finding out the difference in the ports of the sea is of a very high magnitude considering the low amount of current video analysis in marine surveillance systems present. Nearly now a day's sea transports are used in 80%. With the growing use of marine transportation, an increase of criminal behaviour from the traffic of banned materials to terrorist attacks using sea transport is continuously occurring. This work is motivated by significant surveys on video detection for object recognition and analysis system in a marine environment for surveillance. In this paper proposed system represents the object recognition and tracking.

**Keywords:** Radar image, moment invariant, target recognition, BP neural networks.

## INTRODUCTION

The detection of small targets using microwave radar of great interest is to the signal processing and radar communities <sup>[1]</sup> in Marine environment. Traditionally, signals (can be classified as Deterministic signals. Research in unmanned marine systems has experienced a substantial increase in the last years leading to the emergence of multiple systems with various operational degrees. Unmanned surface ships have been applied both to safety measures and military applications <sup>[1]</sup> or civil oriented ones such as special data gathering <sup>[2],[3]</sup> or multiple vehicle processing support<sup>[4]</sup>.

For this paper, recognition is defined as the identification of an individual target, whereas classification will refer to the identification of a class target <sup>[4]</sup>. Detection is required before either of those steps. There are many methods for target classification, such as statistical pattern organization, object recognition, multi-sensor based information fusion, neural networks recognition and fuzzy clustering method etc. <sup>[5-7]</sup>

The underwater vehicle for surveillance <sup>[8]</sup> was proposed with navigation and swarm network communication for the analysis feature extraction and target identification. Minesite groundwater contamination mapping was introduced<sup>[9]</sup> for the study of radar images and database samples of underground water contamination. A Novel Wave Bird Concept <sup>[10]</sup> was proposed for Marine Surveillance. This method includes statistical pattern classification for determining the recognition model.

**Marine Radar Target:** The primary objective of pre-processing radar images for recognition by neural networks is one of feature extraction. Figure 1 represents the four methods. There are,

1. Target Data Collection
2. Multimodal Image Fusion
3. Multimodal Target Recognition
4. Multimodal Target Tracking

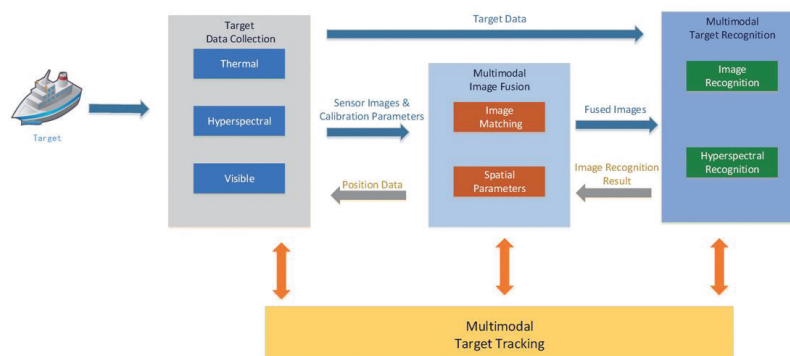


Figure 1: Block Diagram of the Methodology

In this method used to analyzed and track the object in the marine field. Multimodal target recognition has two purposes Such as Image Recognition and Hyperspectral Recognition.

**Radar Working State Characteristics:** The marine radar uses:

- Different range to detect pulses,
- Large bandwidth,
- It changes the amplitude and size depends upon target echo.

**Image Morphological Features:** Image Morphological Features are,

1. Target’s area S
2. Target’s mass M
3. Target’s inertia I
4. Target’s density D
5. Target’s circumference C

**Image Invariant Moments:** In the field of pattern recognition, graphics feature of an image is a crucial object of feature extraction, and moment features these elements are used in this method. The concept of the invariant moment was proposed and applied to pattern recognition<sup>[11]</sup>. Pattern recognition is very useful for image extraction.

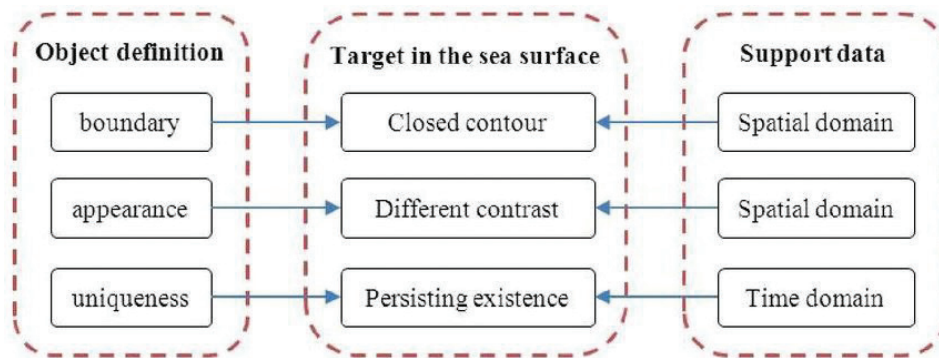


Figure 2: Block Diagram of Object Recognition

Figure 2 shows that the object recognition technique. In this object recognition technique used for marine applications.

**Marine Search and Rescue Radar Recognition System:** Marine explore and analyzed the radar object recognition scheme proposed in this paper first got the video signals, trigger, headline and antenna azimuth signals. Then through the radar data acquisition card which is based on PCI bus convert the radar echo signals into 2-D range and behaviour of the image. The system removed visual features and moment invariant characteristics from radar image depend upon the neural network. The system structure is shown in Figure 3 consists of Radar, Image acquisition in 2D, Parameters acquisition, neural network.

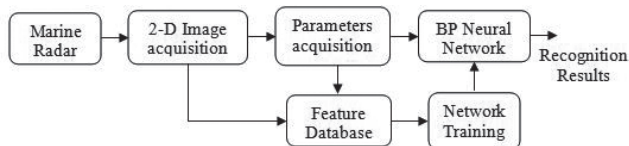


Figure 3: Block Diagram of the Proposed System

**Experimental Results and Discussion:** In this paper, propose BP Neural network. In this technology represents the four radar working parameters, five image morphological characteristics and seven image invariant moments are removed as detection features for BP neural network. PCI-based radar data acquisition card. For three kinds of radar objects, 150 object images are obtained from marine radar and used as the model set to train the BP neural network.

## CONCLUSION

The problem of obstacle detection for avoidance in unmanned surface vessels was addressed. In this paper, a new radar target recognition method for marine monitoring and analyzing system is introduced. This technique uses radar working parameters, image fusion, image recognition, partitioning and BP Neural network. Recognition algorithm is the main proposed method. In this proposed method used to identified and detect the object. The recognition results show that BP neural network algorithm is applied well n radar target recognition when invariant moments are used as a kind of stable target feature.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Under Sea Laser Communications Field Demonstration in Narrow-Beam

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## ABSTRACT

In this paper described that the narrow beam laser correspondence through the waters Island. The transmitter and receiver were mounted on an aluminum truss and set in the water. The transmitter comprised of a constant modulator and encoder, a 515 nm wavelength business laser, collimating optics, and a directing mirror. The collector incorporated a guiding mirror, a central plane camera, a straight mode torrential slide photograph diode (APD), a photograph multiplier tube (PMT) single photon finder, a huge range imaging camera, an iris to shift the field of view, optics to part the pillar between the different identifiers, and field-programmable door exhibit (FPGA) hardware for continuous demodulation and disentangling. The PMT and APD locators were utilized for correspondences showings; the imaging and central plane cameras were utilized for channel portrayal estimations and framework arrangement. Interchanges and portrayal information were gathered through an assortment of conditions over the five day field try, including day and night, quiet and high winds, and surge and ebb tide. In the examination, the transmit control; beneficiary field of view, and connection separation were shifted. The water transmission actiivity and volume scrambling capacity were measured all through the test to adjust the outcomes. Continuous correspondences shows with the PMT were completed between 1 megabit-per-second (Mbps) and 8.7 Mbps at 7.8 meters, which spoken to in the vicinity of 8 and 12 shaft eradication lengths. With the APD, 125 Mbps were exhibited at 4.8 meters, speaking to around 5 annihilation lengths.

**Keywords:** *optical communications; undersea communications; lasers; field experiment;*

## INTRODUCTION

An optical communication through the water is a promising innovation to remotely transmit information between undersea stages. Optical transmission guarantees information throughputs requests of extent more noteworthy than those accessible through acoustic or radio recurrence interchanges. In situ seawater shows have accomplished between 2-50 megabits for every second (Mbps) <sup>[1, 2]</sup>, while research facility exhibits have come to past a gigabit for each second <sup>[3-7]</sup>. Limit bar laser correspondence (laser com) gives both the most astounding information throughput joins and the longest connection removes by augmenting power transmission and limiting worldly scattering and foundation light. We have directed a field exhibit of thin shaft undersea laser correspondence. The showing had three primary destinations. The principal target was a constant exhibition of a correspondences transmitter and single-photon affectability collector, worked in the vicinity of 1 and 10 Mbps. The second target was to show a higher

flag level correspondence at 125 Mbps. The third target was to portray laser proliferation through seawater to illuminate the outline of a future restricted shaft laser correspondence framework. The show effectively expert each of the three goals. The analysis and outline results are portrayed in this paper. Mostly frequencies in permanent spectrum assignments <sup>[8]</sup> are idle frequency bands and are not used effectively for communication. Idle frequencies are also called as White Spaces. Spectrum sensing is highly concentrated for cognitive radio in order to use it effectively. On board data units (OBDU) <sup>[9]</sup> are placed in each vehicle to sense and cache the information in order to reduce the service access delay and congestion in VANET environment.

## EXPERIMENT DESCRIPTION

The experiment comprised of a transmitter, a receiver, and a control focus. Transmitter and collector equipment were contained in water-tight holders with windowed end tops mounted on two closures of an

aluminum truss. The transmitter and receiver were each associated with the control focus with a power link and optical filaments.

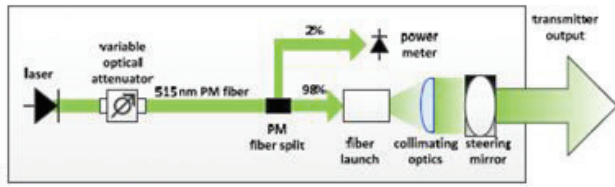


Figure 1: Transmitter Section

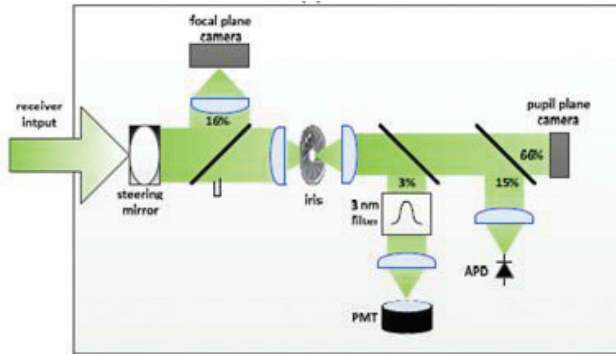


Figure 2: Receiver Section

The transmitter comprised of a commercial gallium nitride laser with an inside wavelength of 515 nm (free-space), a variable optical attenuator (VOA), collimating optics, and a directing mirror. A piece chart of the transmitter is given in Figure 1. The laser was straightforwardly adjusted with the information encoder controlled in a field-programmable entryway exhibit (FPGA). The optics, guiding mirror, and directing mirror controller were in the transmit holder set in the water. The laser, VOA, and FPGA stayed in the control fixate on shore. The optical flag was transmitted over fiber from the control focus to the transmit compartment. The collimated shaft propelled into the water had a mode field measurement of 5 mm. The optical transmit power was measured to be 0.25 mW in free space.

The receiver included a directing mirror, a central plane camera, a straight mode torrential slide photograph diode (APD), a photomultiplier tube (PMT) single photon finder, an expansive territory camera to picture the student plane, and an iris to shift the field of view. A piece graph is given in Figure 2. The opening size for the beneficiary optic had a 2 cm measurement. The PMT and APD locators were utilized for correspondences shows. Both indicators were business segments, particularly a Hamamatsu H10682-210 PMT and a Hamamatsu C5658 APD. The student and central plane cameras were

utilized for channel portrayal estimations and framework arrangement. These paper optical flag was coupled to the four sensors by optical pillar splitters. The PMT yield was handled in FPGA gadgets for ongoing demodulation and deciphering. The majority of the above parts were housed in the get holder brought down into the water. The correspondence framework worked in two modes, both using on-off keying (OOK). The main mode was a high affectability (~1 photon/bit), low information rate (1-10 M baud) connect using the PMT. This mode executed continuous synchronization and forward blunder revision. The second correspondence mode used the APD and worked at 125 Mbps. The constant APD showing utilized a business bit mistake rate analyzer.

### RESULTS AND DISCUSSIONS

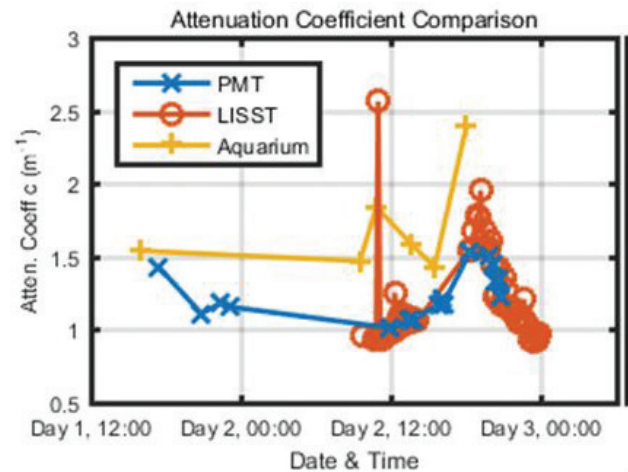


Figure 3: Measured attenuation coefficients

A comparison of the attenuation coefficient measurements is appeared in Figure 3. Each of the three transmission activity estimations demonstrated comparative outcomes, with most perceptions of C in the vicinity of 1 and 2 m<sup>-1</sup>, run of the mill of harbor water. The aquarium estimations watched the most noteworthy weakening esteems, likely because of the water examined from the surface as opposed to at the examination's profundity. The LISST's deliberate constriction coefficient coordinated those seen at the correspondence wavelength, recommending that weakening was commanded by scrambling as opposed to ingestion (a normal outcome for harbor water). The transmission activity related generally with the tide (and hence the profundity), with more weakening seen at low tide.



## CONCLUSION

The field test was a successful proof of idea exhibit of narrow beam undersea laser correspondence between settled terminals. Communication rates between 1 and 125 Mbps were shown through characteristic waters with both low power transmission and little collector optics. The exhibit was completed in harbor waters close to the shore, where the bar constriction was generally high because of particulate dissipating. Hence, the exhibition separation of 7.8 m, while humble in outright terms, speaks to in the vicinity of 8 and 12 annihilation lengths. This was expert in spite of trial imperatives that fundamentally diminished the power coupled to the interchanges collector. In particular, the variable optical attenuator in the transmitter and the bar splitters in the beneficiary essentially decreased the coupling to the correspondence collector. A deployable laser correspondence terminal would exclude these requirements. In this paper access the current PMT handset could accomplish separates up to 22 termination lengths. For harbor water like the field exhibition, this would be a separation of 20 meters; for clear sea waters, the connections could close more than several meters. By performing tight shaft laser correspondence through common waters, the field test gives a vital pathfinder to a vehicle showing of narrow beam undersea laser communication.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Understanding Protection Concerns of Life Boat Beginning Procedure using Game Prototype

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## ABSTRACT

Novel propelled game systems give us new potential outcomes to impersonate a confused preparing process, with the advantage of security improvement. In this paper, we outline and execute a 3D game which mirrors the lifeboat beginning procedure. Lifeboat beginning is such a complex however indispensable process which can on one side sparing individuals' life on ocean and on the opposite side partner numerous potential perils. It includes both the tractor moves and boat operations. The essential target of the diversion is to enable tenderfoots to better comprehend the arrangement of the operations in beginning procedure and administrator the potential perils occurring amid the starting. There is additionally extraordinary instructive hugeness with the advancement of the amusement to the overall population for upgraded consciousness of security issues. The key modules of the diversion are outlined in light of physical reenactment which gives the players upgraded conceivable insight and pleasant association.

**Keywords:** Life Boat Beginning Procedure, Game Prototype, protection concerns.

## INTRODUCTION

Lifeboat beginning is such a confounded procedure which includes a few parts, including tractor driver, boat team and examiner. Their participation directly affects the after effects of salvages which truly are life and demise issues <sup>[1]</sup>. Familiarities with the operations significantly influence the speed and proficiency of the safeguard. The rescuers themselves may likewise confront extreme conditions, e.g. obscurity, tide, wind, and rain/snow <sup>[2]</sup>. Completely understanding and sufficient practices turn out to be particularly imperative before confronting the genuine risk. In this way, a training preparing process ends up plainly imperative <sup>[3]</sup>. Training preparing process winds up noticeably imperative. Generally, the preparation method for beginner is to have him/her read instructional manuals and afterward hone in a genuine launching condition <sup>[4]</sup>. Nonetheless, there are quite often chances for unpracticed administrators in this circumstance and furthermore concentrate manual of a confounded operation process could mistake for fledglings to see, particularly including administrators with various parts<sup>[5]</sup>.

Game based preparing for lifeboat beginning gives an extensive variety of advantages for both scholarly

world and industry, including: give an intelligent virtual condition to the students, where they can encounter distinctive parts and comprehend the entire photo of the preparation procedure <sup>[6]</sup>. It likewise enables the students to pick the preparation level while certain and in particular won't hazard their lives. Spare surprising time on the preparation cost. Cater for remote preparing; learners are not really on location. It likewise bolsters peer survey, input and preparing evaluation <sup>[7]</sup>. Make the learning pleasant. Since the lifeboat beginning procedure is not broadly known to people in general, it will likewise empower open engagement for instructive reason.

The prime goal of the present work is to configuration, actualize, and test an entire design empowering total lifeboat dispatches prepare <sup>[8]</sup>. This work has two principle commitments: a novel game based preparing framework for beginners to be acquainted with lifeboat beginning procedure without the dangers of this present reality; a game stage to energize open engagement with the end goal of security instruction. Recognition and Tracking of Moving Object in Underwater Sonar Images (USI) <sup>[10]</sup> was proposed to track the application of Wiener filter that enables the tracking of objects. Object recognition is a system comes under the process of underwater image

processing that loads an image. Pre- processing the image, filtering and scaling the image includes in finding the object.

**Proposed System:** In this area we show the diversion plan which includes the pedagogical contemplations based. Game pipeline indicates the key operations amid the lifeboat beginning procedure. Virtual condition setting enables the players to pick the distinctive levels as per their self-assurance.

This game is created to target both the expert clients for lifeboat beginning preparing and the overall population for wellbeing mindfulness instruction. The storyline is the same for both and executions are somewhat unique for those two targets. Our diversion is comprised of various practical modules with each in charge of a basic errand. Hence the game is adaptable for accomplishing both targets. For preparing reason we concentrate on the right arrangement of the lifeboat beginning procedure, while for overall population engagement we accentuate on the submersion and fun of the game.

We outline the game pipeline as indicated by the starting manual as tractor associates with the lifeboat: ensure associated legitimately; inspector checks the earth security and the tractor functioning admirably; tractor driver and boat teams set out; tractor driver, watercraft group, and inspector set up radio correspondences; inspector gives beginning signal; ensure signal is gotten before beginning; tractor moves out from the boat storage; ensure no hit or impact with ecological resources; tractor drives towards to the shoreline; pick the right driving mode as per distinctive street conditions; tractor crashes into the water: modify the sensor, camera, light to coordinate distinctive condition; tractor drives to the starting range: achieve the starting point and evade the encompassing dangers submerged; tractor separates with lifeboat when the water profundity is sufficient for beginning: identify the correct water level; [9] application

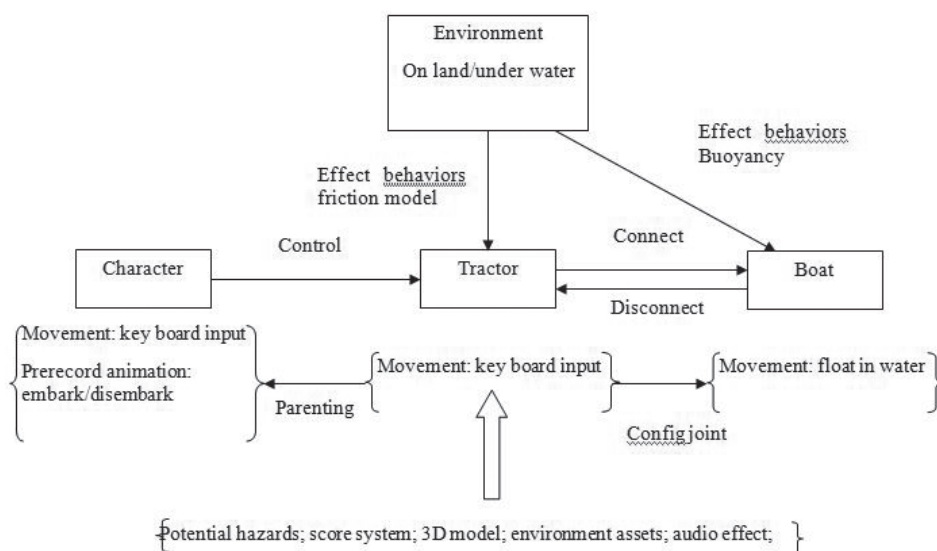
of machine learning for real-time evaluation of salinity (or tds) in drinking water using photonic sensors tractor drives back to the boat shelter: change driving mode and ensure staying away from any risks; tractor driver lands.

## DISCUSSIONS

So as to ensure the client encounter, the operations planned deliberately for instructional method, which don't connect with specific visual criticism in the game, are disregarded in the diversion for open engagement. Notwithstanding, they are still imperative for preparing reason. There are more risks amid the starting procedure to make the game all the more engaging, e.g., running pooch, roller balls and people on foot. Players ought to dependably be mindful about these risks and move securely without causing any threat. This is a decent approach to viably practice the players' reaction ability. The check for the succession of operations will be debilitated here. The players will just depend on the console contribution without the utilization of draw down menus.

There are three fundamental resources in this amusement: characters (tractor driver, boat team and inspector), tractors and water crafts. Once the driver leaves on the tractor, the driver is child rearing with the tractor which implies we overlook the relative movement of the driver and tractor.

The moves of the tractor will be straightforwardly controlled utilizing the console input, same standard for the boat group and the boat. The development of watercraft is triggered by tractor and affected by water. The connections between them are appeared in Figure 1. Essentially the players permit move operations to control the characters and tractors, satisfy the starting procedure without cause any risk inside given time. The score framework will give criticism toward the finish of the game.



**Figure 1: Proposed System Architecture Diagram**

## CONCLUSION

In this paper, we propose a game stage model for lifeboat beginning procedure utilizing instructive and specialized methodologies. The diversion enables fledglings to gain lifeboat beginning background in a virtual situation without the dangers of this present reality. It gives a significantly more secure to clients to get comfortable with the operations. This can be utilized for expert preparing purposes later on. Besides, the diversion fills the instructive need of the consciousness of security issues for overall population while being engaging. The client assessment comes about demonstrate that individuals learn better when they are effectively occupied with securing and developing information in a learning-by-doing circumstance.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Vector Based Electronic Nautical Chart for Effective Visualization of Spatial Indexing

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## ABSTRACT

Electronic nautical diagram is broadly utilized as a part of cruising to guarantee the wellbeing. At The present review, we concentrate at viable representation of vector-based electronic nautical outline amid structural ordering improvement. The recovery of the execution information from the administration is used commonly for the spatial ordering. The R-tree is used to develop the outline of the framework. In this paper we proposed the outcome demonstrated and assessed of the framework outline was ordered by the R-tree. This demonstration and assessed is represented by the nautical graph.

**Keywords:** *spatial ordering; electronic nautical outline; electronic diagram framework; R-tree.*

## INTRODUCTION

The ECDIS part which is helps to information of the ENC which is vector based. The ECDIS is known as electronic chart display and information system. And electronic nautical chart is known as ENC. The SENC organize is a non-uniform framework which it is changed from the ECDIS by the circulation of IHO s57 of the ENC. In the paper <sup>[1]</sup>, data of the digital hydrographic is demonstrated. The changing is based on the ENC cell's different structure. The information about the every ENC cell was measured and stored. SENC utilized as a part of indicated ECDIS items can satisfy prerequisite of successful representation without spatial ordering support. SCAMIN attributes for archipelagic seas and conceptual model of environmental, geological and geo-technical response of dredged sediment fills to geo-disturbances in lowlands are discussed by <sup>[2]</sup> <sup>[10]</sup>. Be that as it may, spatial filed SENC is fundamental to electronic graph framework (ECS), which does not meet the control of IMO for restricted figuring assets. The reactive-tree is described by <sup>[3]</sup>. ECS is generally utilized as a part of little and medium-sized boats that can't manage the cost of ECDIS. Spatial ordering can lessen the quantity of showed ENC protests by just recovering ENC objects contained in current showed territory. GAP-tree, an approach to 'on-the-fly' map generalization of an area partitioning is discussed by <sup>[4]</sup>. Joined with on-line speculation technique, the perception impact of ECS can be incredibly moved forward.

Whatever remains of this paper is sorted out as takes after. In area 2, the foundation of ENC impact representation is displayed. In segment 3, the ENC perception stack is depicted. In the <sup>[5]</sup> applicability of oceanographic information and proposed spatial indexing system is described. In segment four, dimensions of the sketch calculation is introduced. Segment five envelop a trial comes about, lastly segment six examines the future work and closes

## BACKGROUND

If there is dual various approaches for guarantee successful representation of ENC items: spatial file and online speculation. On-line speculation concentrates on decreasing the points of interest of items as indicated by show levels. While, spatial file bolsters discovering objects in current show territory rather than the full zone. A dynamic index structure for spatial searching is discussed by <sup>[6]</sup>. Those two techniques can be utilized as a part of blend.

**Online Generalization Method:** Another system of utilizing SCAMIN credits is recommended to be connected to a more extensive region of the Sibenik harbor. SCAMIN consider for each ENC items is characterized into five gatherings as indicated by their navigational reason. Other than on-line era strategy said above, many reviews have been done on-line outline. Receptive tree, a completely unique and responsive information construction was exhibited based on the

vector structures custom fitted to proficient stockpiling moreover recovery of statistical articles on various intensity of information.

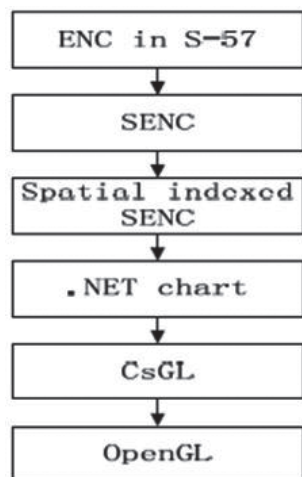
**Spatial Indexing Method:** The level of the metadata is showing and questioning is proposed by the C-squares. The marine information of the framework is the range of the spatial. In the paper [6] is explained the framework’s network reference was uniform actualizing detriments and circumstances. The S-100 framework is referred lattice by the proposed of C-squares at the meeting of IHO-HSSC. And also broke is additionally done by the S-10X.

By used the spatial file method the worldwide matrix was getting by the introverted ECN cell. We get B-tree by adjusted the stature of the R-tree [7]. By the help of the spatial area the information recovering is indicated rapidly bolster. The tree hubs are moderated to rectangles covering to obtain the R-tree variety from R+-tree. The tree’s streamlined is additionally reinsertions and page cover in limit by the R\*-tree [8]. The fundamental guide applications are helps to great deal of the subsequent and there is no favor cuts are additionally in the split system.

Hilbert R-tree forces a direct requesting scheduled the information rectangles. The requesting groups “comparative” information rectangles jointly to the range limit and edges of the subsequent least jumping rectangles[9].

Orthogonal Frequency Division Multiplexing (OFDM) is a current and known technique for high efficient data transmission and high bandwidth data transmission; it can be achieved by converting the wideband signal into narrow band signals[10].

**ENC VISULIZATION STACK**



**Figure 1: Visualization Stack of ENC**

The figure 1 shows the visualization stack of the ENC. In the below the figure the every layers are clearly explained. By the help of the CsGL the ENC visualization is proposed 1<sup>st</sup>. it is the environment of the Net system. This net system is limited performed system. For the ECS development is not popular in the environment of the Net system. The on-line generation technique and spatial index fulfilled the ECS requirements.

**ENC in IHOS-57:** To the marine graphs the vector format is interchanged from the IHOS-57. The IH organization is developed the marine charts. By the CD or download is available for update the service in officially by supplied normally and datum WGS84 is referred.

**SENC:** The ECS’s internal format is compiled by the ENC of the SENC. The manufactures differs from the data of the SENC.

**Spatial Indexed SENC:** By the help of R-tree the ENC indexing is enhances the SENC to the SENC spatial indexing. The SENC format is maintained by the R-tree structure.

**Net Chart:** By the IHO S-52 standard the polygons, lines, points and all types of geometry with the colors are draw by the CsGL from the SENC format which is interprets from the Net chart.

**CsGL:** Allowing the any GL from the powerful C-library and quiet the wrapper are made by the implementation of the CsGL. It is made by the help of the Net language. It is suitable for most applications and it was obestable is proved.

**OpenGL:** The three dimensional graphics and two dimensional graphics applications are interactive; the portable development of the environment is done by the open GL.

The special effect, rendering and texture mappings are helps to develop the speed and innovation of the application of the open GL.

**GEOMETRY OBJECTS DRAWING ALGORITHMS**

The polygons, lines and points are classified as the geometry types in the ENC objects. The algorithms of reconstruction and storage structures of the polygon and line are focused in this section. The line segments and points are connected by the 1D object of the line

string. The line string represents the DEPCNT and COALINE on the ENC objects. The line string object's recreation operation was explained in the 1<sup>st</sup> algorithm. The sequentially assembling of edges and nodes of the geometry co-ordinates are composed. The final rendering is done by the 'GL\_LINE\_STRIP' function.

**Algorithm1 DrawLineString**

**Input: GList:** groups of RCID, each group contain 3 RCID (RCID\_First, RCID\_Edge, RCID\_Last); VCTable; VETable;

**Output:** void.

- 1: CList: a empty list for geometry coordinates.
- 2: For each group of RCIDs in GList
- 3: Retrieve first connected node from VCTable by
- 4: RCID\_First and add it to CList.
- 5: Retrieve Edge from VET able by RCID\_Edge.
- 6: Foreach node in Edge
- 7: Add node toCList.
- 8: **End for**
- 9: Retrieve last connected node from VCTable by
- 10: RCID\_Last and add it to CList.
- 11: **End For**
- 12: Call 'GL\_LINE\_STRIP' with CList.

End Draw LineString The structure of VC Table and VE Table are further described in Figure 2 and Figure 3.

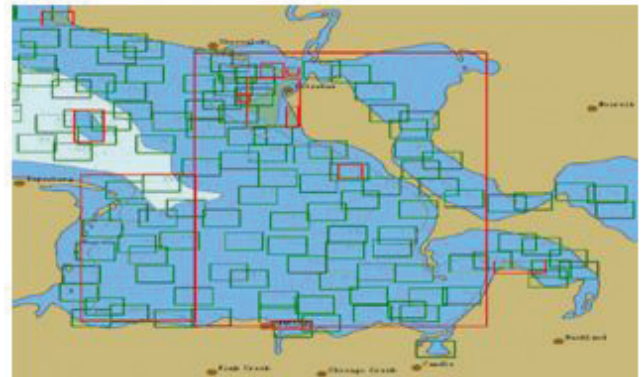
RCID	numOfPoints	Lon, Lat, ...
1936	14	-168.0645, 64.9591, ...
1940	4	-168.0002, 64.9997, ...
1945	2	-166.6683, 65.0144, ...
...	...	...

**Figure 2: VE Structure**

RCID	Lon, Lat
1690	-168.0864, 64.9594
1670	-172.2324, 64.9999
1671	-175.8783, 64.9999
...	...

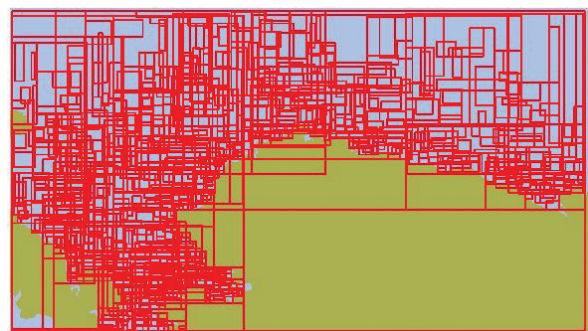
**Figure 3: VC Structure**

**PERFORMANCE EVALUATION**



**Figure 4: Bounding boxes in ENC objects**

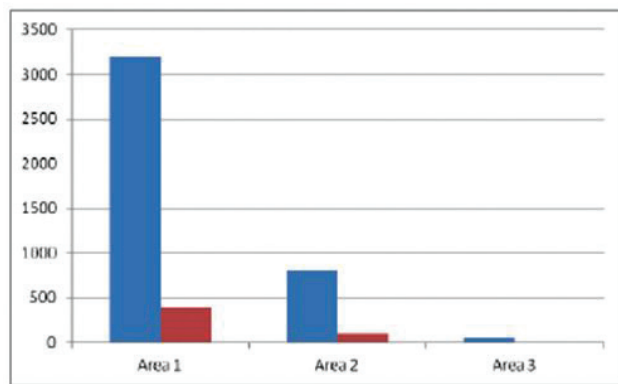
The R-tree spatial index and performance visualization of the SENC is evaluated in this section. The NOAA online is retrieves the experiment dataset [13]. The electronic chart system is shows the continuous depiction of the water in the US coastal by the NOAA ENC. The ENC cell particular are depict the region of geographic in the NOAA ENC features. The evaluation of the performance is carried out by the US1AK90M. The Figure 4 shows the bounding boxes of the ENC objects. The DEPCNT and SOUNDG are the types of objects in SENC built at the AR-tree. The R-tree generates height six, the maximum node is six and the minimum node is three. These above details are the R-tree parameters. The figure 5 shows the R-tree non leaf nodes in the MBRs.



**Figure 5: R-tree indexes of ENC objects**



**Figure 6: Areas 1 in 'US1AK90M'**



**Figure 7: Experimental Results**

The Figure 6 shows the 3 territory assessment execution perception which is recorded from the SENC. If there is different scales of territory is finished. In the Figure 7 shows the results of the assessment. The rendering and dimensioning are observed from the paper.

## CONCLUSION

The ECS with SNEC is record the impact enhancement of the concentrate in this paper. With a specific end goal to additionally depicting the spatial listed SENC, electronic nautical chart perception stack is agreed. And it is depends on Net system condition and CsGL. The rendering is comes by the SENC by the perception procedure on the calculations of the object geometry. The perception procedure is additional one at that point. Finally, execution assessment is completed to demonstrate the exhaustion of spatial ordered SENC with R-tree. Later on, streamlining of R-tree ordered SENC will be done to additionally enhance the perception impact.

**Ethical Clearance:** Taken from AMET University Chennai

**Source of Funding:** Self

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# A New Four Port Full Bridge Isolated DC-DC Converter with PMSG Wind and PV Based Power Generation for DC Microgrid

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## ABSTRACT

This paper presents a new four port full bridge isolated dc-dc converter combining photovoltaic power generation, permanent magnet synchronous generator based wind energy system and energy storage device like battery. The converter is designed in order to show high performance compared to conventional multiport converters. A power factor correction cuk converter is used for voltage boosting and power quality enhancement of wind side converter. Sepic based converter is applied for photovoltaic generation side and a isolation transformer unit is added at output to decrease THD of the converter by operating it at nominal frequency. A full bridge dc to ac converter is used before isolation transformer and a full bridge rectifier is added at the output for DC microgrid applications. The proposed four port full bridge isolated dc-dc converter combining PV, PMSG wind and battery is simulated in MATLAB/SIMULINK software to verify the performance of the converter.

**Keywords:** *Permanent magnet synchronous generator (PMSG), Photo-voltaic system (PV), Battery.*

## INTRODUCTION

Cuk is a special type of DC-DC converter which has merits over conventional buck, boost and buck/boost converters. It employs automatic power factor correction for renewable energy resource systems. A high power factor converter can operate at low production cost at high efficiency. If power factor is unity, total loss of the converter is negligible. Multi port converters has advantages like integration of more than one source, operating with the presence of either of the input but the system size increases with increasing ports and offers less efficiency. It shows more reliability than any other converter and can be used as a power management device. A four port dc-dc converter <sup>[1]</sup> proposed for considering the efficiency of the converter. PFC rectifier for PMSG based wind system <sup>[2]</sup> for power management and better power quality. Multiport dc-dc converter with three inputs PV, battery, super capacitor for reliable operation <sup>[3-5]</sup>. Reactive power for optimization is using firefly algorithm <sup>[7]</sup> for power quality and reliability. In Power Electronics and Renewable Energy Systems proposed a multi port converter based on solar with led driver. It shows bidirectional capability charging and discharging. Bidirectional multiport dc-dc converters are required for double side energy transfer applications

such as energy storage systems including battery, super conducting energy storage systems.

**Proposed four port full bridge converter:** Figure 1 shows overall block diagram of proposed multiport isolated full bridge dc-dc converter .With full bridge multiport converter system the proposed converter can operate with the presence of either of input. New our port full bridge isolated dc-dc converter combining photovoltaic power generation, Optimal Scheduling Based on Instance Niche for Channel Assignment in Ad-Hoc Network permanent magnet synchronous generator based wind energy system and energy storage device like battery is implemented for reliable dc power supply. PV is modeled using its single diode equivalent circuit and mathematical model of its characteristic equations. Perturb and observe algorithm is employed to extract maximum power from photo voltaic source. Permanent magnet synchronous generator based wind energy system is used as one more input to multiport system. In wind side a power factor corrected cuk converter issued. Figure 2 shows the circuit diagram of proposed four port full bridge multi port dc-dc converter. From the circuit diagram we can inference that if only wind source is available circuit operation is cuk converter. Similarly if only photovoltaic source is available in the absence of wind generation, circuit operation is

like sepic converter. Battery is used as another source of the proposed converter which makes the four port converter more reliable. THD of the proposed converter is very less in the range of two percent. Boosted dc voltage from pv and wind side converter is fed to full bridge dc to ac converter. Then it is fed to isolation and boost transformer followed by Design of a Single

Input Fuzzy Logic Controller Based SVC for Dynamic Performance Enhancement of Power Systems a rectifier to make it suitable for dc applications. Since this is an isolated converter load side disturbances does not affect the performance of the converter<sup>[8]</sup>, design of a Single Input Fuzzy Logic Controller Based SVC for Dynamic Performance Enhancement of Power Systems.

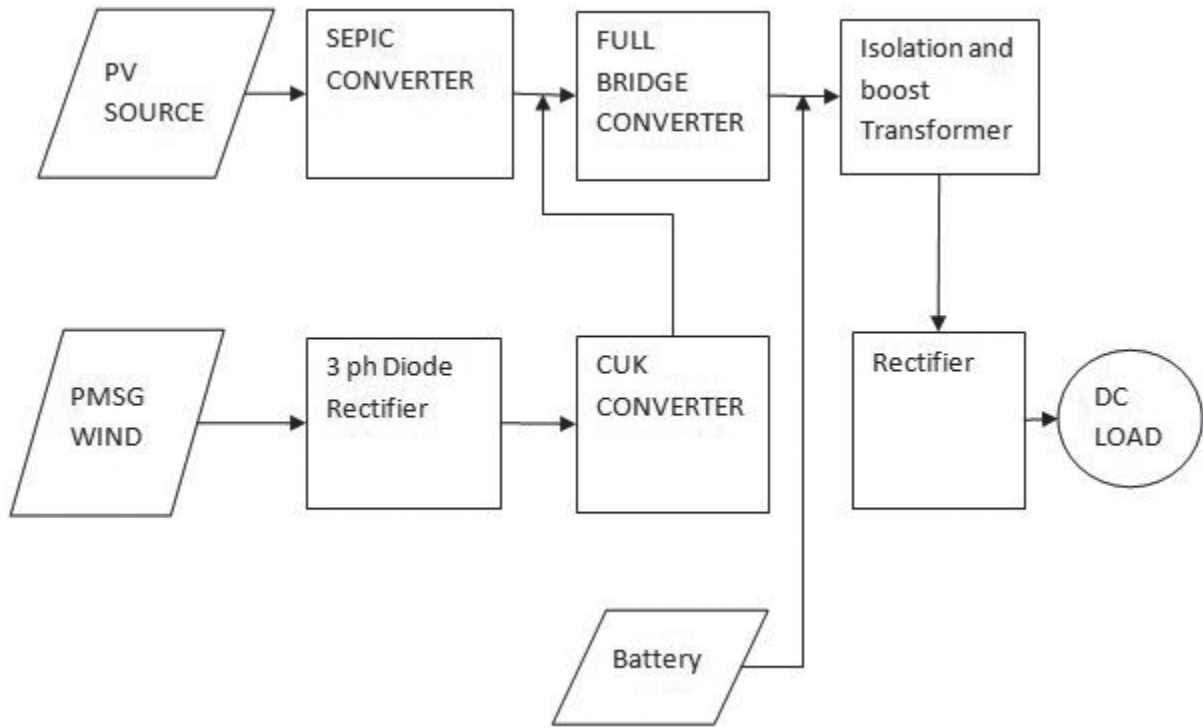


Figure 1: Block Diagram of proposed multi port converter

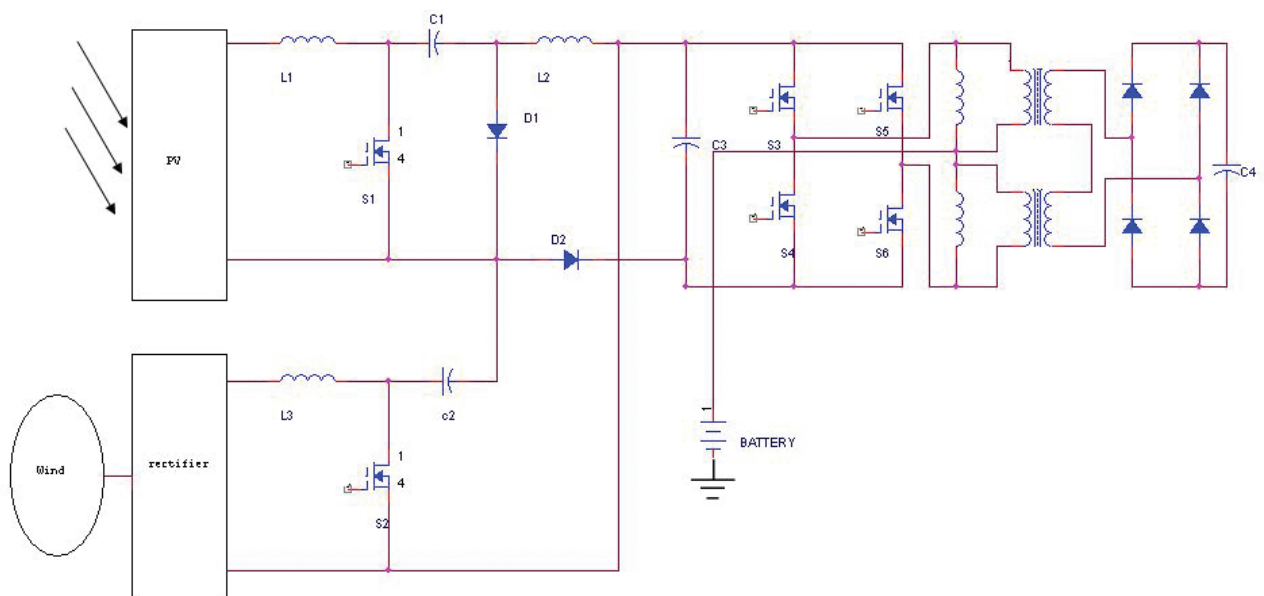


Figure 2: Circuit Diagram of proposed multi port converter

### SIMULATION RESULTS AND DISCUSSION

The proposed four port full bridge isolated dc-dc converter combining PV, PMSG wind and battery is simulated in MATLAB/SIMULINK software and the results are presented in this section. Figure 3 shows

simulation circuit diagram of proposed multiport converter implemented in MATLAB software. Figure 4 to 8 shows the performance of proposed multiport dc-dc converter output load voltage of the converter, PV response, PMSG wind response and THD of the converter.

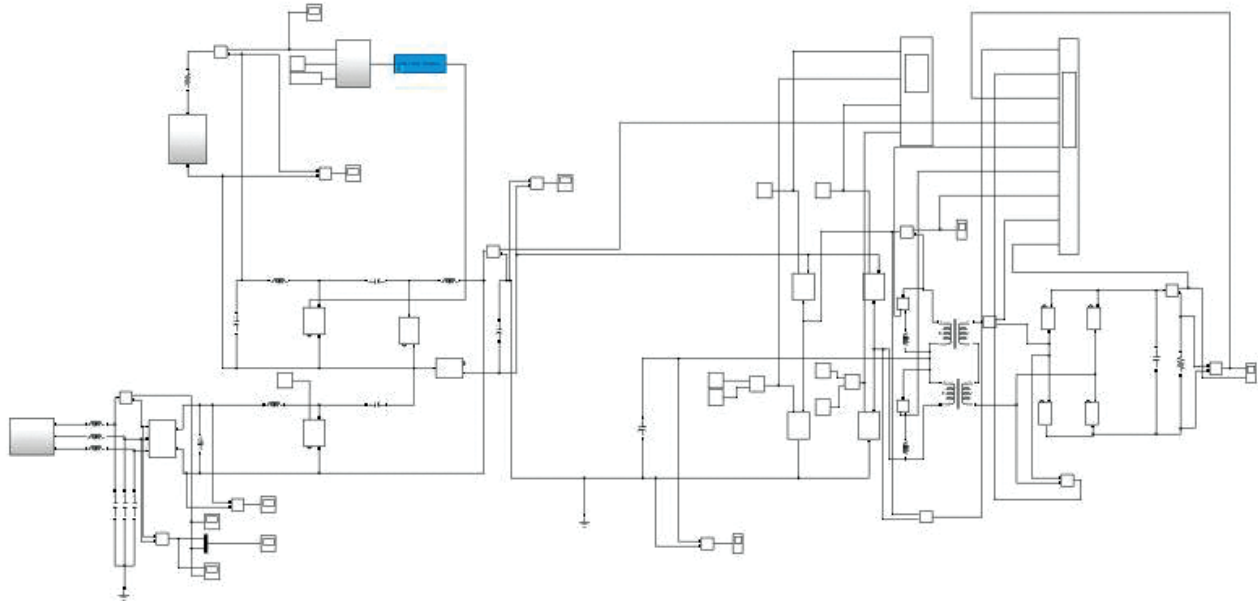


Figure 3: Simulation circuit in MATLAB of proposed multiport converter

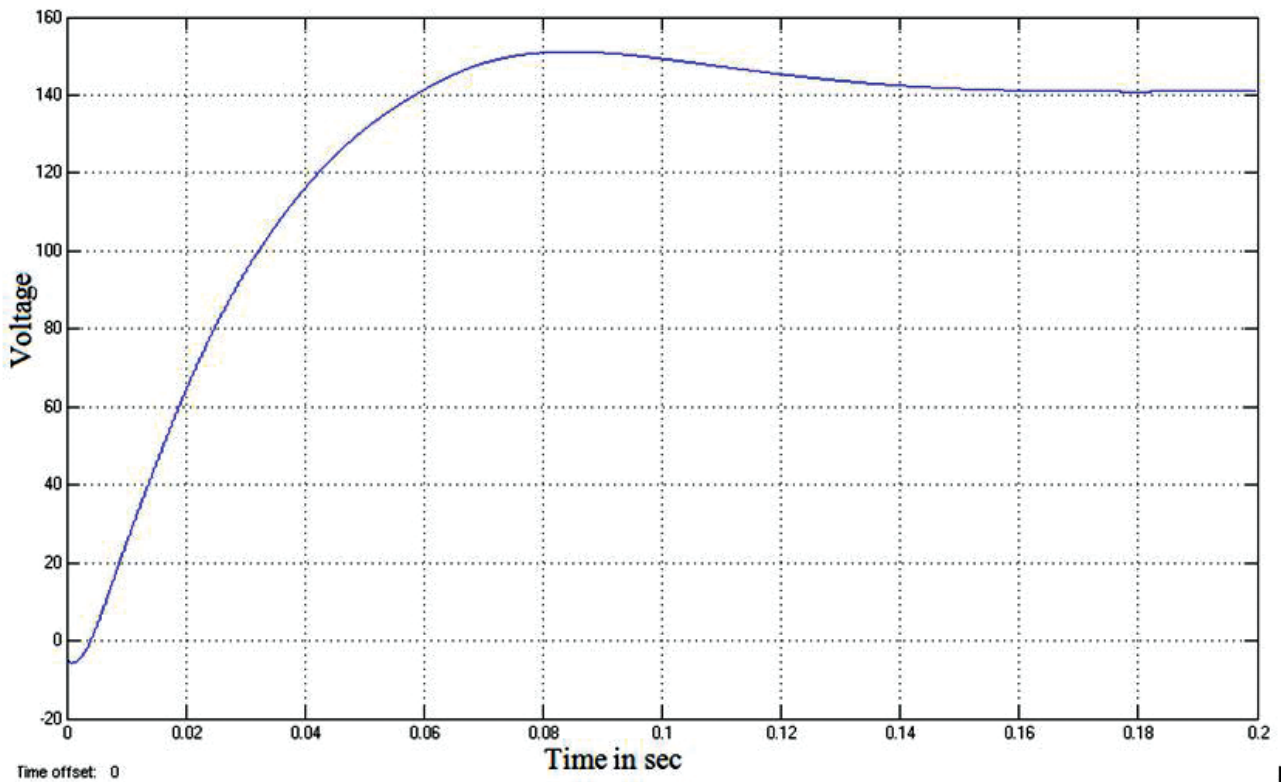


Figure 4: Performance of four port full bridge dc-dc converter

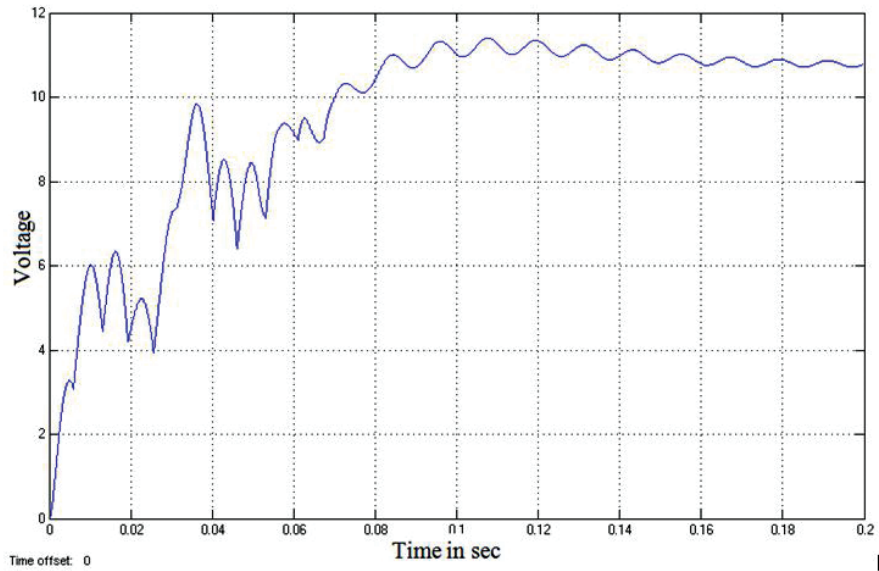


Figure 5: Photo voltaic output voltage

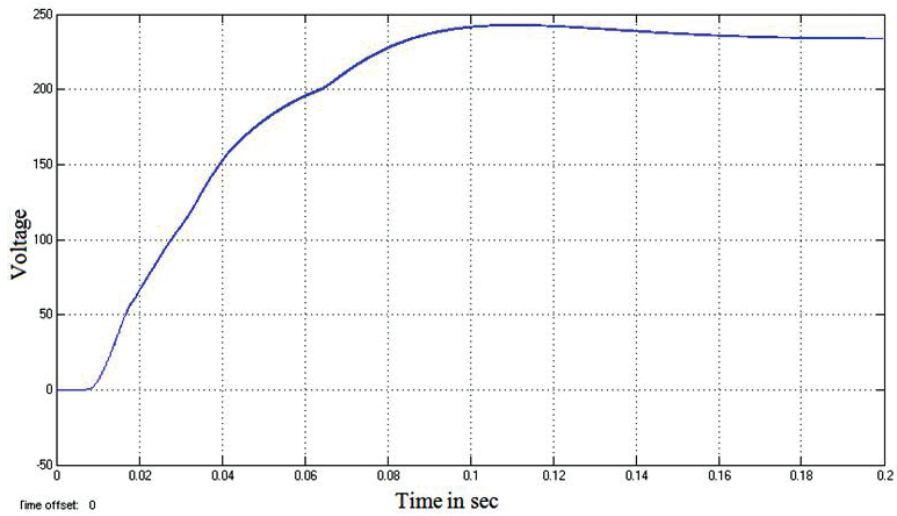


Figure 6: PMSG wind performance

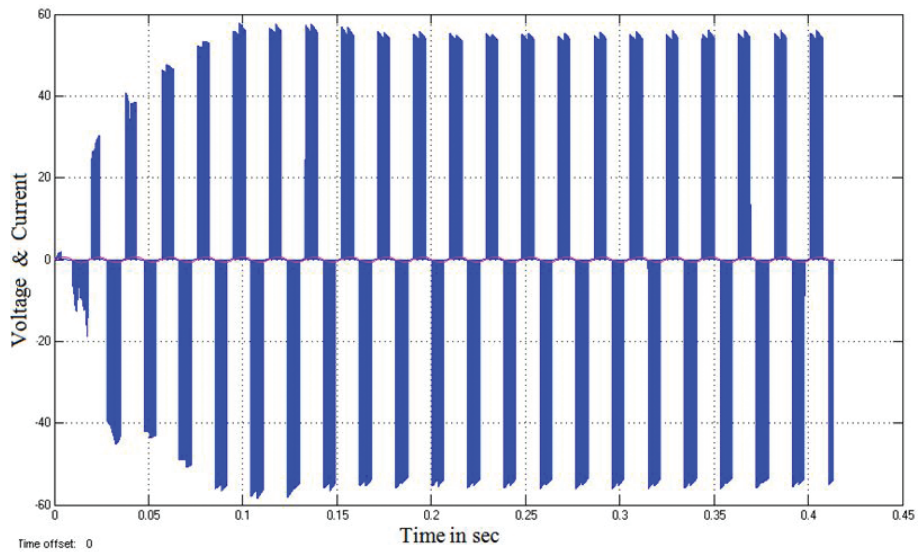


Figure7: Four port full bridge dc-dc converter voltage

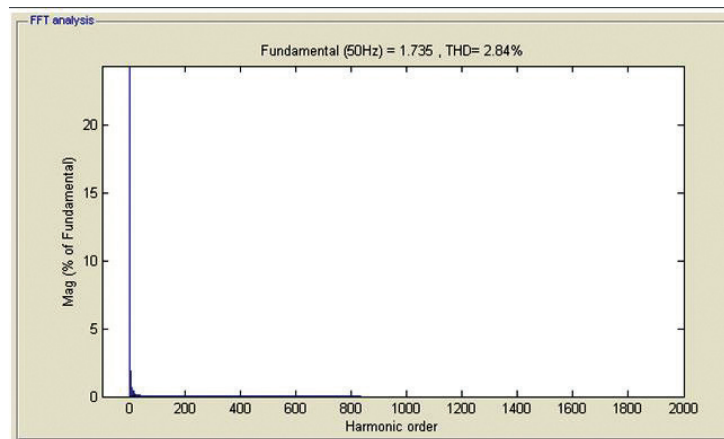


Figure 8: THD of proposed converter

## CONCLUSION

This paper presented a four port full bridge isolated dc-dc converter combining photovoltaic power generation, permanent magnet synchronous generator based wind energy system and energy storage device like battery. The converter is designed in order to show high performance compared to conventional multiport converters. A power factor correction cuk converter is used for voltage boosting and power quality enhancement of wind side converter. Sepic based converter is applied for photovoltaic generation side and a isolation transformer unit is added at output to decrease THD of the converter by operating it at nominal frequency. A full bridge dc to ac converter is used before isolation transformer and a full bridge rectifier is added at the output for DC microgrid applications. The proposed four ports full bridge isolated dc-dc converter combining PV, PMSG wind and battery is simulated in MATLAB/SIMULINK software and the results verify the high voltage boosting of the converter, low THD of the converter, high power factor improvement.

**Ethical Clearance:** AMET University

**Source of Funding:** self

**Conflict of Interest:** Nil

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# Image Resolution Enhancement by Using Undecimated Wavelet Decomposition

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## ABSTRACT

A method of an image resolution enhancement system based on the Undecimated Wavelet Transform (UWT), for the interpolation of the high frequency sub band images from the original input images. First the edges enhancement process is done during the intermediate stages of the wavelet transform. Then the UWT is applied, for the decomposition of different sub-band from the input image. Then the interpolation process is done between the input images and the high frequency sub-band images. This high frequency sub-band is altered by using the UWT algorithm based high frequency sub-bands. Finally the Inverse UWT (IUWT) algorithm is performed to add all the sub-bands for generating the new high resolution image which is called as the enhanced high resolution image. The Peak to Signal Noise Ratio (PSNR) is found in order test out resolution enhancement method performance.

**Keywords:** *Undecimated Wavelet Transform (UWT), high frequency sub band, IUWT*

## INTRODUCTION

In the field of image application there are many a types of image enhancement systems are available. Among them some of the methods are reviewed here below.

A Color image contrast enhancement system is explained in<sup>[1]</sup>. The intensity channel is measured only for histogram calculation where the Gaussian mixture model based histogram method is employed. A technique based on depth map color image enhancement based color stereopsis explained in<sup>[2]</sup> Investigation of Formazan of Benzaldehyde Compound as Corrosion Inhibitor for Preventing Mild Steel Material in Acidic Medium. The depth perception for red and blue channel is calculated and the intensity of the given RGB image is weighted.

A color image enhancement based on partial differential equation is discussed in Synthesis, growth and characterization of novel semiorganic nonlinear optical potassium boro-succinate (KBS) single crystals. A shock filter is built on single vectors of all input image and produces a selective smoothing by reducing the noise. Image enhancement based local processing is presented<sup>[3]</sup> for medical image processing. For color images, the RGB image is converted into HSV color

space. Then two types of enhancements are used like; non linear transformation and local processing neighborhood pixels are used to the luminance channel only for image enhancement.

An approach for virtual histogram based on color image enhancement is explained<sup>[4-5]</sup> for getting the clear image. In this the given RGB image is changed into YCbCr color space, where the global and local processing takes place on chrominance and luminance components. Dynamic histogram equalization based brightness preserving based color image enhancement technique is explained in<sup>[6]</sup>. Here the RGB color space is changed into HSI and only the intensity channel is selected and processed.

## METHODOLOGY

The proposed methodology of this paper is generally based on the image enhancement by means of the UWT decomposition algorithm and the images are enhanced by means of the IUWT process. The framework of our image enhancement method is as shown in Figure 1.

**UWT Decomposition:** The first step of our system is that the input images are decomposed by means of the UWT decomposition algorithm. The decomposition is done by means of separating the images into four sub

bands namely LL, LH, HL, HH sub bands. That is the UWT will start to enhance the images by decomposing it by different layers of sub bands as same as the DWT decomposition. Find the satellite image using KNN and decision tree [7] for getting the clear space image. More number of comprehensive features is obtained from the decomposed image by using the UWT method. The main purpose in the undecimated wavelet transform is that there is no decimation occurs.

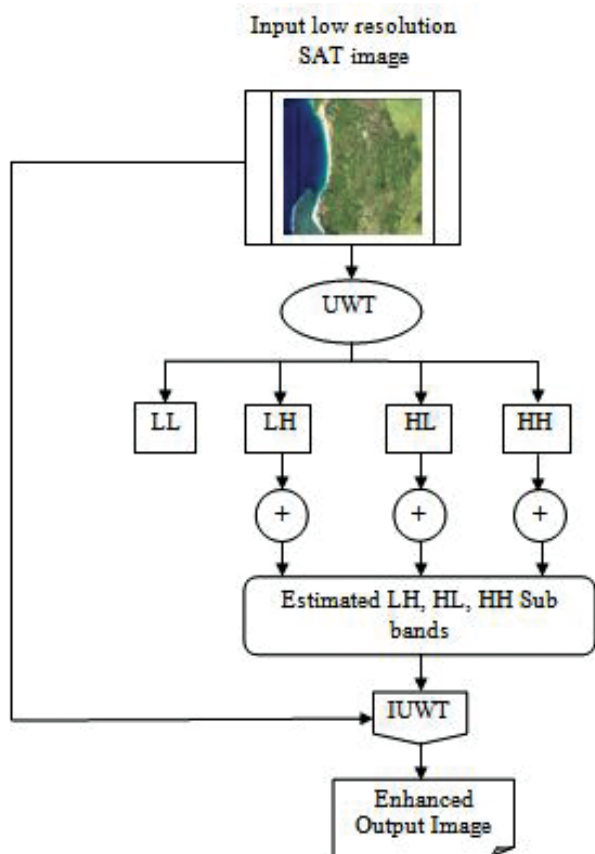


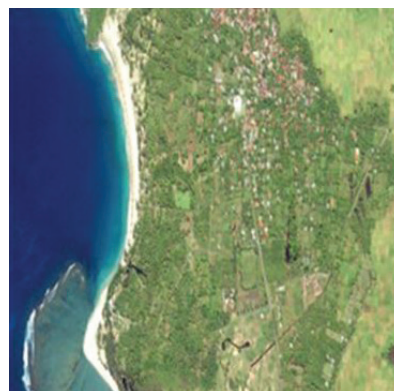
Figure 1: Block diagram of our proposed Image Enhancement System

### INVERSE UWT (IUWT) ENHANCEMENT

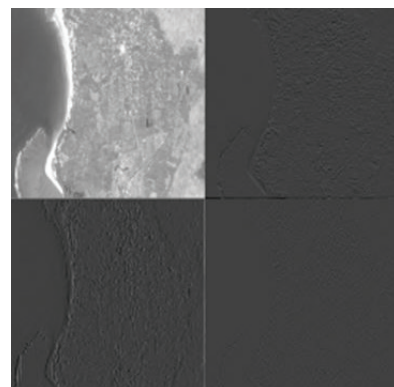
From the different layers of sub bands obtained only the high frequency sub bands are processed here. The undecimated wavelet transform eliminates both the down and up sampling process during the forward and the inverse wavelet transform. From this up sampling the high frequency sub bands can easily process by means if interpolation method where the sub band images will be combined together to form the enhanced information of all the three higher frequency sub bands. Image Super Resolution Using Wavelet Transformation [8] based on Genetic Algorithm for efficient image processing.

### RESULTS AND DISCUSSION

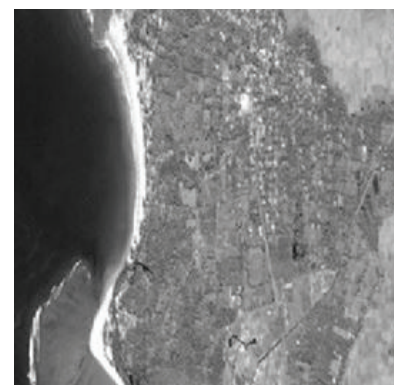
The proposed enhancement technique is tested using the various satellite images in order evaluate the performances of our system. The following Figure 2 shows that the low-resolution input satellite images and it decomposed sub-band images by means of UWT method and the enhanced image by means of the interpolation using IUWT. From the resultant output images we can understand that that satellite images are enhanced by using our resolution enhancement method.



(a)



(b)



(c)

Figure 2: (a) Input Low-resolution satellite image (b) UWT decomposition output (c) Enhanced Output image by interpolation

## CONCLUSION

An image resolution enhancement method based on the interpolation of high frequency sub-bands from the original input images by means of the UWT algorithm is discussed in this paper. The method is been implemented and tested with some well-known benchmark images available publically. Then the PSNR calculation method is used evaluate and analyze the performance of our proposed image resolution enhancement method. The resultant PSNR value obtained by our enhancement method is of 7.26 dB. Our satellite image resolution enhancement method will be very useful than many other enhancement method available previously.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Man Overboard Monitoring system in Automatic Identification and Data Capture (AIDC)

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## ABSTRACT

This framework will involve wrist groups which will be allocated to all team individuals on board deliver with the novel assigned ID code. There will be sensors set on principle deck and zones inclined to Man Overboard Situation, accordingly if a man crosses this line of control and is out of range it will trigger a caution in the extension. Therefore showing a conceivable man over the edge circumstance and extraordinarily recognizing the group part who's is the casualty. Radio-frequency identification (RFID) makes use of electromagnetic fields to recognize and track labels connected to objects. The labels contain electronically put away data. Inactive tags collect signal strength from close-by RFID readers examining radio waves. Energetic labels have a nearby power source work at particular meters from the RFID reader. Not at all like a standardized identification, there is no need to have a tag in viewable range of reader, so it might be inserted in the followed problem. RFID is one method for Automatic Identification and Data Capture (AIDC).

**Keywords:** *MAB, AIDC, safety standards, emergency responders, marine communications*

## INTRODUCTION

It can happen rapidly: a slip on a smooth deck; inclining too far without a handhold; a flashing loss of balance; and abruptly the ocean has wrapped its bone chilling fingers around another casualty<sup>[1-3]</sup>. Whenever of year most BC seaside waters are shockingly cool, and a light hearted trip on a sunny day can all of a sudden turn into a battle for survival<sup>[4]</sup>. Unmistakably, an over the edge boater on a performance outing, or one whose fall went in secret, is stuck in an unfortunate situation surely<sup>[5]</sup>. Be that as it may, the measurements disclose to us that regardless of the possibility that assistance is near hand, a fall into icy water can be deadly. Witnesses regularly report... "I don't see how it happened. He went down so quick and never came up again." Here's the way it can happen and what you can do about it. Man Overboard: Are Current Standards Sufficient to "Rescue" the Injured Seafarer<sup>[6]</sup> it was accepted that hypothermia was the instrument. Subsequently, any frosty, wet dead body was accepted to have passed on of hypothermia<sup>[7]</sup>. In this system is mainly to eliminate the need of a PC and to develop the system probably to reduce the cost. The

smart phones create many opportunities to improve health monitoring and many technologies are developed every year with large scale adoption. The system was developed to monitor the non-invasive signs such as temperature, blood pressure, heart rate, and to detect smoke in atmosphere the gas sensor is used and if the patient fallen down to detect fall detection accelerometer. The proposed system consists of an Arduino controller, GSM 900A, android application<sup>[8]</sup>.

**Proposed System:** Icy water diverts warm from the body 25 times speedier than demeanour of a similar temperature and accordingly, the body center instantly starts to lose warmth to the outside condition. At to start with, the body tries to produce more warmth by shuddering, however this is insufficient to counterbalance the loss of warmth to the water. Inside 20 to 30 minutes, contingent upon water temperature, body center temperature drops to underneath 35° C (95° F) psychological working and judgment wind up plainly influenced. This cooling, if not checked, prompts bewilderment, obviousness and in the end passing. Figure 1 explores the system architecture of automatic identification and data capture.



**Figure 1: system architecture of automatic identification and data capture**

A person's reaction to icy water will shift contingent upon various elements including dress, measure of muscle to fat quotients and movement, yet the enduring decrease in center temperature will proceed until after the individual is expelled from the water. Many books and sites contain diagrams in light of expected survival times without defensive apparel in different temperatures of water. These tables are helpful in anticipating most extreme survival times. Notwithstanding, we have all known about strange instances of long-term survival in chilly water—a long ways past as far as possible proposed by the table. The table essentially demonstrates a normal of expected survival times, accepting a casualty doesn't capitulate to different strengths meanwhile.

For over two decades, open security programs that concentrated on systems for diminishing warmth misfortune in chilly water were second just to those that advanced the wearing of life coats or individual buoyancy gadgets. Boaters were prompted they could expand survival time by hoisting a part of the body out of the water onto skimming destruction. Each square inch of body surface expelled from the water will incrementally amplify the cooling time, despite the fact that the air might be frosty and a wind blowing. On the other hand warm misfortune can be diminished by embracing the H.E.L.P. (warm escape decreasing stance) position, or by clustering near others to diminish warm misfortune. While these systems are exceptionally helpful, they don't consider all variables.

By the 1990's the insights gathered by the US Coast Guard and the Canadian Red Cross, among others, were recounting a story that was no longer conceivable to disregard. It worked out that disregarding the consideration paid to hypothermia over past decades, suffocating kept on being a noteworthy reason for death.

We had been more right than we understood a very long while prior. Most casualties of frosty water drenching really kick the bucket of suffocating, not hypothermia—and many suffocating casualties were near wellbeing when they passed on. For example, the Canadian Safe Boating Council/Smart Risk Study demonstrated that in the vicinity of 1991 and 2000, 41% of the individuals who suffocated while sculling were inside 10 meters of shore at the time. An extra 22% were inside 10 to 15 meters of shore. A British review from 1977 demonstrated that 55% of untamed water drowning happened inside 3 meters of wellbeing!!! Also, 66% of suffocating casualties were solid swimmers.

Obviously some system was grinding away that kept these casualties from having the capacity to help them. The instruments are physiological and neurological stun brought on by sudden drenching in frosty water, and the practical handicap caused by the cooling of the muscles of the appendages not the body center.

## DISCUSSION

Inquiry and Rescue teams found the most widely recognized harm found in survivors of coldwater drenching was hypothermia; recuperated bodies demonstrated a huge center temperature drop, predictable with the possibility of hypothermia. Presentation to cool water was obviously the reason for death; it was accepted that hypothermia was the instrument. Therefore, any frosty, wet dead body was accepted to have kicked the bucket of hypothermia; Regardless of the possibility that the casualty had passed on after under 20 minutes; And despite the fact that it is inconceivable for a casualty to wind up plainly hypothermic in less than 20 to 30 minutes inundation in chilly water.

## CONCLUSION

As a group we had been focused on hypothermia as a reason for death. Inquiry and Rescue teams found the most widely recognized harm found in survivors of coldwater drenching was hypothermia; Recuperated bodies demonstrated a huge center temperature drop, predictable with the possibility of hypothermia. Presentation to cool water was obviously the reason for death; it was accepted that hypothermia was the instrument. Therefore, any frosty, wet dead body was accepted to have kicked the bucket of hypothermia; Regardless of the possibility that

the casualty had passed on after under 20 minutes; And despite the fact that it is inconceivable for a casualty to wind up plainly hypothermic in less than 20 to 30 minutes inundation in chilly water. Indeed, even in ice water, it takes over 20 minutes to cool the body center underneath 35° C (95° F).

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Cascade and Reliquefaction Framework on Ethylene Bearer

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## ABSTRACT

These compressors are utilized chiefly in house hold applications however present day rehearse sees their utilization in payload refrigeration. A minor departure from this is the multi cutting edge sort where the rotor has openings cut in it, fitted to which are spring stacked edges. On the other hand the sharp edges may depend on outward constrain. Both these sorts, when the compressor is halted the fixing weight and oil film are broken and in this way the suction and release are normal. This lessens beginning burdens however requires a suction non return valve to be fitted. Where these are fitted to vast refrigeration frameworks it is conceivable to utilize variable speed thermistor controlled electric engines. In this way the compressor can keep running at ideal transformation to keep up plant proficiency.

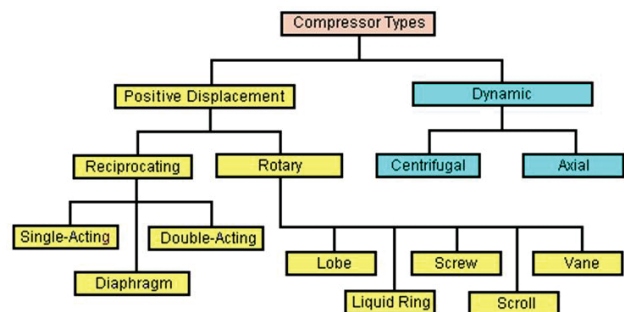
**Keywords:** *compressors, thermistor, electric motor, condenser, thermodynamic analysis*

## INTRODUCTION

For marine utilize outward compressors are discovered just on cooling obligations, as they are not sufficiently adaptable for the scope of working conditions essential for freight operations<sup>[1]</sup>. However some change of limit is required notwithstanding for aerating and cooling obligations, and one of the most ideal methods for diminishing limit is by the utilization of flexible gulf control valves <sup>[2]</sup>. Different strategies incorporate utilization of a damper valve in the suction pipe, speed variety, or “hot gas sidestep” which includes a bit of the release gas from the compressor being driven straightforwardly to the evaporator, bypassing the condenser <sup>[3]</sup>. Thermodynamic analysis of an eco-friendly alternative new refrigerant (mixture of R744 and R290) was proposed and performed with five refrigerants such as R407c, R408a, R410a, R404a, and R417a, which are in the higher temperature circuits of a cascade refrigeration system <sup>[6]</sup>. Removal of Methylene Blue from Waste Water using activated carbon prepared from activated carbon adsorbent for the removal of methylene process is completed from blue dye from aqueous <sup>[7]</sup>. It is also capable of sensing fire breakout in the area and weight of the gas in order to provide real time monitoring and alert over Internet. If an abnormal condition is detected, the device sends an alert to the smartphone app of the user and also generates an alert e-mail to other authorities<sup>[8]</sup>.

## COMPRESSOR

On the off chance that the limit control is an accurately built programmed framework, it will dependably keep the compressor with in an attractive range. In the event that limit control is manual at that point mind must be taken not to set the control at excessively incredible a deviation from the plan ideal. On the off chance that this is not done there is a plausibility of slowing down of the cutting edges of the compressor with resulting surging or vibration <sup>[4]</sup>. The system is utilized for little household Refrigerators, AC units, Packaged AC Units for Control Room AC and Mess Room AC. They are totally fixed units. No support or repair is conceivable without cut open the compressor packaging <sup>[5]</sup>. Figure:1 explores the compressor types in details.



**Figure 1: Compressor types**

As shown in Figure 2 reliquefaction system utilized as a part of Reefer Container Machinery. Electric Motor

is inside the compressor packaging. Engine windings are cooled by refrigerant disregarding the windings. It can be expelled for repair and upkeep in the wake of opening the end cover. Indeed, even compressor upkeep

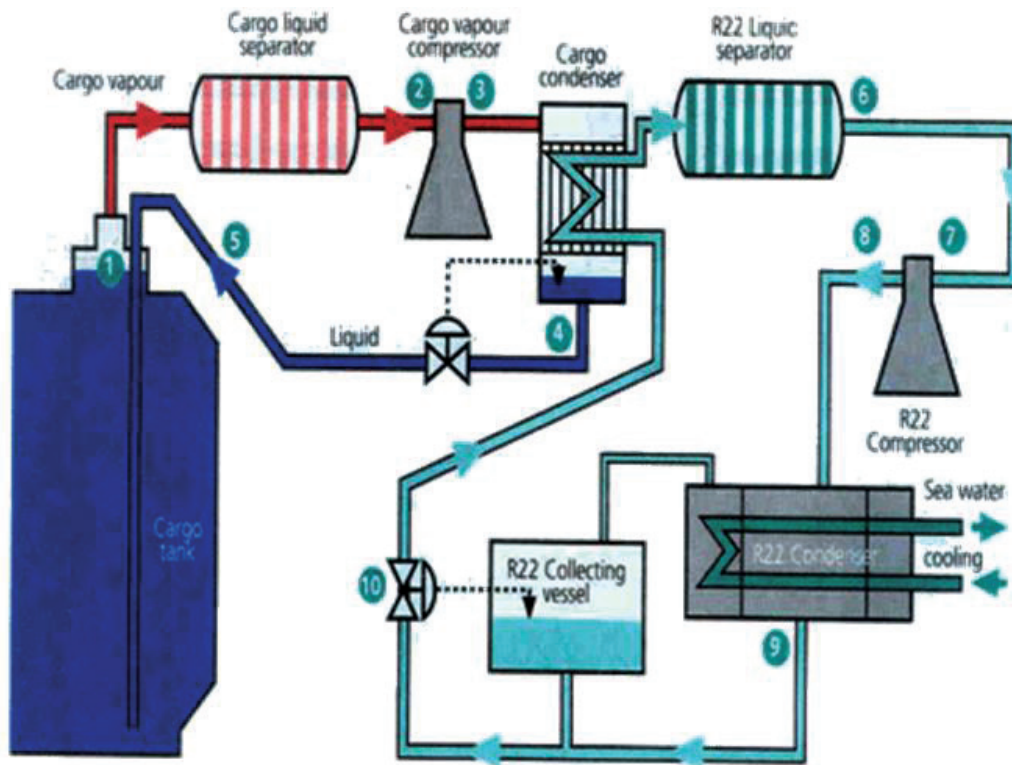


Figure 2: Reliquefaction Process

Compressors are utilized as a part of payload frameworks to pack vapour for pressurization and liquefaction. The compressor tightens the refrigerant vapour, raising its weight, and drives it into the loops outwardly of the icebox. The compressor is the segment at the core of the refrigerant circuit as shown in Figure 3. It has the capacity of coursing, refrigerant inside the circuit, attracting it as a gas from the evaporator and after that packing it and conveying it at higher weight to the condenser.

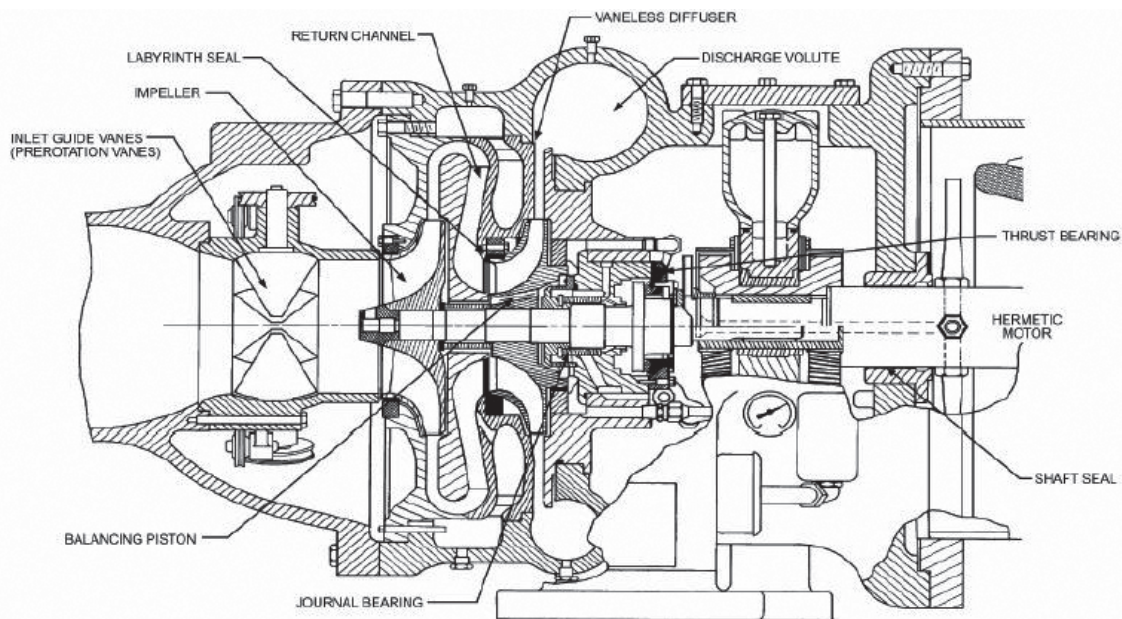


Figure 3: Core of the Refrigerant Circuit

Amid the pressure stroke of a responding machine, the gas winds up noticeably more blazing and a portion of the oil on the chamber divider will go out with the release gas. To lessen the measure of this oil which will be conveyed the circuit, an oil separator is every now and again fitted in the release line. The hot entering gas is made to encroach on a plate, or may enter a drum digressively to lose a significant part of the oil at first glance by outward compel. Somewhere in the range of 95 to 98% of the entrained oil might be isolated from the hot gas and tumble to the base of the drum, and can be come back to the crankcase. The oil return line will be controlled by a buoy valve, or may have a drain opening. In either case, this metering gadget must be moved down by a solenoid valve to give tight close off when the compressor stops, since the separator is at release weight and the oil sump at suction

### DISCUSSION

At the point when the vapor refrigerant is compacted and conveyed from the compressor at high weight and temperature it is common for the high weight refrigerant vapor to extend some crankcase oil from the compressor alongside it. This oil is destructive in the event that it comes to the evaporator curls. Thus the oil and gas must be isolated, preceding the gas going into the condenser.

### CONCLUSION

This gadget is fitted on the release line from the compressor. At the point when the vapor refrigerant is compacted and conveyed from the compressor at high weight and temperature it is common for the high weight refrigerant vapor to extend some crankcase oil from the compressor alongside it. This oil is destructive in the event that it comes to the evaporator curls. Thus the oil and gas must be isolated, preceding the gas going into the condenser. This partition is done in an oil separator, which is a protected compartment containing confounds to isolate the oil and vapor, a buoy controlled needle

valve which opens consequently once the oil level achieves a specific level and returns the oil back to the compressor crankcase and the vapor is sent to the condenser for liquefaction.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Web of-Things Devices Based on Dns Name Auto Pattern In Ipv4 System Using Dnsnav4

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## ABSTRACT

This paper proposes a Space Name Framework (DNS) Name Auto configuration called DNSNAv4 for Web of-Things (IoT) Gadgets in Web Convention (IP) rendition 4 (IPv4). The manual setup of space names of gadgets may be an awkward weight for clients as the quantity of gadgets increments. A heritage plot called DNS Name Autoconfiguration (DNSNA) for IPv6 systems can be utilised to enrol DNS names of IPv6 IoT gadgets naturally into a DNS framework. In any case, the heritage conspires called DNSNA is not appropriate in the present systems because the more significant part of operations in the Web is set up for IPv4. In this paper, we propose DNSNAv4 to bolster appropriate usefulness to give the inheritance a chance to plan of DNSNA give DNS naming administrations to IoT gadgets in the IPv4 condition. In DNSNAv4, an IoT gadget can enrol gadgets by interfacing with a dynamic host arrangement convention (DHCP) server so that the devices can enlist their DNS names and the comparing IPv4 addresses into a DNS server through a DHCP server. Subsequently, with the standard convention of DHCP, DNSNAv4 can give clients simple DNS name auto-configuration of their IoT gadgets in the IPv4 condition.

**Keyword:** Web of Things, IPV4, IPV6, DSR Protocol, Cryptographic Algorithm, DNS, throughput

## INTRODUCTION

The Web of things (IoT) is the system of physical gadgets, vehicles, building frameworks, and different installed gadgets with hardware, programming, sensors, and actuators that empower these articles to gather and trade information. As of late, the IoT has turned out to be one of the most blazing examination fields. As per Gartner, the quantity of IoT gadgets is required to increment by right around 26 billion units by 2020. By countless, it is wasteful to physically arrange their area names in the Space Name Framework (DNS), which enables DNS servers to interpret between space names and Web Convention (IP) addresses. Lee et al. proposed a DNS Name Auto setup (DNSNA) plot for IoT gadgets. In light of this, DNSNA has been intended to give a wide range of IoT gadgets with a proficient DNS naming administration. Be that as it may, the present web is set up for IPv4 systemsBee inspired agent based routing protocol-primary user.

To change web from IPv4 to IPv6, it takes a great deal of cost, for example, cash and times something to that effect. Plainly, we ought to utilize IPv6 systems lines

later on however it can't at this moment. Indeed, we can utilize IPv6 arrange in the IPv4 organize condition through prevention of Co-operative Black Hole attack in Manet on DSR protocol using Cryptographic Algorithm, for example, burrowing and address interpretation. Be that as it may, it is a wasteful technique because an innovation to interface IPv4 and IPv6 has more overhead superior to anything the web works as unadulterated IPv6 systems. That is the reason DNSNA is hard to be connected to the right now organizing framework.

**Related Work:** The framework described that internet of things has a tremendous scope in the point of view of individual and organization<sup>1</sup>. Path link is same for DNSNA and mDNS from client to a selected node, and it consumes one milli-watt per message<sup>2</sup>. Gateway is a node to send and receive the packets at the same time it validates the DNS name from DNS name server. Local system administrators have restriction to access the configuration where preferred<sup>3</sup>. With the help of length field in RDNSS and DNSSL, the validity of DNS is checked <sup>4</sup>. The techniques produce hostname of FQDN which includes suffix or prefix to the portion

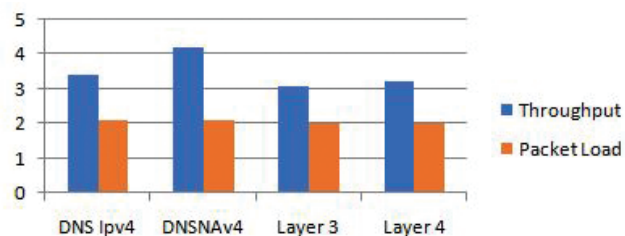
of FQDN<sup>5</sup>. When a request from DNS UPDATE is sent to DHCP server, it deletes all PTR RR details of the client IP address by submitting the requests. The survey shows that communication between SU will get delay by lowering the PU active period [6]. If some PU loses its activity means it will undertake by co-operative PU which leads SUs longer time. Dynamic Source Routing Protocol is a reactive routing protocol and is called an on-demand routing protocol<sup>7</sup>. The Throughput is defined as the total number of packets delivered per second over the entire time. The duplicity is prevented by audit service outsourcing method<sup>[8]</sup>. The detection time is reduced by a periodic verification method, and it is implemented. Filtered Wall (FW) is preferred to filter the unwanted materials form OSN client<sup>[9]</sup>. The goal of the proposed method is to provide flexible substances by using content filtering for OSN's.

## PROPOSED SYSTEM

Since the most recent switches likewise work as DHCPv4 servers, we expect that all switches and DHCPv4 servers utilized as a part of this paper are a similar gear. Initial, an IoT gadget asks for an IPv4 deliver to the DHCPv4 server in the subnet. The DHCPv4 server sends data with an IPv4 address and through a DNSSL choice of DHCP which is DNS addition data (e.g., home) The IoT gadget creates a DNS name for DNS benefit when the IoT gadget gets the answer message if it is legitimate. After the IoT gadget produces its DNS name, IoT gadget sends a demand message to enrol the DNS name. At that point, the DHCPv4 server checks the DNS name on the off chance that it is legitimate or not, when the DHCPv4 server gets a demand message going to enlist. On the off chance that the message is authentic, DHCPv4 server refreshes the comparing DNS name through DHCP. Finally, all configuration was done, a user can get a DNS name list and remote-control IoT devices through own mobile device (e.g., Smartphone, tablet PC). But, if the message is not valid or the DNS name is duplicate DHCP does not specifically provide resolution about this problem.

## RESULT AND DISCUSSION

Deploying nodes within the system and on the gateway, with control technologies, IPV4 network endpoints have some limitation. This process can be taken place at Layer 3 and Layer 4 in Figure 1.



**Figure 1: Packets throughput during DNS and DNSNA using IPv4**

Based on the number of stacks in the protocol, the network connection becomes more complicated. Access Control Lists permits the authorized hosts to send and receive the packets at the IP layer. On the designer side, a routing header is included through a suitable operating system by the network designer. When the operating system forwards packets with routing header then at the end point it is configured to filter the header on accessing location.

## CONCLUSION

In this paper, we propose a DNS Name Auto course of action (DNSNAv4) for DNS naming organizations in Web of Things contraptions in IPv4 sort out circumstances. DNSNAv4 goes for giving a capable DNS name auto setup advantage for IoT devices with minimum human intercession. For the straightforward execution of DNS name auto arrangement, DNSNAv4 uses the Dynamic Host Setup Tradition (DHCP) that is a standard tradition for the framework parameter auto plan, for instance, IP address apportioning, recursive DNS server areas, and DNS postfix space names. Like this, with DNSNAv4, customers can go without quite a bit of extending plays the DNS name enlistment of their IoT contraptions. We assume that our DNSNAv4 is a promising approach for the supportive IoT DNS naming organizations in the IPv4 masterminds conditions. As future work, we will ask about on the growth of the DHCP for organization disclosure in DNSNAv4. We will similarly consider the security issues of DNSNAv4.

**Ethical Clearance:** AMET University

**Source of Funding:** self

**Conflict of Interest:** Nil



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# An Introduction to the Use of Synthetic Aperture Radar (SAR) To Detect Marine Oil Spills

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## ABSTRACT

This paper discusses the use of remote sensing devices like satellite mounted space borne radar (SAR) to detect oil pollution in the oceans and waterways. The principle of the radar, how imaging is done in the real and synthetic aperture radars, and its superiority as a remote sensor is described. In this paper the oil spills detection, the factors that affect the detection are explained, along with photographs of radar images. The methods currently used to discriminate between actual oil slicks and look-alikes caused by natural phenomenon are briefly mentioned. The importance of utilizing the SAR images with updated technology is stressed to prevent pollution and enable oil spill response personnel to act swiftly and efficiently to protect the world's oceans and coastlines if a spill occurred.

**Keywords:** *Oil spills, radar principle, Doppler beam sharpening, synthetic aperture radar, SAR image processing.*

## INTRODUCTION

Marine life, land animals and humans all are affected by the Oil spills. The main reason for the oil spill is emptying their bilge tanks and cargo oil tank washings before entering port or after leaving port. Large area oil spills result from tanker ruptures or collisions with reefs, rocky shoals, or other ships it is explained in<sup>[1]</sup>.

Annually, 48% of the oil pollution in the oceans is fuels and 29% are crude oil. Tanker accidents contribute with only 5% of all pollution entering into the sea is explained in <sup>[2]</sup>. After analysing the satellite images it is found that the large amount of oil spill is detected compared to the reports from that ship accidents. According to the European Space Agency, 45% of the oil pollution comes from operative discharges from ships<sup>[3]</sup>.

The frequent oil spills can be a much greater threat to the marine environment and the ecosystem compared to the oil spill accidents like the Prestige tanker carrying 77,000 ton of fuel oil at (Galice, northwest coast of Spain in 2002)<sup>[4]</sup>.

This paper also referred the application of multi frequency airborne electromagnetic to iron ore exploration <sup>[8]</sup>. High resolution seismic imager of palaeo channels, near West Wyalong <sup>[9]</sup>. Growth and Characterization of Organic Based Marine Dye NLO

Material: 7-Bromo-6-chloro-3-[3-[(2R, 3S)-3-hydroxy-2-piperidyl]-2-oxopropyl]-4(3H)-quinazolinone<sup>[5]</sup>.

The Oil Company or shipping operator involved is the responsible for setting up emergency evaluation and employing remediating measures to minimize the extent of a spill. If they do not have the resources, the government regulatory agencies responsible, in all spills, the government agencies play a key role in ensuring the environmental protection laws are being met it is explained in<sup>[6]</sup>.

To control the effects of oil spill and to clean-up the area, some factors have to be identified they are:

- Location of the oil spill
- Size of the oil spill
- Wind and wave information for predicting the direction of oil movement.

These can be done by remote sensing that has capability of observing events. Remote sensing devices used include the use of thermal infrared imaging, infrared video and photography from airborne platforms, airborne and space-borne optical sensors, airborne laser fluouro sensors, as well as airborne and space borne SAR. Satellite imagery is acquired by recording radiation reflected back to space using a variety of space-borne sensors<sup>[7-8]</sup>.

**METHODOLOGY**

**RADAR-Radio Detection and Ranging:** In the radars the electromagnetic waves are used to measure the distance between the ship and the obstacles. The electromagnetic wave travels in the speed of the light so the distance is measured very quickly. The radar transmits the electromagnetic waves and receives it, after it is reflected by the obstacles. The time taken to receive the reflected waves is measured and used to calculate the distance. Figure 1 expresses the RADAR - radio detection and ranging. The Block Diagram of RADAR - Radio Detection and Ranging is explained in Figure 2.

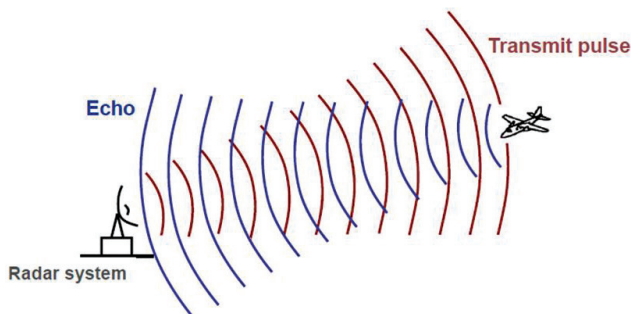
$$R = 1/2ct$$

R – Range,

t – Time,

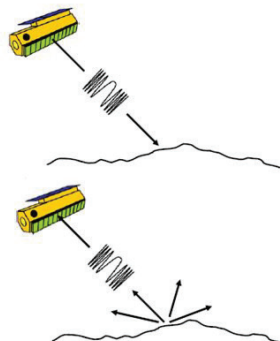
c - Speed of light in vacuum.

**Radar Principle**



**What does the Radar measure ?**

• Radar reflectivity (backscattered signal) of targets as a function of their position



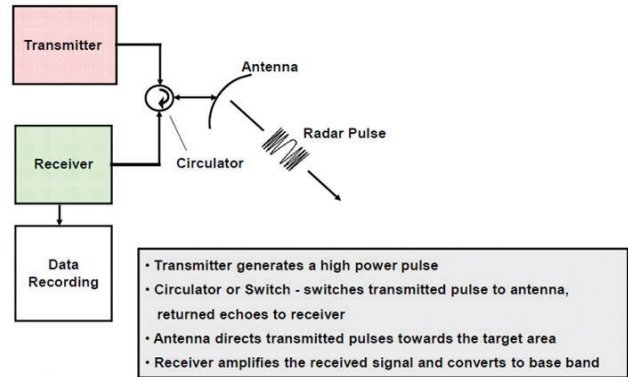
• radar transmits a pulse (travelling velocity is equal to velocity of light)

• some of the energy in the radar pulse is reflected back towards the radar. This is what the radar measures. It is known as radar backscatter  $\sigma_0$  (sigma nought or sigma zero).

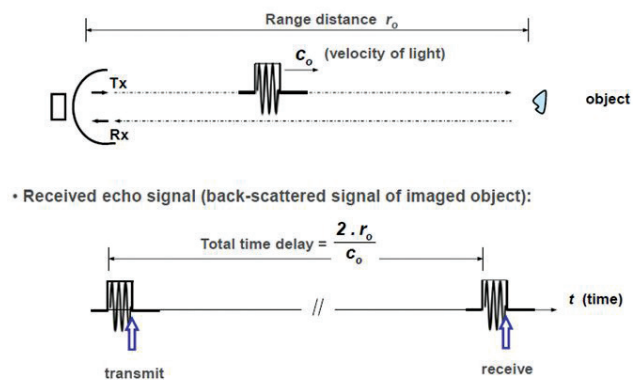
**Figure 1: Workflow of RADAR - Radio Detection and Ranging**

The factor  $1/2$  accounts for the fact that the radar signal actually travelled twice the distance measured: first from the radar to the object and then from the object to the radar<sup>[10]</sup>.

**Basic Radar Block Diagram**



**Radar Measurement Principle**

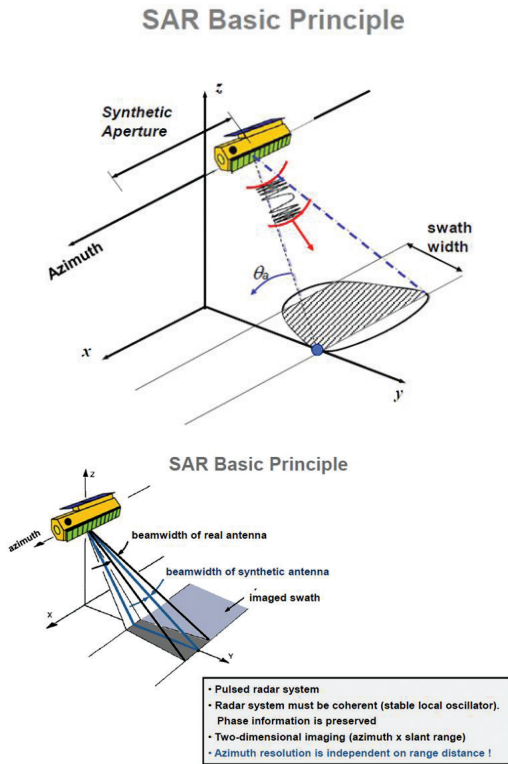


**Figure 2: Block Diagram of RADAR - Radio Detection and Ranging**

**Superiority of radar:** Radars also called as active remote-sensing instruments because they provide their own signals to detect the presence of objects and they can work during day or night. The waves from the radar are not deflected by the rain and cloud so the output image from the radar is clear. So it can be operated at the all weather conditions. For these reasons, radars are used in all-weather instruments.

**Imaging:** Remote-sensing radars such as Synthetic-aperture radar (SAR) give high-resolution images of surfaces for a few tens of meters. Some post-processing techniques are used to get the geophysical information from these high-resolution images obtained from the radars. The radars are classified into two types based on the mechanisms by which radars produce images; they are real aperture and synthetic aperture radars.

**Radar imaging explained:** When the aircraft or satellite moves along the straight path, the stripes like radar images are taken. These strips are called as tracks or swaths.



**Figure 3: Basic Principle of Synthetic-Aperture Radar (SAR)**

To separate objects in the cross-track direction and the along-track direction within a radar image, two methods is to be implemented. Figure 3 explains the basic principle of Synthetic-Aperture Radar (SAR) The range direction, also known as the cross-track direction in radar imaging; it is the direction normal to the direction of imaging platform is moving. In this direction, based on the time delay on the radar signals and the back-scattered from the surfaces of the object the radar echoes are separated. This is true for both synthetic aperture and real aperture radar images.

The azimuth direction, also known as the along-track direction, is the direction parallel to the movement of the imaging platform. The angular size or the Doppler

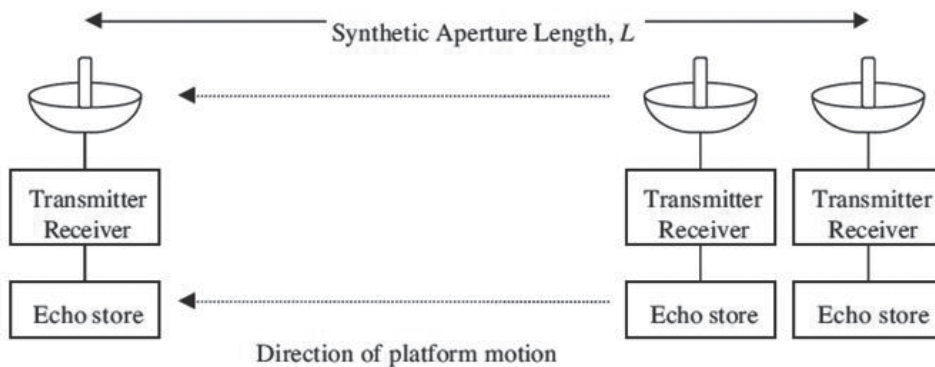
history is used to separate surface pixels in the along-track dimension in the radar images.

Using the Doppler history and time delay results, the image with the high resolution is obtained by the SAR no matter the surface distance is shorter or longer. This advantage makes the high resolution space born SAR images without large size antenna.

One side of the flight track an antenna of imaging radar is fixed to illuminate the surface. The above figure shows the antenna has a fan beam to illuminate the elliptical surface. The illuminated surface is called as the image swath. The radar transmits short effective pulse of waves to the illumination beam (see Fig. above); the echoes from the longer distance will take longer time to receive. In summary, to achieve along-track resolution real aperture radar uses the same imaging mechanism as passive imaging systems.

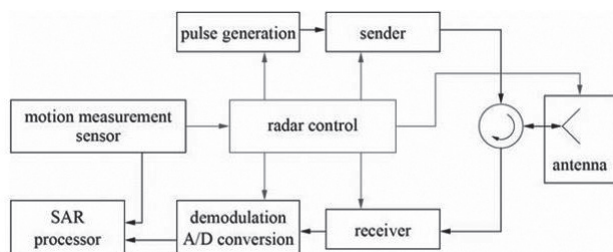
**Synthetic aperture radar (SAR):** This is a particular functioning of a radar system that utilizes the motion of the radar platform and specialized signal processing to give high-resolution images. Two targets at various along-track positions will be at variable angles relative to the aircraft velocity, resulting in various Doppler frequencies. The Doppler Effect is the well-known phenomenon that makes a change in the pitch of a car horn as it travels past a not moving observer. Using this effect, targets can be split in the along-track way on the basis of their different Doppler frequencies. This technique was originally known as Doppler beam sharpening, but later became known as SAR (synthetic aperture radar).

**Synthetic Aperture:** A SAR is imaging radar mounted on a moving platform. It works similar to conventional radar, In the case of Synthetic Aperture Radar the consecutive time of transmission/reflection due to the platform movement translates into different positions. Figure 4 express the principle of Synthetic Aperture



**Figure 4: the principle of Synthetic Aperture**

A fitting combination of the received signals allows the construction of a physical antenna length is shorter than virtual aperture. This basic attribute of SAR is giving it the property of being imaging radar. In the synthetic aperture radar the image results from processing the raw data and represents a measure of the scene reflectivity. Basics of SAR as block diagram are explained in Figure 5.



**Figure 5: Basics of SAR block diagram**

1. With a bandwidth according to the range resolution, pulse generation creates pulses
2. Sender amplifies the pulses and transfer it to the antenna via circulator
3. Receivers amplifies the output signal of antenna and applies a band pass filter
4. After the demodulation and Analogue to Digital conversion, the SAR processor calculates the SAR image
5. Arranges the operation is sequence. Particularly the time schedule.

**Detection of Oil Spills by SAR:** In radar images oil spills appear as dark areas because of the attenuation of the capillary waves. Bragg waves or Capillary waves are wind ripple waves with less than a few centimetres wavelength. The oil spill areas images from the SAR have the dark and high contrast compared to the surrounding. Some of the detection types are explained in recognition and tracking of moving object in underwater sonar images as in [11]. A few examples of SAR images of recent oil spills are given below in Figure 6.



**Figure 6: Radar image of the sea surface**

A super tanker outer hull was breached after hitting rocks and 70,000 tonnes of crude oil was dispersed southward under storm conditions. (February 15, 1996, Grounded near the town of Milford Haven, Wales)

This image is taken by the RADARSAT after a week oil spill. The dark areas are the areas of oil spill and areas of lighter tone directly south are, areas where the absorbers was sprayed on the oil to encourage emulsification. Image size: 100 km X 100 km, acquired by TerraSAR-X details are given Figure 7.



**Figure 8: Sample output of TerraSAR-X**

**Factors affecting the detection of oil spills:** However, dark images can also be formed due to other causes, making oil spill detection difficult. We discuss these examples below [7] Oil slick look-alike natural dark patches are termed. Look-alikes do include threshold wind speed areas (speed <3 m/s or >10m/s), grease ice, natural films/slicks, winds slicks (calm zones), wind sheltering by land, wind shadows behind islands, wave shadows behind land or structures, internal waves, biogenic oils, surface currents, reflections of the bottom topography in shallow waters, fresh water slicks, plumes of municipal sewage, shear zones, weed beds that calms the water just above them, rain cells, glacier flour, and whale and fish sperm etc.

**Weathering:** Oil discharges in the oceanic environment will immediately start to spread and dispersed by natural processes called weathering over time. The weathering processes depend on the quantity and composition properties of the spilled oil. Environmental conditions such as temperature, currents, sunlight and mixing are also important for the weathering of spilled oil.

Oil slicks are relatively thin and small in size when they are compared with major accidental oil spills so it is difficult to find. It is therefore very important to detect an oil spill at the very instant it occurs to help spill control personnel.

The SAR “sees” only the “Bragg waves”, these waves are created by many of the ocean phenomena. This is the reason why SAR images express Oil spills, Wave fields, Wind fields, Current fronts, sea ice, Internal waves and other phenomena discussed above. Hence further categorization of the dark areas as oil spills and look-alikes is therefore required.

Traditionally, the detection of dark formations constitutes detection of dark area and statistical classification methods to characterize the dark formations are oil spills or look-alike objects.

Some photographs of oil spill look-alikes are reproduced here to understand the complexities Figure 9 display the dark patches in the Marmara Sea, Turkey.

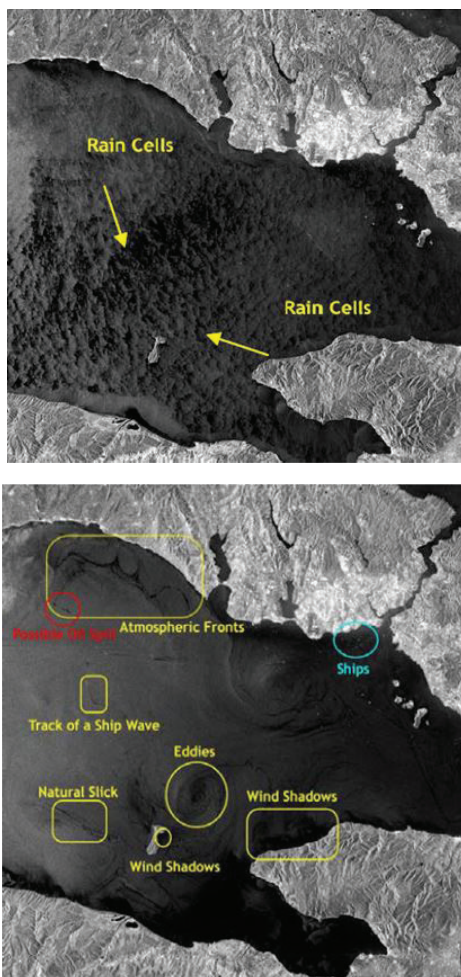


Figure 9: the dark patches in the Marmara Sea, Turkey.

## RESULTS

**Further classification of dark areas:** As results of constant experimentation and research, a few modern methods of finer processing of SAR images, to distinguish between real and look-alike oil slicks are briefly outlined below.

**Filtering procedure:** Adaptive filtering methods are used to discriminate high contrast areas generally Gamma (7x7), Lee (7x7), Frost (7x7) and two pass filters low pass filter (5x5), median filter (3x3) are used in oil spill discrimination studies. These filters reduce the loss of information boundaries of the area.

**Thresholding and Segmentation:** The results of the segmentation algorithm are sensitive to the choice of similarity and area thresholds. If the neighbouring pixels from the SAR are Similar they are merged into regions. It runs iteratively to merge the resulting regions.

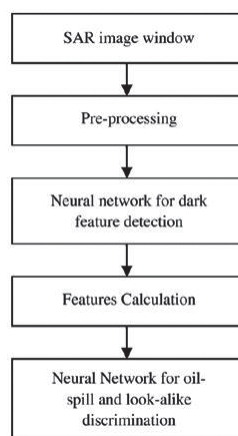
**GLCM Analysis:** Texture is a combination of regular frequency with repeated patterns. Texture analysis is the segmentation of textural features with respect to the outline of a tiny element, direction of regularity and density. In this context, GLCM (grey level co-occurrence matrices) are used as a specified texture measure.

In one study, Entropy measurements and Angular Second Moment were preferred. In this study, thresholding, Filtering, and segmentation techniques were applied and it shows that every method was relatively effective depends on the cases. Lee filter was the most effective one. Others were effective on the spreading of oil spills. It was observed that the result of texture analyses had compatible results with segmentation and thresholding techniques.

**Neural networks:** Recent work has shows that neural networks represent an effective tool for modelling a variety of non-linear discriminate problems. And it may be viewed as a numerical model consists of several non-linear elements called neurons. Neural networks are also used in applications of analysis of MFCC features for EEG signal classification as in<sup>[12]</sup>.

**Methodology:** Two neural networks are used the first NNs uses input from SAR images and gives a black and white image with captured dark formations. That seems like a group of black pixels forming dark objects. For each detected dark object a set of ten features was

calculated. And send it to the second NNs, which decides the dark image is an oil spill or not. Figure 10: expresses Flow Diagram with functional Output of proposed methodology.



**Figure 10: Flow Diagram with functional Output of proposed methodology.**

## DISCUSSION

At the no way surveying place the emergency status of the oil spill are found by the man made effective tool and remote sensing. The operational monitoring system which is satellite based is used for real time data production of the remote sensing. This satellite based system is directly used one and also quick responsible system. The probability level of the oil and oil spill position finding are the system main requirement.

In the activities of emergency response the oil spill have critical is monitoring and detection done in the discharge of the major cases. If there are four various fundamental issues are available in this system. They are

- Damage quantity
- Monitoring

- Alarm
- Prevention

When the continuous oil spill pollution is occurs this system is implemented for detection. By this implementation the spill monitoring is developed. For the effective plan the continuous monitoring and detection improvement is important for the response.

## CONCLUSION

In the defence department, oceans and fishers department, fishing and shipping industries, oil industries, chemical industries and coastal guard are the applications of this system based on the remote sensing data.

The both economically and socially are important factors for transportation overseas increment and development in the seas of spill pollution. In the eco system, the climate change of the global is damaged the system by the harmful effect of the spill pollution in the marine. The coastline protection of the slick drifts and polluted are location are detected by using the oil slick. The polluter determination is possible in the spill monitoring system which based on the satellite. And this system is also used for the precautions of the oil spill.

The problems of the marine pollution policing and monitoring are the valuable information of the space-borne. This system is studied in this paper. For protect the marine from the pollution by the spill monitoring system development and implement.

**Ethical Clearance:** AMET University

**Source of Funding:** Nil

**Conflict of Interest:** Nil

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# Analysis of Active Semiconductor Components Effective Numerical Models of the in the Optical Communication Systems

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## ABSTRACT

Numerical modeling is an important tool for design and simulation of optical components in the optical communication systems. Signal characteristics of active devices, like distributed feedback laser and avalanche photodiode, which can be obtained from simulations, is the key for performance optical systems. Selection of appropriate numerical methods and tools leads to possibility create effective models emulating more sophisticated optical communication configurations. Sufficiently precise and time effective numerical methods are necessary to obtain characteristics compatible with real devices. Equivalent circuit models utilize sets of differential equations. The key output characteristics of the laser and avalanche photodiode are the optical power, instantaneous optical phase and electrical current at the output. Those fundamental characteristics can be utilized for determination of signal to noise ratio, impact impulse response on the bias voltage and time duration of transmitted symbol. To achieve the maximum signal to noise ratio it is necessary to suppress noise of the semiconductor laser and emit light on the maximum output power. It may be achieved when the laser lasing at the wavelength 800 nm for maximal injected current 24 mA. The 80 V reverse-bias voltages near the breakdown voltage allows maximize output electrical current, simultaneously with high bit rates around 25 Gb/s which increase impulse response of photodiode. Carefully controlling of these parameters is possible by optimization of optical communication system performance.

**Keywords:** *Equivalent circuit model, semiconductor laser, avalanche photodiode, rate equation noise.*

## INTRODUCTION

The continually growing amount of transmitted data requires modelling and design of components which are utilized in the core and access optical networks. The performance of the optical networks is dependent on the active and passive optical components. In case of active optical components like optical lasers, amplifiers and photodiodes are important their signal characteristics. The time dependent quantities like optical power at the output of laser, electrical current at the output of photodiode and their noise properties are the key [1-3]. It was proposed many types of numerical methods. The first group of the numerical models is physical based models. This group provides high accuracy and excellent physical meaning of output characteristics. On the other hand, the computational speed is slow. These models are usually utilized for designing new structure types of the optical components [4-6].

The second group is equivalent circuit models. In this case the device is modeled by using of equivalent circuit models that describes its inner and output signal characteristics.<sup>[7]</sup> Plasmon-Assisted Enhancement and Tuning of Optical Properties in  $\beta$ . Plasmonics described the equivalent circuit models are expressed by sets of differential equations. Their signal characteristics are comparable with the measured characteristics of the real devices. The accuracy is directly related to the extraction technique of parameters for the sets of differential equations. In general, this group of numerical methods has medium accuracy and physical meaning. <sup>[10]</sup> Studies on synthesis, structural, surface morphological and electrical properties of Pr<sub>6</sub>O<sub>11</sub>-MgO nanocomposite presented their main advantage are time effectively of the simulation. The last group is semi-analytical models. These models are based on the combination of two previously mentioned numerical models. The resulting numerical model has good physical meaning, high accuracy and is time effective <sup>[8]</sup>. Applications of intelligent sensor networks and wireless communication are to the instrumentation of civil engineering structures in <sup>[10]</sup>.

## NUMERICAL MODEL OF THE SEMICONDUCTOR LASER

The DFB lasers are the group of well-established optical sources utilized in the optical communication systems. It can be used as source of optical radiation in the optical transmitters as well as local oscillator in the coherent optical detectors. These optical sources provide wide scale of output powers, laser line widths and emitted wavelengths [11] described the harmonic balance modeling for photo detector nonlinearity. The dynamic properties of DFB lasers can be modelled by using of coupled laser rate equations [eqn 8, 9]. These equations are represented by set of differential equations which describes relation between carrier number  $N(t)$ , photon number  $S(t)$  and optical phase  $\theta(t)$ . The impact of noise is modeled through Langevin noise sources  $F_i(t)$  [5-7, 2]

$$\begin{aligned}\frac{dN(t)}{dt} &= \frac{I(t)}{q} - \frac{N(t)}{\tau_n} - g \frac{N(t) - N_0}{1 + \epsilon S(t)} S(t) + F_N(t) \\ \frac{dS(t)}{dt} &= g \frac{N(t) - N_0}{1 + \epsilon S(t)} S(t) - \frac{S(t)}{\tau_p} + \frac{\beta N(t)}{\tau_n} + F_S(t) \\ \frac{d\theta(t)}{dt} &= \frac{\alpha}{2} g (N(t) - \bar{N}) + F_\theta(t),\end{aligned}$$

where  $I(t)$  is the injected current,  $q$  is the electron charge,  $n$  is the carrier lifetime,  $p$  is the photon lifetime,  $g$  denotes the gain slope,  $\epsilon$  is the nonlinear gain compression factor,  $N_0$  is the carrier number at transparency,  $\beta$  is the fraction of spontaneous emission coupled into the lasing mode,  $\alpha$  is the line width enhancement factor,  $\bar{N}$  and  $N$  is the time-average carrier number. All the necessary parameters are stated in [7, 8].

## NUMERICAL MODEL OF THE PHOTODIODE

In the optical communication systems are usually utilized two main types of photodiodes as photo detectors. The performance of photo detectors is often determined by their sensitivity, frequency response and noise. The p-i-n (PIN) photodiodes can achieve relatively high bandwidth, but the sensitivity is limited due to noise. On the other hand, the avalanche photodiodes (APD) provide higher sensitivity. Their sensitivity is caused by internal gain in the electrical domain. However, it has consequence in the limited bandwidth. The main difference with the PIN photodiodes is that

the absorption of photons of incoming light may set off an electron-hole pair avalanche breakdown. This configuration allows generate more electron-hole pairs [2, 3]. For the purpose of modeling photodiodes has been designed PIN photodiode model. This model is suitable for simulation through the equivalent circuits. Nowadays there are a wide range of types of equivalent circuit models. The basic model takes into account that electric field profile in the intrinsic area is uniform [4, 5]. In fact the electric field profiles aren't uniform and improved models utilize non uniform approximation of electric field profile [6]. Other models improve the fundamental PIN structure to the structures like separate absorption and multiplication structure, separate absorption grading charge multiplication structure and single carrier multiplication and separate absorption-charge-multiplication structures. In the case of PIN structure of photodiode is assumed that the depletion width in the N and P regions is negligible due to width of the I region. The electric field profile is uniform in the I and zero in the P and N regions while the I region contains residual doping. This PIN model of photodiode is suitable for the reversed biased APDs in Harmonic balance modeling for photo detector nonlinearity the PIN structure is described by rate equations that are represented through the sets of differential equations. For reverse-biased PIN structure are valid the following equations.

## NUMERICAL SIMULATION AND RESULTS

The model of semiconductor DFB laser and numerical model of PIN-APD photodiode have mutual description by the rate equations. As was mentioned the rate equations are represented by sets of differential equations. From this reason, the numerical method 4th-order Runge-Kutta was chosen by authors of this article for solving these equations. From this point of view it is clear that both numerical models can be easily implemented in the one programming environment and simulated simultaneously. The integration step  $\Delta t$  of 4th-order Runge-Kutta was set at 10 ps. This time step is sufficient for stability and numerical accuracy.

The main output of the numerical model of the semiconductor DFB laser is time-dependent optical power and phase. These two parameters are important for system simulations like propagation of optical signal through.

In Fig. 1 is depicted time-dependent optical power  $p(t)$  and phase  $\theta(t)$  for the injected current  $I = 25$  mA

and carrier wavelength = 1550 nm in the steady state. The measured value of the threshold current is 10.2 mA [9]. From this reason, the numerical model of DFB laser was stimulated in the range of the injected current  $I$  from 12 mA to 24 mA and the wavelengths from 800 nm to 1550 nm. The range of wavelengths is suitable for the optical communication systems which utilize single-mode optical fibers. From Fig. 2 is clear the average output powers  $P$  for given range of injected currents and wavelengths are in the range from 0.334 mW to 4.507 mW. Figure 1 explains the time-dependent a) optical power  $p(t)$  and b) phase  $\phi(t)$  and Figure 2 explores dependence of the average output power of dfb laser at the wavelength and injected current.

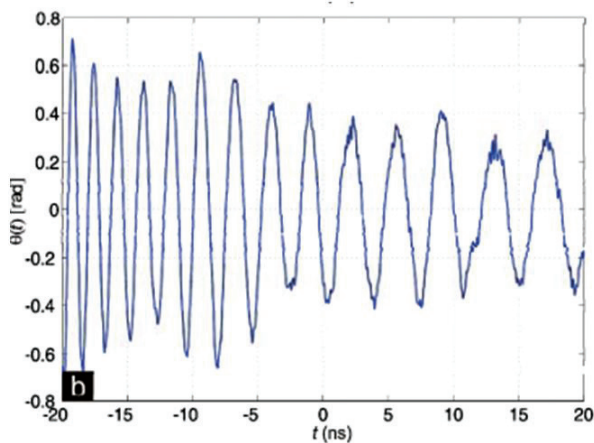


Figure 1: Time-dependent a) optical power  $p(t)$  and b) phase  $\phi(t)$ .

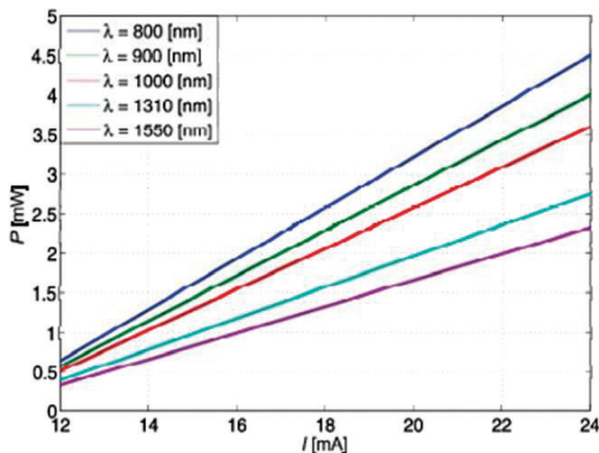


Figure 2: Dependence of the average output power of DFB laser at the wavelength and injected current

### DISCUSSION

In this paper, we presented the numerical model of the semiconductor DFB laser and the numerical model

of PIN-APD. These active components of the optical networks have significantly influence on the system performance. Both of these models are based on the equivalent circuit model. The advantage of these models is their high accuracy, very good physical meaning and low computation time.

The results of numerical model of the DFB laser show that average output power depends on the injected current and wavelength. For the maximum level of output power 4.5 mW is needed choose shorter wavelengths around 800 nm and the highest injected current 24 mA. This result is directly related to the next important characteristic of the laser – SNR. For achieving of maximum level of the SNRdB 34 dB it is necessary to emit laser light on the maximum output power and the variance parameter  $\sigma$  can be set to lowest level. In the case of PIN-APD the impulse response depends on the symbol rate and reverse-bias voltage. For the highest quantum efficiency is appropriate choose reverse-bias voltage 80 V near the breakdown voltage of the photodiode. The usage of lower symbol rates (around 1 Gb/s) minimizing of impulse response. The combination of these two parameters is possible reach high electric current at the output with the acceptable impulse response.

### CONCLUSION

From the point of view of the numerical modelling are these models mutually compatible and it can be utilized the same numerical method for solving sets of the differential equations. The output characteristics of these models are suitable for simulation of the optical communication systems, which operate at the well-known wavelengths. From this reason, it was presented basic characteristics like dependence output power  $P$  on the injected current, impact of laser noise on the SNR, impact time duration  $T_0$  and reserve-bias voltage  $V_j$  on the impulse response.

On the base of numerical results, it is possible to make conclusion that numerical model of the semiconductor DFB laser is applicable for wide range of the output powers and SNR which are related to laser line width. Also, the numerical model of PIN-APD is able to model important characteristics of real photodiodes like impulse response. These two selected numerical models don't provide the best numerical results that

can be achieved, but their signal characteristics allow effective modeling of transmission signals in the optical communication systems.

**Ethical Clearance:** Taken from AMET University

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# Analysis of Cloud Computing Data Center Using Stochastic Modelling

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## ABSTRACT

Cloud data centers (CDC) are an integral part of today's internet services. Enterprises and Businesses around the world rely heavily on data centers for their daily computation and IT operations. In fact, every time we search for information on the internet, or we use an application on our smartphones, we access data centers. In CDC, most compute resources are represented as virtual machines (VMs) which are mapped into physical machines (PMs). Performance is often is a key metric for CDC. This paper presents a stochastic model based on queuing theory to aid in studying and analyzing performance in CDC. CDC platforms are modelled with an open queuing system that can be used to estimate the expected Quality of Service (QoS) guarantees the cloud can offer. We give numerical examples to show how the model estimates the number of required VM instances needed to satisfy a given the QoS parameters. In particular, we plot the response time, drop rate and CPU utilization while varying the incoming request arrival rate, and for different number of VM instances. We cross-validate our analytical model using a DES (Discrete Event Simulator). Our analysis and simulation results show that the proposed model is able to estimate the number of VMs needed to achieve QoS targets when varying the arrival request rate.

**Keywords:** *Cloud Data Center, Queueing Theory, Performance Analysis*

## INTRODUCTION

A cloud computing infrastructures consist of services that are offered and delivered through a data center, that can be accessed from a web browser anywhere in the world. Introduction to cloud computing is explained by [1]. Cloud computing providers offer computing resources (servers, storage, networks, development platforms, and applications) to users either elastically or dynamically, according to user- demand and form of payment. Cloud computing addresses three main areas of operation such as Infrastructure-as-a- Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). Cloud computing fundamentals and definitions are discussed by [2, 3]. Compared to SaaS and PaaS, IaaS it is a form of cloud computing that provides virtualized computing resources over the Internet. In a PaaS model, a cloud provider delivers applications, and other development, while providing cloud components to software over Internet. Public infrastructure-as-a-service cloud security is explained by [4]. On the other hand, SaaS uses the web to deliver applications that are managed by a third-party vendor and whose interface is

accessed on the clients' side over Internet. Because of the web delivery model, SaaS eliminates the need for organizations to install and run applications on their own computers or in their own data centers. A cloud platform-as-a-service for multimedia conferencing service provisioning and Changes in requirements engineering after migrating to the software as a service model are discussed by [5, 6]. Data sharing in cloud computing based on attribute based encryption system in [7]. A Secure & Efficient Audit Service Outsourcing method designed to prevent the fraudulence of prover[8]. An efficient mechanism on probabilistic queries and periodic verification is proposed to reduce the audit costs per verification and implement abnormal detection timely. In implemented an approximation automated structure, called Filtered Wall (FW), to filter disposed of substance from OSN client substances [9]. The goal of paper is to utilize efficient classification procedure to stay away from overpowered by unsuccessful messages. In OSNs, content filtering can also be abused for a unique, more reactive. The method layout of a structure provides adaptable substance based content filtering for OSNs, in light of ML methodology

Queueing theory has been regularly used in the literature to study and estimate QoS parameters in cloud environments. For example, in Analysis of cloud computing technology, an analytical performance model of single VM live migration is evaluated which show that an effective live migration can reduce service rejection probability scenarios and total delay. A statistical distribution is proposed with the extension of CloudSim, to overcome the virtualization layer overhead, insufficient trace logs and complex workload in cloud computing resource usage. The system studied the performance of M/M/m queuing model to optimize the performance of services in an on-demand service in cloud computing and proposed an interacting stochastic model approach to overcome the performance quantification of a large-scale virtualized IaaS CDC. The method developed a new technique for efficient live migration of multiple VMs based on queuing models. To evaluate the blocking rate, they modelled the arrival request using the M/M/C/C queuing model. Similarly, to evaluate the average waiting queue length, the average waiting time, the average queue length and the average sojourn time of each migration request, they modeled the arrival request using the M/M/C queuing model. The proposed an analytical model, based on Markov chains, for cloud-hosted applications and services. The proposed model predict the number of VMs instances needed to satisfy a given Service Level Objective (SLO) performance requirement such as response time, throughput, or request loss probability.

### CLOUD DATA CENTER MODEL

We consider a large data center in a cloud system composed of PMs with each PM hosting many VMs, as illustrated in Figure 1. Indeed, large data centers of Google, Microsoft, Yahoo and Amazon etc. contains tens of thousands of PMs. Each VM is allocated to one PM, where as a PM can be allocated multiple VMs through a hypervisor. VM it is software that can run its own operating system and applications just like an operating system on a physical computer. The Load Balancing (LB) server maintains the schedule queue to receive all requests from clients. A service request from a client is transmitted to the LB server running a service application, associated with an SLA. Client requests are submitted to a LB queue and then processed on the First-In First-Out (FIFO) basis. The arrivals of requests follow a Poisson process. Therefore, the inter-arrival times between successive arriving requests are independent and exponentially distributed random variables with rate 1. Queued requests are distributed to different PMs and the scheduling rate depends on the LB server capacity. We assume that the service time of the LB server queue is exponentially distributed with mean service time 1. Thus, the LB server queue is modeled as an M/M/1/C queuing system. Such a queue has a finite size C; so, an arriving request can be rejected if it finds the buffer full, otherwise it will be accepted.

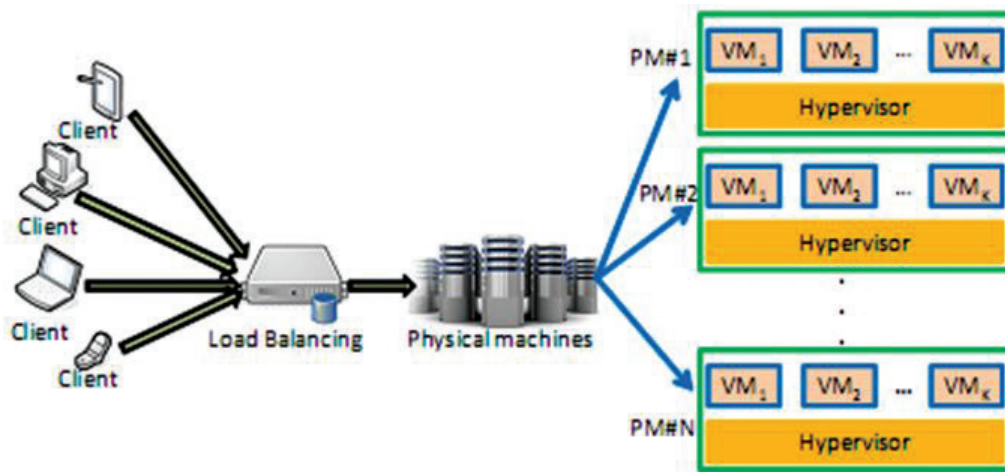


Figure 1: The Architecture of the Cloud Data Centre system

We suppose there are N PMs in the CDC. The requests are evenly distributed by the LB server to each PM with the same probability 1. Consequently,

the arrivals of requests at each PM follow a Poisson process with arrival rate N. We assume that all PMs are homogeneous service. Therefore, the server time of each

PM is exponentially distributed with mean service time server 1. We model each PM in the CDC as an M/M/m/K ( $K > m$ ) queuing system. Each PM may run up to  $m$  VMs, and  $K$  is the maximum number of the requests in the PM. We assume that an inter-arrival time of requests and service times are exponentially distributed. If the queue reaches its maximum limit, the extra requests are dropped. If the resource is available then request is accepted and routed by the LB to the corresponding VM. It's assumed that all VMs allow the same web services with the same functionality to clients via Internet. As the maximum number of requests in the system is  $C$ , we assume that  $C$  is equal to the number of PM times the number of VMs that can be allocated to a single PM. So,  $C$  is given by the following formula

$$C = N \times K \quad \dots(1)$$

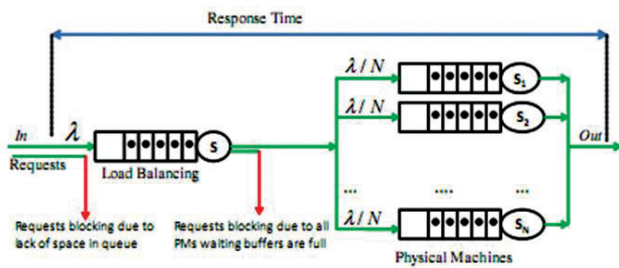


Figure 2: Queuing Model

The queuing model of the CDC is shown in Figure 2. An arriving request that finds the LB queue full will be dropped. Once the request is admitted to the LB queue, it must wait until the LB processes it on a FIFO basis. We assume we operation in a homogenous cloud environment where by all PMs are equal in processing capacity and sizes with and each PM has a waiting buffer which can occupy, containing at most  $(K-1)$  requests. If a PM with free buffer spaces is found, the request is put into the PM waiting queue for further service. If all PMs waiting buffers are full, then the request is dropped. Thus, a client request may be assigned to a PM, dropped because all PMs waiting buffers are full, or dropped due to the insufficient LB buffer space.

**THEORETICAL ANALYSIS**

**Load Balancing Queuing Model:** The LB is modeled as an M/M/1/C queue. The maximum number of requests in the system is  $C$ , which implies a maximum queue length of  $C-1$ . An arriving request enters the queue if it finds less than  $C$  requests in the system and is lost otherwise. Using the balanced equations and the

normalization condition, we obtain the steady-state probability of  $k$  requests in the system

$$\lambda_{eff} = \alpha(1 - \pi_i(K)) \quad \dots(1)$$

$$\pi = 1 - a$$

$$k \quad 1 - aC + 1k \quad \dots(2)$$

We then deduce the performances parameters as follows. First, the rate of loss can be obtained as follows where  $a = \lambda$  denotes the offered load in LB server. The mean throughput service  $X$  is given by  $1 - aC$

$$X = \lambda$$

$$1 - aC + 1 \quad \dots(3)$$

**Cloud Data Centre Queuing Model:** We model access to each PM as an M/M/m/K ( $K > m$ ) response time and mean waiting time in the P Mi as follows

$E(n) \quad E(n)$  queue. The maximum number of requests in the PM is  $K$ , and each PM may run up to  $m$  VMs. Let us define the state of a

$$E(rc) = \alpha(1 - \pi_i(K)),$$

$$E(w) = w \alpha(1 - \pi_i(K))$$

**SIMULATION AND NUMERICAL RESULTS**

Let  $\pi_i(n)$  denote the steady-state probability of having  $n$  requests in P Mi ( $i = 1, 2, \dots, N$ ). Using the balanced equations and we note  $\alpha = \lambda$ , we find that

There are a number of available network simulation tools. Some of these simulators are designed specifically for cloud environments (e.g., CloudSim, iCan Cloud, EMUSIM, MDC- Sim) and some are generic in nature (e.g., OPNET, NS, OMNeT, J-Sim). All of these available simulators did not have the capabilities to capture accurately the internal behavior and dynamics of the CDC. For this reason, we choose the Java Modeling Tools (JMT) to implement the performance  $\pi_0(\alpha)$

$m!m_n - m_r n, \forall n \geq m$  where  $\pi_0$  is given by of the proposed model.

**RESULTS AND DISCUSSION**

**Simulation Environment:** We consider a scenario of a small scale CDC where the CDC has 10 PMs.

The average request arrival rate to the system is 1000 requests per second.

$$\pi_0 = (1 + (\rho m)^m (1 - \rho)^{m-1} + m! (1 - \rho)^{m-1} (\rho m)^i) - 1$$

$$i!$$

$$i = 1$$

The service times of each request in the LB are exponentially distributed with an average of 0.0001 seconds. Two types of where  $\rho$  denotes the offered load and is expressed as Figure 3 exhibits performance results obtained from simulation and analysis for web requests; whereas, Figure 3 exhibits those results for database requests. All of these figures depict clearly the impact of the number of VMs on key performance metrics. Specifically, the requests arrival rate reaches the 2200 requests per second; we can see the impact of the number of the VM instances on the drop rate measure. The response time variation versus requests arrival rate depicted in demonstrates that from 1600 requests per second, as the number of VM instances decreases, the response time increases and reaches 0.14 second. It is obvious that as the number of VMs increases the drop

rate decreases. However in the database performance case when the arrival rate reaches the 1300 requests per second, we can observe that as the requests arrival rate and the number of VMs decrease, the response time and drop rate increase. Figure 3exhibits the CPU utilization for multiple numbers of VMs. We observe that for the three values of number of VMs (namely: 21, 22 and 23), the curves are approximately linear, consequently as the number of VMs increases as the CPU utilization increases. As opposed to scenario of having 20 VMs, the CPU utilization parameter in these cases starts from 50% for 1000 requests per second and reaches 100% from 2200 requests per second and more. Figures 3 (a) and (b) shows that when we increase the number of VMs and the requests arrival rate, the response time and the drop rate metrics decrease. Considering the CPU utilization measure depicted in Figure 5(c), we observe that when we have just twenty VMs, the CPU utilization percentage is higher and it reaches 100% from 1500 requests per second and more. For the three values of VMs (21, 22 and 23), the three curves are similar and when the requests arrival rate tends to 2300 requests per second, the CPU utilization reaches 100% value.

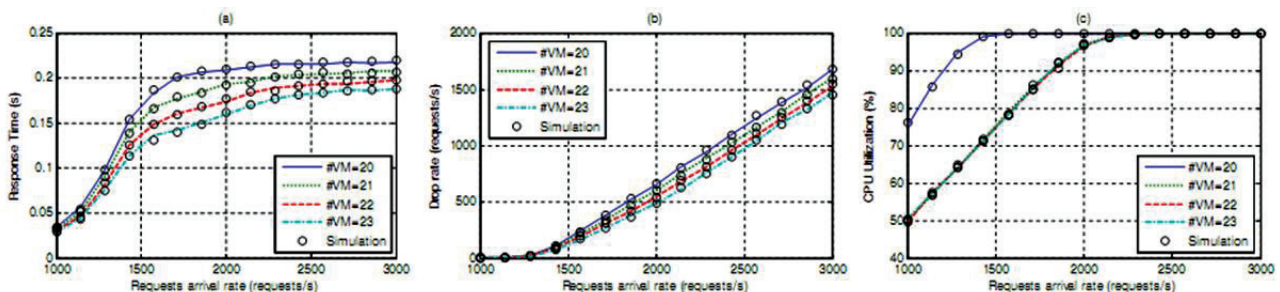


Figure 3: Database performance curves using multiple VM instances as functions of requests arrival rate

CONCLUSION

In this paper, we presented an analytical model that can be used in studying the performance of CDC and is able to estimate accurately the needed number VMs to achieve a target QoS metric. We have considered the typical architecture in which a CDC houses a collection of PMs that will be used to run VMs and also LBs. Scenarios were presented to illustrate the usefulness of our analytical model-specifically, in determining the impact of the number of allocated VMs on key performance and QoS parameters which included response time, drop rate and CPU utilization. We cross-validated the results obtained from our analytical model with simulation

results obtained from the popular JMT simulator. The simulation and the analysis results are in agreement and thus implying that, our analytical model is correct. As a future work, we plan to conduct experimental work of an elastic-scaling mechanism on a real-world CDC in which our analytical formulas derived in this paper are used to scale resources automatically to meet QoS targets in accordance to variable workloads.

**Ethical Clearance:** Taken from AMET University

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# Analyze the Quality of Power Using A Graph Theory Network Flow Algorithm

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## ABSTRACT

This paper explains about the power quality and transmits maximum power between the grid based electrical systems. These system stream calculations are connected to a graphical portrayal of a power framework topology to decide the base number of framework branches should have been lost keeping in mind the end goal to ensure separating the two hubs in the framework that are chosen. The number of framework branches that are discovered fills in as an inexact marker of framework vulnerabilities. The technique utilized as a part of these availability investigations makes utilization of surely understood diagram hypothesis organize stream greatest stream calculations, additionally presents another calculation for refreshing an old system stream answer for the misfortune of just a solitary framework branch. The proposed new calculation permits for essentially diminished arrangement time that is fancied in a ongoing condition. The benefit of utilizing the proposed technique is delineated by utilizing a point by point case of the 2008 island development that happened in the Entergy control framework.

**Keywords:** *Graph Theory, Network theory, Directed graph, Edge flow, Power quality*

## INTRODUCTION

Black out are caused by loss of transmission line or transformer. These line blackouts spoke to the loss of basic interties that associated the Consolidated Edison Company (Con Edison) to neighboring frameworks. One of the reasons for the disappointment was credited to “Inability to perceive that a basic interconnection to the West (Y84) was adequately inaccessible”<sup>[1-2]</sup>. Knowing the accessibility of an intertie can be troublesome. An intertie is definitely not fundamentally a solitary transmission line whose status can be checked. Or maybe, an intertie can be a part of the system. This work proposes the use of system stream examinations amid ongoing force framework operation to give better system representation and mindfulness<sup>[3,4]</sup>.

Diagram hypothesis has been utilized as a part of various approaches to concentrate the topology of energy frameworks. In concentrated of North American power matrix by evacuating basic parts utilizing an assortment of measurements, for example, nodal degree (the quantity of lines exuding from a transport) and between (the quantity of most limited ways that navigate a given component). A few reviews have proposed utilizing worldwide framework helplessness measurements, for

example, net-capacity worldwide proficiency what’s more, powerful diagram resistance to distinguish basic parts inside a power framework<sup>[5-7]</sup>.

**Proposed Method:** The proposed techniques decide the worldwide defenselessness of the current framework, which is spoken to by a solitary number. Next, a segment is expelled from the current framework topology and the worldwide powerlessness is recomputed. The segment that caused the best negative change in the powerlessness metric is viewed as the most basic segment. Once the adjustment in metric is figured for the loss of any component, the parts in the framework can be positioned by noteworthy. Be that as it may, just showing the worldwide helplessness for the current framework does not speak to much huge data to a framework administrator. The worldwide weakness measurements are dictated by the structure of the whole framework, darkening the physical elucidation of the metric and in addition the area of potential issues in the framework.

**Graph Theory:** In chart hypothesis, a diagram is made out of vertices and edges. Vertices go about as hubs inside the chart while edges interface vertices together. In the event that a power framework is portrayed as an arrangement of transports associated together by transmission lines, at

that point transports in the framework would move toward becoming vertices and the transmission lines would move toward becoming edges. A most extreme stream organize stream calculation can decide the greatest stream that can be conveyed from a source to a sink inside a coordinated diagram where each edge has a particular stream limit. A stream speaks to some physical amount being transported, for example, data in a data organize or, on the other hand current in an electrical system. A coordinated chart is a diagram made out of coordinated edges. Coordinated edges can just permit stream in one course. The limit of the edge the other way is zero. The network flow has the following criteria

- For each edge, the flow across an edge cannot surpass the ability of that edge.
- For every vertex other than the source and sink, the sum of the flows entering a vertex must equal the flow exiting that vertex.

The six vertexes directed graph is shown in Figure 1. The edge flow in network theory is shown in Figure 2. Figure 3 explores the edge flow after second iteration in network theory. The edge flows after third iteration in network theory are given in Figure 4.

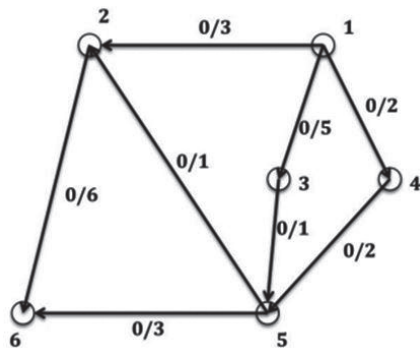


Figure 1: Six vertexes directed graph

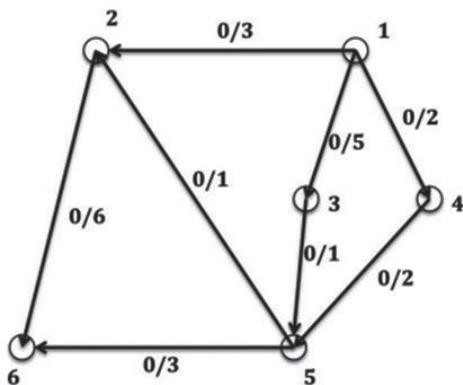


Figure 2: The edge flow after first iteration in network theory

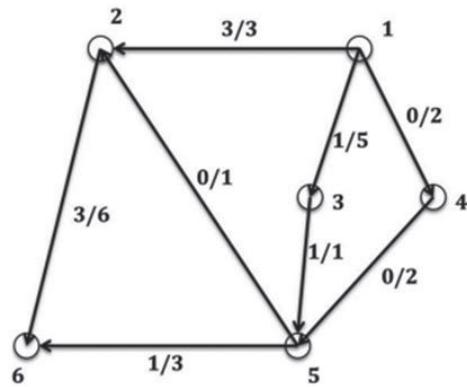


Figure 3: The edge flow after second iteration in network theory

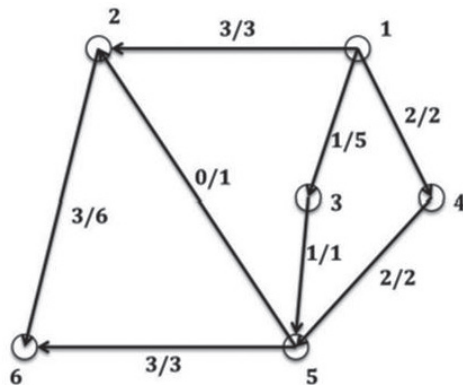


Figure 4: The edge flow after third iteration in network theory

## RESULTS AND DISCUSSION

At the point when the system stream calculation is connected to a power framework arrange, the decision of the transports chosen as sources also, sinks is imperative yet clear. An extensive power framework may have 10,000 transports. In the event that a solitary transport were chosen as the source, and each different transport serves one time as a sink, this would require 9,999 distinct cases to be run utilizing the organize stream calculation taking after an adjustment in topology. Not just is this tedious it is likewise pointless. Rather, as it were a little subset of transports should be chosen. For instance, a single midway found transport with high degree can be chosen as the source. These transports have a tendency to be critical to the framework somehow, for example, expansive generators, basic burdens, or phasor estimation unit (PMU) locales. Choosing the areas of sinks requires some learning of the framework. At least one sink ought to be situated in each real load focus and era center point. This is on the grounds that it just requires a solitary sink to be found in an influenced

zone with a specific end goal to show framework worry because of line blackouts. Such a setup would ensure, to the point that the system stream arrangements would demonstrate an issue if blackouts in the framework start to disengage any huge working ranges from the source. Utilizing this strategy, it is conceivable that an island could frame that does exclude any of the picked sinks, which would be undetectable to this approach.

### CONCLUSION

The proposed calculation uses all around recorded most extreme stream organize stream calculations, for example, Edmonds furthermore, Karp, and in addition another technique for refreshing a system stream arrangement utilizing a solitary way seek. The technique was clarified in detail and was connected to an entertainment of the 2008 Entergy island arrangement. The aftereffects of the calculation after every blackout unmistakably show that an expansive region containing Baton Rouge and New Orleans is by and large gradually separated from whatever remains of the system. The technique can supplement regular observing instruments or fill in as an option perception apparatus in the occasion state estimation is not accessible.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

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# Chirp Technique Based Under Water Communication Systems

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## ABSTRACT

In this paper, by using the multi chirp rate signals the multi user communication is achieved in the underwater acoustic systems. In general, the time, frequency is assigned for the single users for the communication systems like TDMA (Time division multiple access), CDMA (Code division multiple access) and FDMA (Frequency division multiple access). In proposed work, the multi chirp rate is assigned for the multi users for the marine systems. By using FFT (Fractional Fast Fourier Transform), the multi chirp rate signals are separated. Inter symbol interference (ISI) is caused by the multi patch is improved by the Virtual Time Reverse Mirror (VTRM).

**Keywords:** *Time Division Multiple Access, Frequency Division Multiple Access, Fractional Fourier Transform.*

## INTRODUCTION

Under water acoustic channels communication is one of the challenging approach for the researchers. The main consideration of the under water systems is, path loss, multi path propagation delay and low speed for the multi user communication systems. The non linear outputs generated by the signals are highly producing the double selective fading. The good tolerance is highly achieved in the Linear Frequency Modulation (LFM) signals. These signals are transmitted in the SONAR, DOPLER RADAR systems.

Modulation technique of OFDM signals allow to generate the sub-carrier signal from original information signal. Each sub-carrier signal has equivalent or significantly lower rate data stream. Based on generating number of sub-carrier signals, total numbers of FFT points are considered. In FFT based frequency transformation technique also, modulation technique is used along with FFT. Different types of digital modulation techniques are available for partitioning single higher rate data stream into number of lower rate data streams. Among those more important techniques are Quadrature Amplitude Modulation (QAM), Quadrature Phase Shift Keying (QPSK) modulation and Binary Phase Shift Keying (BPSK) modulation. In this section, brief literatures regarding OFDM modulation techniques are described. In <sup>[1]</sup> problem of decode-and-forward (DF) relaying systems with limited channel state information (CSI)

based adaptive modulation (AM) is described. They first develop SNR based AM and obtain the regions of the source-destination and relay-destination link SNR. The modulation technique of different input combinations are based on frequency transformation techniques. Binary Phase Shift Keying (BPSK) modulation is one of the important modulation techniques among different modulation techniques described in <sup>[2]</sup>. The developed CSI based AM technique will be useful in upgrading OFDM technologies.

## RELATED WORKS

In order to implement the uplink and downlink of LTE based 4G network, an effective adaptive modulation technique is developed in this research work. Their primary objective is to minimize the error probability of a LTE system and to bring the spectrum efficiency through a process known as adaptive modulation and coding rate. In this work, the performance of BER and spectral efficiency of various digital modulations like QPSK, 16 QAM, and 64 QAM is analyzed and compared with adaptive modulation technique. In design and detection of multilinear chirp signals for underwater acoustic sensor networks <sup>[3]</sup> for communication. Adaptive Modulation and Coding (AMC) rate are reviewed. Degradation effect of Modulation technique makes a problem in partitioning techniques. Due to degradation effects of modulation techniques, BER & SNR rate should be decreased traditionally. This article focuses

variable adaptive methods to implement a modulation technique which analyzes the performance measurement in terms of variable rate, variable error probability and variable coding or hybrid technique. Also this article focuses upon variable power technique and describes two or three different power techniques<sup>[4]</sup>. The comparison between them also is found in this manuscript.

In Pre-Compression Algorithm for Optimal Acquisition<sup>[5]</sup> Least Square Error (LSE), Minimum Mean Square Error (MMSE), Least Minimum Mean Square Error (LMMSE), Low rank (Lr) – LMMSE channel estimators are integrated with the physical layer. The performances of those algorithms are estimated in terms of BER, SNR, MSE and throughput. Simulation result of this article proved that increment in modulation scheme size would leads to improvement in throughput

along with BER value in AdaBoost algorithm <sup>[6][7]</sup>. As per this manuscript perspective, there is a trade-off among modulation size, BER value and throughput. The results of this paper concluded that higher modulation schemes establish higher data rate with higher BER value. Figure 1 displays structure of virtual time reverse mirror (VTRM).

**The Communication in the Multi User under Water:** The Virtual Time Reverse Mirror (VTRM) System is only required to perform the receiving the signal. There is no need to perform the sending operations. The original signal is retrieved to estimate the impulse response of the channels. To achieve the virtual time reverse mirror, the information signal with the convolution code is received. The multi chirp signal is act as the transmission signal after the multiple path system.

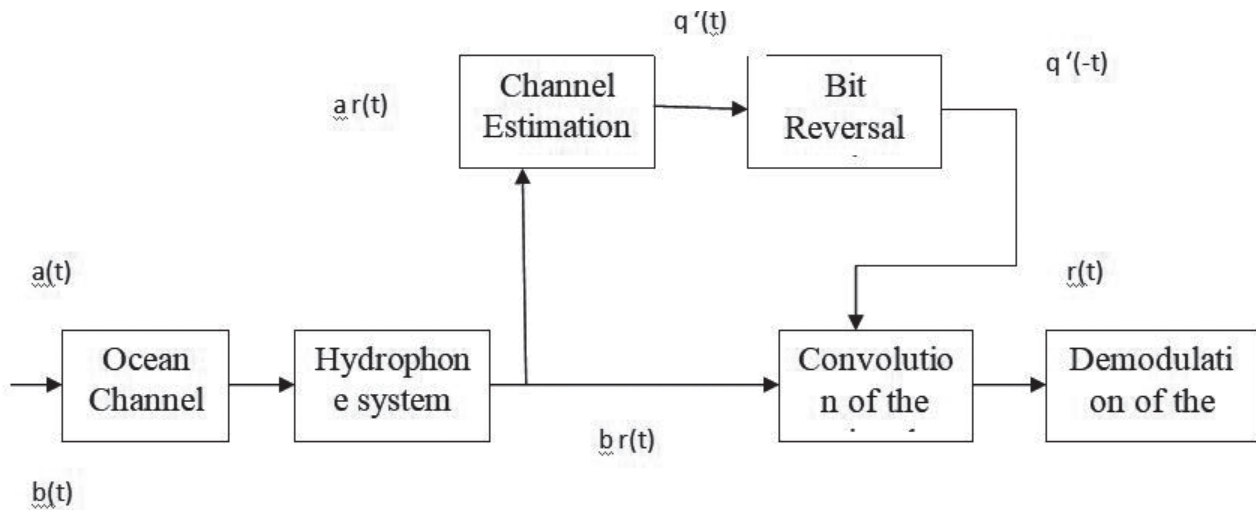


Figure 1: Structure of Virtual Time Reverse Mirror (VTRM)

**RESULTS AND DISCUSSIONS**

There are two input signals are given to the ocean acoustic system. Named as,  $a(t)$  and  $b(t)$ . The acoustic system is giving the input of the hydrophone system. Then the  $br(t)$  is given to the voth convolution and channel estimation. After channel estimation, the input signal is bit reversed. Then the original signal is retrieved from the demodulation process. There is various modulation and demodulation systems is available. In under water communication systems, the main consideration for modulation and demodulation is Bit Error Rate (BER). The BER analysis is varied according to the number of users in the communication system. Figure 2 displays the BER analysis for multi users system by using multi users

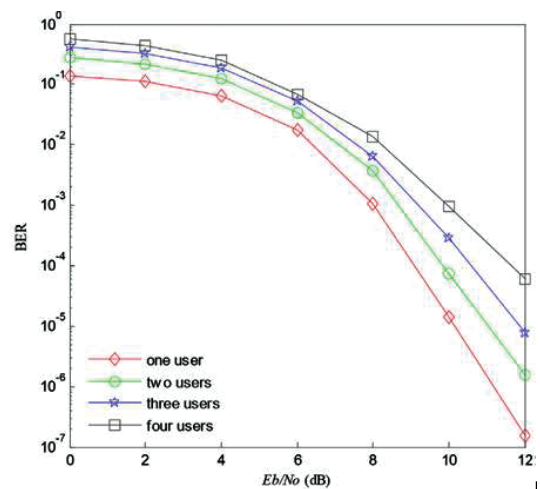


Figure 2: BER Analysis for Multi Users System by using multi users

## CONCLUSION

In this paper, the Virtual Time Reverse Mirror (VTRM) System is analyzed. In that VTRM system, the Modulation and Demodulation is one of the main part to achieve the virtual mirrors. By generating the efficient BER, the system is highly applicable for the underwater applications like Marine systems and Naval architect systems. The communication in the underwater is one of the challenge roles in Marine systems. For high speed data transmission for multi users, the VTRM system is highly applicable.

**Ethical Clearance:** Taken from AMET University

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# Digital Pulse Processing System for X-Ray Spectroscopy Based on Single Photon Detection

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## ABSTRACT

It is described the global architecture of a digital pulse processing system for high resolution X-Ray spectroscopy based on single photon detection and photon energy measurement. The center of the system is executed in a cutting edge half breed gadget (Xilinx Zynq) that coordinates a FPGA texture alongside a double center 32-bits processor (ARM Cortex). It is likewise portrayed the embraced procedure to manage high info photon rates while safeguarding a decent vitality determination. The advanced execution of the system is extreme controlled by few key useful pieces including two limited drive reaction channels and an algorithmic state machine. It is presented a numerical procedure to optimize the digital filters according to different constrains and goals, and it is described the analysis of experimental data to obtain the necessary information for the optimization of the system.

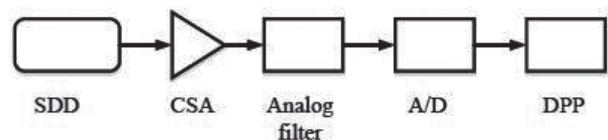
**Keywords:** Programmable Logic; FPGA; System-On-Chip; Digital Pulse Processing; Frontend Electronics; Single Photon Detection; Silicon Drift Detectors; Digital Spectroscopy; X-Ray Fluorescence; Reconfigurable Instrumentation.

## INTRODUCTION

There are many applications and experimental research activities based on X-Ray analytical techniques where high energy resolution at high photon rate is crucial. X-Ray single photon counting and photon energy measurement is nowadays very common in many different areas such as medical applications, non destructive analysis of cultural heritage objects, material sciences, etc in Synthesis and Characterization of CuInSe<sub>2</sub> Nanoparticles by Hydrothermal Method. Despite the fact that it has been a steady change in this field in different angles it is still vital to depend on proficient frameworks for high determination spectroscopy at high photon checking, rates [1] X-ray spectroscopic performance of a matrix of silicon drift diodes This turns out to be particularly significant when costly trial offices or supplies are utilized for normally long time estimations like on account of XAFS tests with synchrotron X-Ray sources.

In this work it is presented a Digital Pulse Processing (DPP) strategy based on Finite Impulse Response (FIR) filters for high resolution X-Ray spectroscopy with novel Silicon Drift Detectors and ultra low noise analog frontend electronics. Nanoparticles by Hydrothermal Method

for x-ray generation [2] for portray the trial information examination to remove the pertinent data that is important to improve the coefficients of the principle FIR channel, and an appropriate streamlining methodology to acquire these coefficients [3]. For our situation there is no simple heartbeat forming and the DPP works straightforwardly on the computerized information stream created by the advanced transformation of the CSA yield in Optical and Electrical Properties of Chemical Bath Deposited Cobalt Sulphide. The Figure 1 demonstrates a run of the mill flag chain from a solitary X-Ray photon finder [5] (e.g. Silicon Drift Detector, SDD) till the computerized beat preparing piece. Optical and Electrical Properties of Chemical Bath Deposited Cobalt Sulphide Thin Films [6] [7] for x-ray beam generation.



**Figure 1: Schematic view of a typical signal chain for photon detection and measurement.**

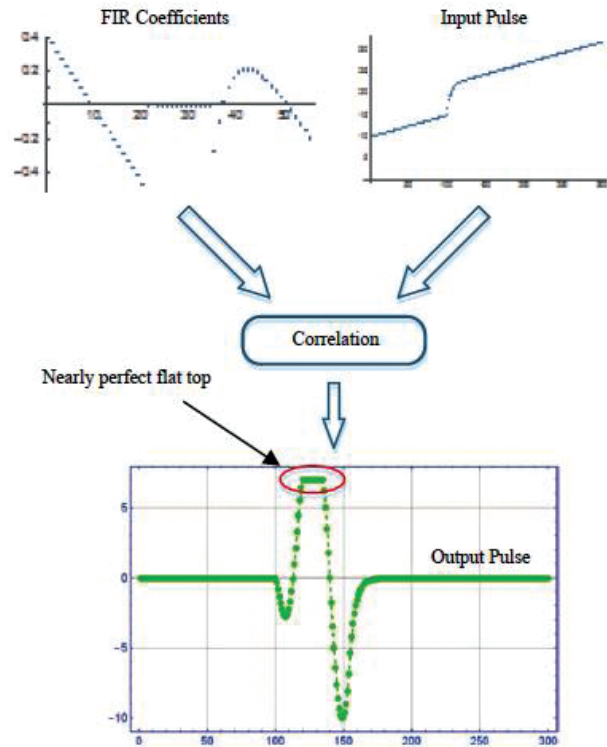
**dpp strategy and corresponding digital design:** The approaching information stream is handled in parallel by two channels, one to recognize the onset of the



information beat and the other one to frame an ideal yield heartbeat with the end goal that its sufficiency can be correctly measured in Figure 2. While the main channel is streamlined to expand the time determination of the beat location, the second heartbeat is upgraded to build the plentifulness determination and to enhance commotion dismissal. The second channel is basically a moderately vast FIR whose coefficients are advanced to create a heartbeat such that its pinnacle is as level as conceivable at any rate for a timeframe sufficiently long to ingest some normal varieties of the measuring time. The output of the FIR goes to a FIFO with a free running read clock but its input port is only enabled during one clock cycle to store the peak value of the FIR output pulse. Detect the presence of epileptic attack in Electroencephalogram (EEG) signals noise reduction [4] using FIR filter. It is the FSM that decides if and when to store the peak value according to few simple criteria in order to avoid wrong amplitude measurements due to the interference of two or more photons too close each other.

**DATA ANALYSIS AND DPP OPTIMIZATION PROCEDURE**

The filter designer can generalize this method by adding other constraints or targets in the form of positive quadratic terms of  $\Psi$  as functions of the FIR coefficients. By setting appropriate weights to each quadratic term of  $\Psi$  it will be possible to obtain an optimum filter by choosing the FIR coefficients that minimize  $\Psi$ . There are a few calculations and multidimensional streamlining schedules accessible in different dialects which are appropriate for the minimization methodology endorsed by this strategy. By rearranging the ordering of the FIR coefficients with deference that utilized as a part of (4), that convolution can be proportionately communicated as a relationship between’s the information flag and the re-filed coefficients. The Figure 3 demonstrates the relationship of a conceivable arrangement of FIR channel coefficients and a perfect (quiet) input beat that delivers the level top perfect yield beat.



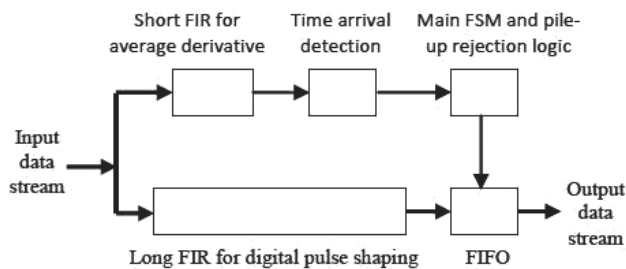
**Figure 3: The correlation of a set of FIR filter coefficients and an ideal (noiseless) input pulse produces the flat top ideal output pulse.**

**IMPLEMENTATION IN A PROGRAMMABLE SYSTEM-ON-CHIP DEVICE**

The depicted advanced framework for heartbeat preparing has been actualized in a present day crossover gadget for programmable frameworks on-chip. This gadget is primarily created by two firmly associating subsystems: the Processing System (PS) which incorporates a 32 bits double center ARM processor and the Programmable rationale (PL) which for the most part coordinates framework entryways, DSP squares and free double port RAM pieces.

**RESULTS AND DISCUSSIONS**

The PS can easily handle the communication with the external world through standard ports such as Ethernet, USB, UART and SPI. We have selected the Ethernet port to communicate with a regular PC where resident software offers a GUI for control, data acquisition, and in general for all non time critical activities which are normally executed in the reconfigurable logic of this hybrid device. Several registers are implemented in the reconfigurable logic and are memory mapped such



**Fig. 2: Schematic view of the Digital Pulse Processing Block**

that can be easily accessed by the processor through a dedicated bus. Both spectra have been generated with a peaking time of 1.2 us. The full width at half maximum (FWHM) of the two peaks corresponding to the Ka and Kb transitions of Ti are respectively 278 eV and 259 eV with our system and 371 eV and 356 eV with the commercial system

### CONCLUSION

We have proposed a global architecture of a digital pulse processing system for high energy resolution X-Ray spectroscopy based on single photon detection and photon energy measurement; including the strategy to efficiently deal with high input photon rates while preserving a good energy resolution. The core of the system has been successfully implemented in a modern hybrid device for programmable systems-on-chip. The availability of abundant reconfigurable logic resources along with a tight interconnectivity with a powerful embedded dual core processor allows an efficient implementation of complex strategies and algorithms like the ones described in this work. The likelihood of quick trade of data between a control PC and the DPP framework allows high information securing and preparing rates as required by present day X-Ray types of gear in view of single photon checking with spectroscopic capacity. The general re-configurability and re-programmability of the framework permit adjusting distinctive DPP plans as indicated by new exploratory necessities without going through extensive and complex equipment upgrades. The portrayed approach in view of an appropriate blend of equipment and programming has demonstrated its awesome potential for future comparative frameworks gone for superior X-Ray spectroscopy managing both high info fluxes and high vitality resolutions.

**Ethical Clearance:** Taken from AMET University

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# Hamming Error Detection Using Triple Adjacentcode Algorithm

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## ABSTRACT

Error detection and correction codes provide reliable delivery of information signals. In general, these types of errors are generated in RAM chips [Error detection]. These errors can be detected and corrected by employing the error-detecting and error-correcting codes in RAMs. The most generalized scheme for detecting the error in error detecting technique is parity bit. In Single Error Correction- Triple Adjacent Error Detection (SEC-TAED) method, the parity bit can be extended to detect a single error as well as triple adjacent errors. Hence, SEC-TAED based hamming code is referred to as "Extended Hamming SEC-TAED codes." Hence, 82% of detection efficiency can be achieved in modified bit-reordered based SEC-TAED process.

**Keywords:** SEC-TAED, Hamming

## INTRODUCTION

OFDM System consisted of channel encoder and a channel decoder for encoding and decoding purpose, Hamming SEC-DAED and extended hamming SEC-DED-TAED codes through selective shortening and bit placement is described by [1]. Source encoder and source decoder are used to convert the analog signals into digital one and digital signals to analog one respectively. Enhanced detection of double and triple adjacent errors in Hamming codes through selective bit placement is discussed by [2]. The purpose of channel encoder and decoder in OFDM System is to transmit the multiple discrete signals into a single channel.

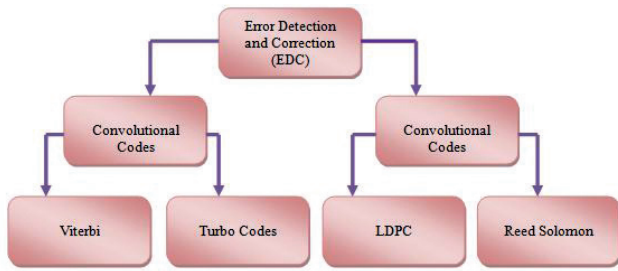
Design and Implementation of MIMO-OFDM using Encoding and Decoding techniques on FPGA are explained by [3]. Two types of binary codes are available for channel encoder and channel decoder of OFDM Systems. These are,

- Block codes
- Convolutional codes

Block codes are the combination of both linear and cyclic codes. It is an error correction codes that encodes data into blocks. Combined analysis of support vector machine and principle component analysis for IDS is explained by [4]. Linear block codes are an error

correction code in which a linear combination of code words also a codeword. Malware detection in the Android application by rigorous analysis of decompiled source code is described by [5]. Linear codes are used in forwarding error correction and in transmitting symbols (i.e. bits) on a communication channel discussed by [6]. Cyclic codes are also blocked codes in which cyclic shifts of each code word considered as another code word belong to that code. Enhanced K Strange Points Clustering Algorithm is explained by [7]. In another hand, convolutional codes are one of the best codes in the encoding part.

Various decoders are available to decode the digital inputs such as Hamming decoder, Viterbi decoder, the Adaptive Viterbi decoder (AVD), Low-Density Power Check (LDPC) decoder, Cyclic Redundancy Check (CRC) decoder, Bose, Ray- Chaudhuri, Hocquenghem (BCH) decoder, and Reed-Solomon decoder. Energy Detection Based Spectrum Sensing in Cognitive Radio Network is explained in this paper [8]. These all are the block codes. Hence it may be a linear error correction codes or cyclic error correction codes. Among those encoders and decoders hamming encoders and decoders is the best Error Correcting Coding (ECC) techniques for Very Large Scale Integration (VLSI) Implementation. Figure 1 explores the classification of error detection and correction (EDC) codes



**Figure 1: Classification of Error Detection and Correction (EDC) codes**

Viterbi and Turbo codes are convolutional codes because convolution function has been performed in the encoder part of data transmission system. In the other hand, Low-Density Parity Check (LDPC) codes and Reed-Solomon codes are the linear error detecting and correcting codes. Other than LDPC and Reed-Solomon code, Hamming code is also one of the best linear EDCs. The code word of linear codes is also linear. Hence, we can improve the probability of error detection and error correction.

**Error Detection and Correction Technique:** In the SEC-TAED method, the parity bit can be extended to detect a single error as well as triple adjacent errors. Hence, SEC-TAED based hamming code is referred to as “Extended Hamming SEC-TAED codes.” Similar to DED combination, Triple Error Combinations are determined by using MATLAB. There are 49 triple error combinations are found in normal bit-order based hamming code. Hamming (12, 8) SEC-DAED code could cause miscorrection for detecting triple adjacent errors. Thus it requires one more parity bit ‘p’ for performing SEC and TAED operation. SEC-TAED process with (13, 8) Hamming code is described in [Alfonso 2012]. Hamming (13, 8) code for detecting triple adjacent errors is illustrated in Table 1.

**Table 1: Triple Adjacent Error Detection for Proposed Hamming (12, 8)**

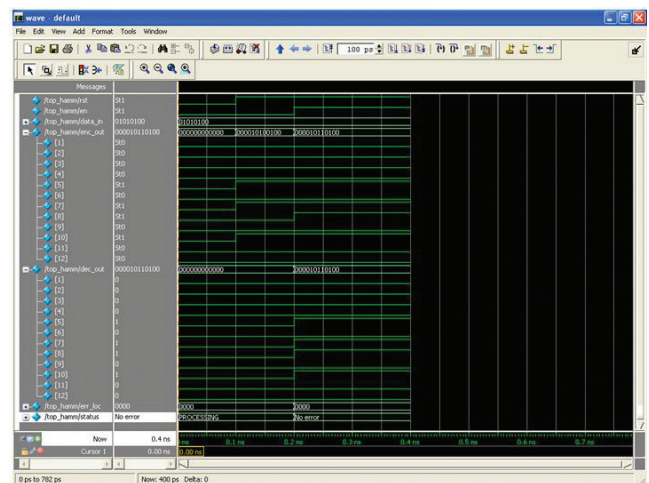
Bit Placement												Detection	
1	2	3	4	5	6	7	8	9	10	11	12	1/10	10%
7	11	2	6	10	1	4	8	3	5	9	12	9/10	90%

In normal bit order, 1 out of 10 combinations only helps to detect the triple adjacent error. But in the case of proposed bit, re-ordered format 9 out of 10 combinations help to detect the triple adjacent errors. Hence, 90%

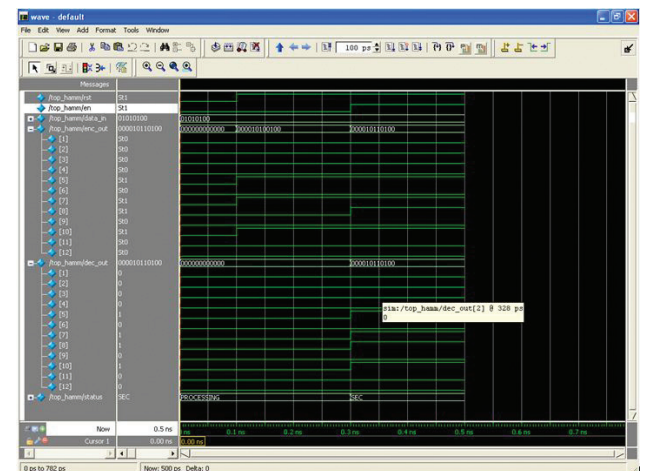
probability detection efficiency can be achieved in the case of proposed extended hamming SEC-TAED code. All combination of proposed bit re-ordered format except 5-9-12 are triple error combinations.

Hence, it helps to improve the bit detective probability wherever the bits flipping occur during data transmissions.

**Simulation Results and Discussion:** The constant 8-bit input is considered as 01010100. The encoded output is obtained as 000010110100. If the same encoded data as it is transferred to the input of decoder means, the status signal provides “No Error” output. Figure 2 shows hamming (12, 8) error-less data transmission. For instance, the third bit of encoded output is changed manually and the input of decoder is as 001010110100. Figure 3 shows hamming (12, 8) single error correction data transmission. The status is displayed as “SEC.”



**Figure 2: Simulation result of SEC-TAED error-less data transmission**



**Figure 3: Simulation result of Hamming (12, 8) SEC-TAED code with single bit flipping**

## CONCLUSION

Channel Encoder and Channel Decoder are an essential blocks of OFDM transceiver architecture. In these blocks, Error Detection and Correction (EDC) codes are suited to encode and decode the original data bits. Hamming (13, 8) SEC-TAED code has 82% triple adjacent error detection efficiency with 100% SEC efficiency whereas proposed hamming (12, 8) SEC-TAED code has 90% triple adjacent error detection efficiency with 100% SEC efficiency.

**Ethical Clearance:** Taken from AMET University committee

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# High Gain Dipole Antenna with Simple Geometry and Material for Multiband Applications

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## ABSTRACT

In general an antenna is act as a transceiver for transmitting and receiving signals with high frequency. It is very important in real time and portable high data rate applications. The parameters decide the characterize of the antenna, the perfectness of antennae are the source resistance of the excitation source that feeds the antennae, characteristic impedance of the transmission line that feeds the antennae, the geometry of the antennae itself, the Voltage Standing Wave Ratio, the Reflection Coefficient, the Directivity, Horizontal Gain, Vertical Gain, Total Gain, radiation pattern, the magnitude of the electric field, efficiency, the current distribution and voltage distribution in the geometry of the antenna. The main parameters to be optimized for wideband portable application are the Gain, Directivity and Efficiency. Dipole antenna transmits the signal in a particular direction only. This work addresses the problem of Gain and Directivity by cascading multiple geometrical structures as well as changing the metal by which the geometrical structure is manufactured. By cascading simple structures it is possible to obtain the same directivity and gain provided by complex structures. The work identifies the second problem of efficiency by using stub or electrical networks as resonators. The stubs are designed by using impedances and admittances information provided by Smith chart at a particular frequency. The tool used for simulation is 4nec2 which stands for Numerical Electromagnetic Code. The frequency of operation used for analysis 300MHz. The wavelength in this frequency of operation is 1m.

**Keywords:** *Antenna Design, Reflection Co-efficient, SWR, Directivity, Gain*

## INTRODUCTION

An Antenna is also named as transceiver because it is capable of Transmitting and Receiving signals with high radio frequency. In general antenna is a device which converts electrical signals into radio waves and vice versa. In transmit a high frequency alternating current to the antenna terminal. In receiver side, obstruct some of the energy of an electromagnetic wave, to produce a very small voltage as its terminal that is applied to the receiver going to be amplified. Antenna design was made by some characteristic suitable for the transmission these are the transmission and reception of radio waves in all directions not only for particular direction <sup>[1]</sup>. The performance and characteristic of the antenna is defined by many parameters like gain, bandwidth, beam width, Voltage Standing wave ratio, radiation pattern etc. Radiation pattern is defined as, in which direction the transmission is higher and lower for communication. Major lobe, minor lobe and side lobe are the transmission

range in the radiation pattern. In recent time's reflector is used back side of the antenna for reducing the reflection. The reflector re-transmits the signal to the target direction. Dipole antenna is a prototyping antenna; it consists of two conductors arranged around an axis. Ultra wide band technology is also known as radio RF technology; short duration pulse is used to transmit data in binary form over a wide spectrum of frequencies. It broadcast the information over a wide bandwidth above 400MHz. Circular disc Dipole and vertical disc Dipole antenna are different antenna <sup>[2]</sup> based on ultra wide bandwidth antenna design for high speed. UWB has ultra wide frequency bandwidth; it can achieve extremely high capacity as high as thousands of Mbps. It works at low power transmission levels, and also provides high secure and high reliable communication. UWB system is purely based on impulse radio features like low complexity. Impedance matching, radiation pattern, stability, data rates, cost, weight, size of the antenna are the challenges facing the wide band antenna design.

## RELATED WORKS

Two Ultra Wide Band [1] expressed Compact directive balance antipodal Vivaldi antennas. UWB Antenna is one of the emerging antennas used for microwave imaging systems. UWB antenna achieved the good impedance matching compared to other type of antennas. Antipodal Vivaldi antenna grants the wide band requirements using FR4 substrate. Antenna Size reduction is one of the difficult processes for using low frequency applications, so UWB antennas are sizable. To reduce the coupling between antennas, Directivity and gain is improved when reducing the coupling between antennas.

Perfect magnetic wall condition (PWB) using Ultra wideband (UWB) antenna described<sup>[3, 4]</sup> for omni direction. Interference is eliminated by using step impedance resonator at 6GHz. Swarm optimization algorithm is used to optimize the UWB antenna design. Embedded resonance slots in ground plane technique does not control any bandwidth and ripple in underwater vehicle for surveillance with navigation and swarm network communication. In Double pole band-rejected UWB antenna based two resonators are used to avoid the characteristics of flat skirt. UWB design based algorithm is possible to adjust the band-stop and band-pass frequency in UWB applications.

**Dipole Antenna:** Dipole antenna is the simplest and mostly used antenna for wide range of applications. The common structure of the dipole antenna is just a straight rod with end to end same axis. Mostly used dipole antenna is half wave dipole antenna; the wave length of the antenna is  $\frac{1}{2}$ .

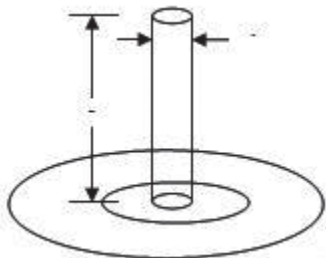


Figure 1: Basic Structure of Dipole Antenna

The most commonly used antenna is Dipole antenna. It is the antennae with simple geometrical structure that can be used for mobile and portable applications. The so many existing antennas have poor directivity, radiation pattern and gain. The directivity can be improved by changing the geometry and size of the antennae, or otherwise increasing the quantity of current flowing to the antenna. The quantity of current flowing through the antenna is not changeable and so keeping the power fed to the antenna constant if we vary the geometry the directivity is also changed significantly. The structure of the Dipole antenna is shown in Figure1.

**Proposed Dipole Antenna Design:** A Dipole antenna is a type of radio frequency based antenna, it consist of a straight rod shaped conductor it can be anything like wire, mounted on a ground plane. The Dipole antenna having two sides, one edge of the antenna is connected to the bottom end of the antenna, and the another side is connected to the earth ground plane. Earth is used as the ground plane of the antenna. The Dipole antenna is a resonant antenna, the functions of rod as open resonator for radio waves, changing the standing waves of voltage and current along its length. The antenna length is determined by the wavelength and radiation pattern of the radio waves. Navigation and swarm network communication for marine communication using normal dipole antenna. Like a dipole antenna, the Dipole antenna has unidirectional and directional radiation pattern. It radiates the radio signal in all azimuthally directions perpendicular to the antenna, but the radiated signal varying with elevation angle. At very high frequency (VHF) and ultra high frequency (UHF) antenna needed a smaller size ground plane. So, artificial ground plane are used to mount the antenna above the ground plane.

**Simulation Results and Discussion:** Our proposed new Dipole antenna design have higher radiation pattern and gain when compared to the existing antenna types. Minor lobe and side lobe of the radiation pattern is less when compared to existing Dipole antenna. Electric field of the proposed Dipole antenna is improved. Figure 2 explores the proposed antenna radiation pattern and Figure 3 return losses.

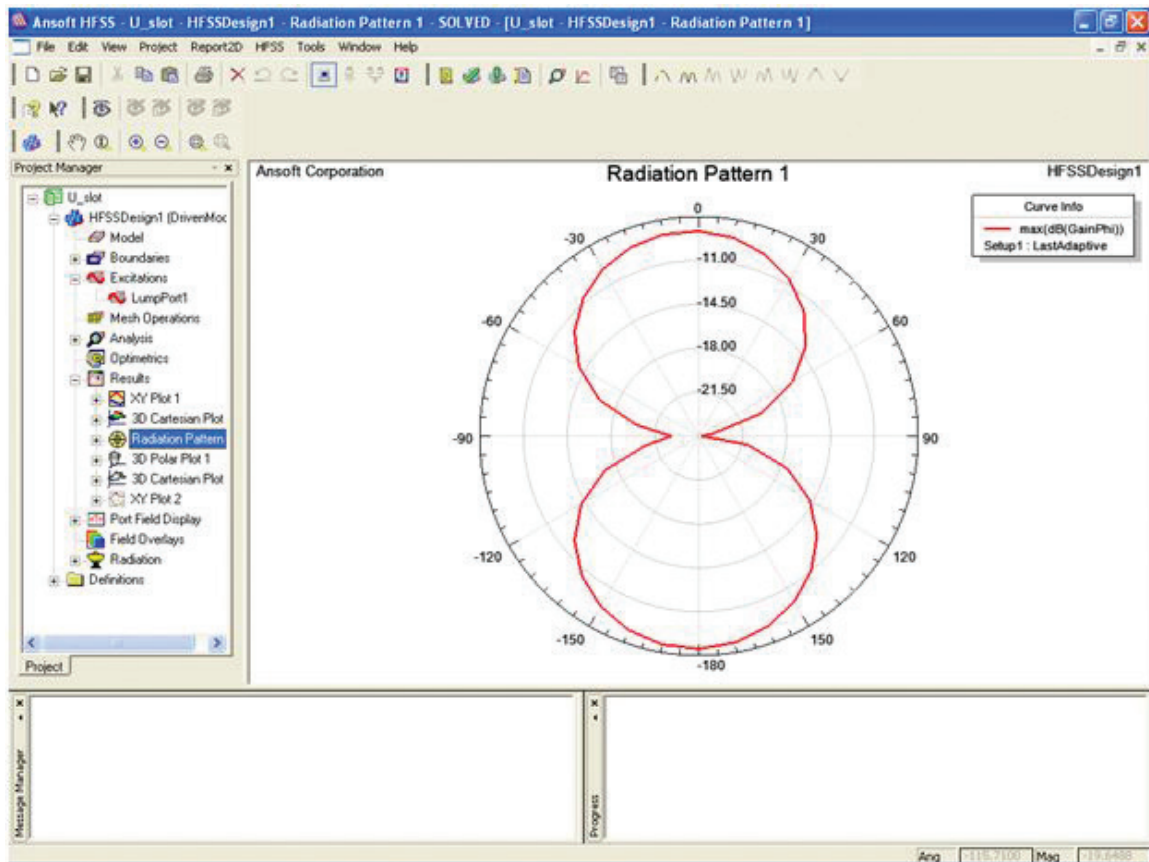


Figure 2: Proposed Antenna Radiation Pattern

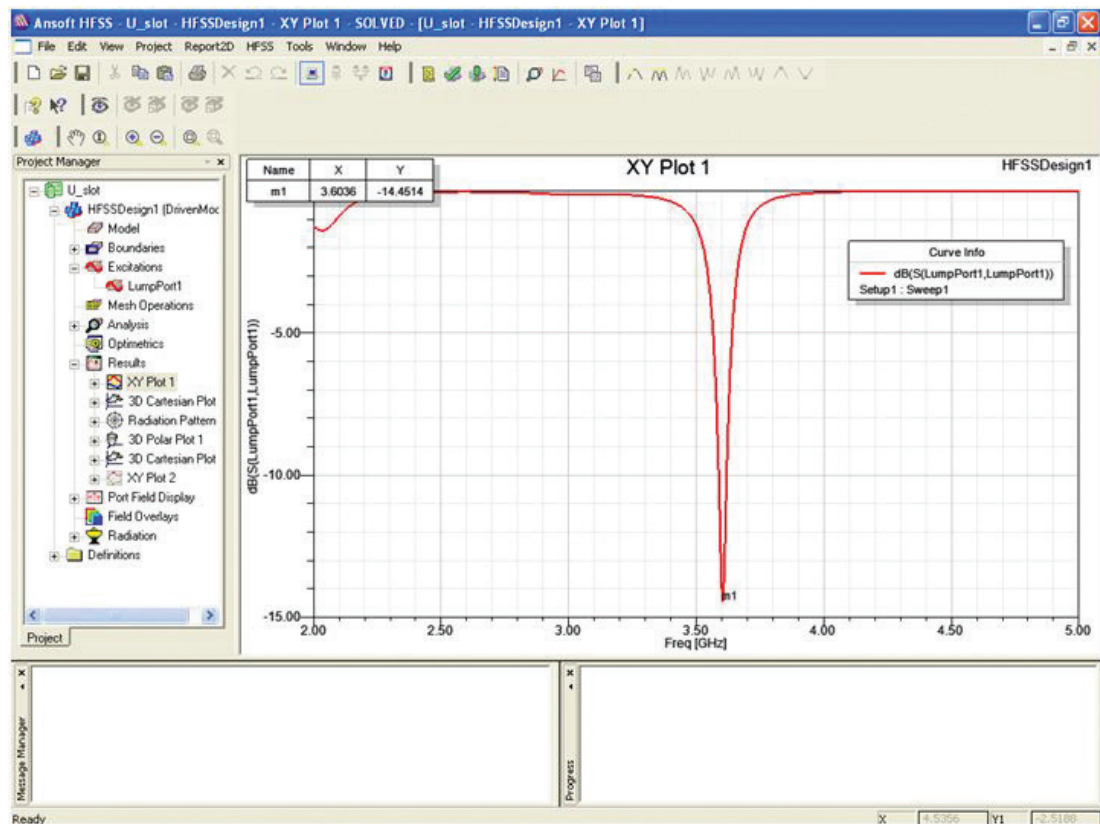


Figure 3: Return Losses



The above shows the return losses of the Dipole antenna. Compared to existing antenna the losses should be reduced and the gain is increased. Figure 4 explores voltage standing wave ratio.

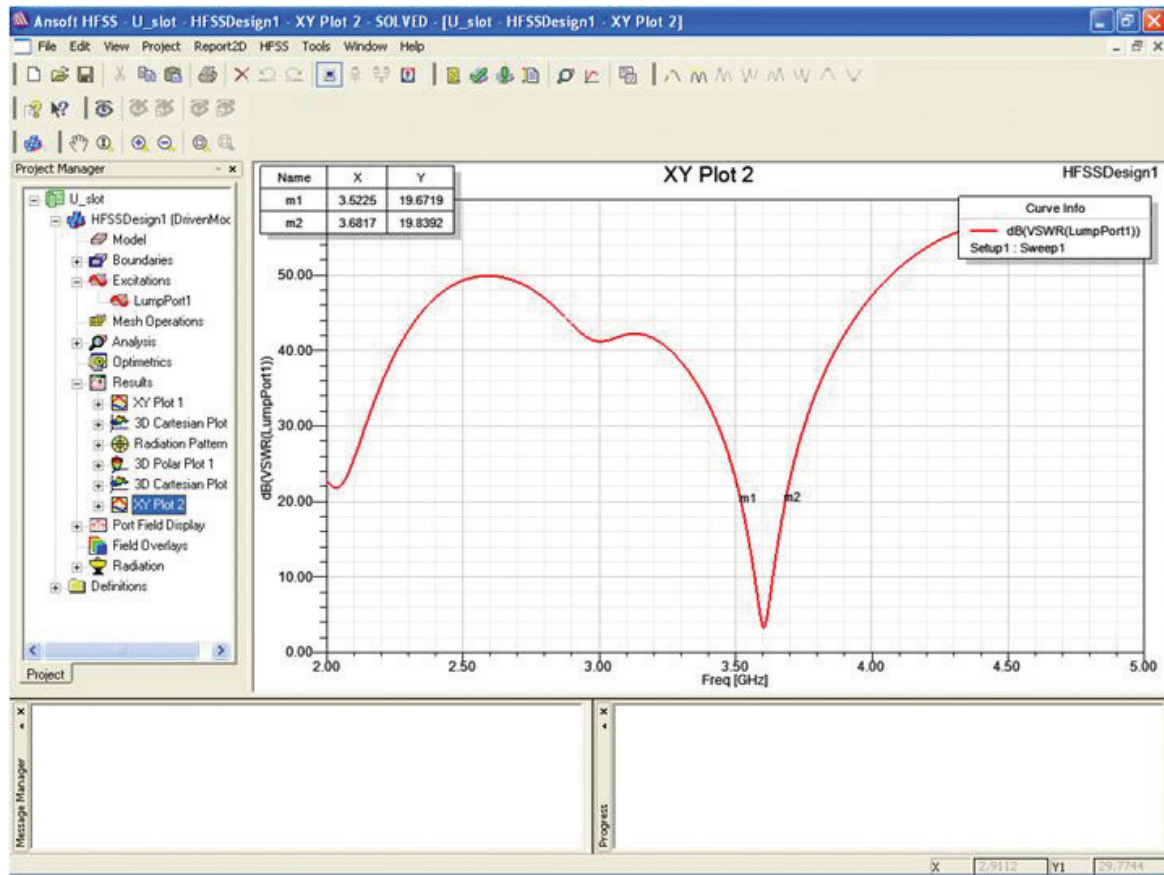


Figure 4: Voltage Standing Wave ratio

**CONCLUSION**

In this paper concentrate on the antenna parameters like radiation pattern, gain, reflection coefficient and voltage standing wave ratio. The proposed Dipole antenna was designed to increase the above parameters. The performance achievements were done by reducing the size and change the metal of the Dipole antenna. HFSS is used as simulation tool for taking the characteristic results of the Dipole antenna.

**Ethical Clearance:** Taken from AMET University

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# Implementation of Secured Multiple Random Fingerprint Password Electronic Accessing System

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## ABSTRACT

Nowadays, the framework is utilised to contrast the info picture, and the image in the folder and they condition are checked, the bank employees have scattered the money. In any case, the proposed model would supplant the security numbers by the biometric framework, and the method would distribute the funds while the examinations get fulfilled. Along these lines, the security of the exchange is enhanced to a more unusual degree. The benefit of biometrics is data of category for each person and that it can differentiate the person though variety at a time (it doesn't construct a variation if the primary biometric test is taken year prior). The upside of our framework is that it not just gathers single unique mark from the client as secret word. Instead, our structure will haphazardly collect few fingerprints from either hand of the client and gives validation. Since the biometric information can't be stolen, the framework would be sheltered and secured.

**Keywords:** *Biometric, Multi Fingerprint, ATM, Encrypt*

## INTRODUCTION

Various aspects of everyday life are gradually being digitised as our life experiences, and creative efforts are accumulated in personal computers, digital media devices, and mobile devices. People use passwords and other authentication methods to protect these collections of personal and potentially confidential information. Traditional confidentiality and authentication methods (e.g., personal passwords) are less than secure. It requires more programming and equipment assets [1]. In addition to requiring the user to remember a variety of passwords, which can result in user error, passwords can be stolen, and simple password authentication is vulnerable to unauthorised breach. However, these problems can be resolved through the use of "physiological passwords" through unique personal biometric identification methods such as recognition of the user's face, fingerprints, own signature, or iris. The secret word technique is the least expensive and most straightforward modernism as it just requires primary programming resources. Then again, this framework is effectively attackable, since it is straightforward to acquire the secret word data from a human [2]. The relationship between the biometric and biometric security system is also known as the lock and key system. The biometric security system is the lock and biometrics is the key to open that lock[3].

For instance, the current day ATMs are utilising pin based security. So going to do the exchange, the security numbers are encouraged as info it is scrambled at the customer part, and the information is unscrambled at the server part [4]. At this point when the examination gets fulfilled, we can complete the exchange. As the innovation is getting enhanced, the saltines are effortlessly recovering the information, and henceforth the cheats are continuing expanding [5]. The information is made accessible in the cloud so that the exchange time gets lessened. In this paper described that the new cryptography algorithm with for efficient data communication [6]. Malware detection in an Android application by rigorous analysis of decompiled source code is presented in this paper [7]. Henceforth the danger of information abuse can be decreased to the more prominent degree through the substitution. In this article described that An Efficient Key-Policy Attribute-Based Encryption Scheme in Cloud Computing[8].Provisioning of Efficient Authentication Technique, Clusters are formed based on the distance, and the Cluster Heads (CHs) are elected by coverage and connectivity. The secret key generation used to create the clusters securely. The Elliptical Curve Cryptography technique verifies the CH is authenticated or not. Thus, the source sends the data to authenticated CH in the network [9].

**Literature Study:** Currently utilizing the security pin number for safety in ATMs, which supplanted signature based framework. The stick based security is the most straightforward stage of security. A pin number is a particular number which is scrambled and decoded amid exchange. These days the stick number can be extricated through numerous routes, for fake action. Along these lines, as an answer, the stick number can supplant by biometric security. The biometric security might be different mark, retina and new cryptography algorithm with for efficient data communication.

**Features and its Description:** The Overall hardware design for the Multi-Fingerprint system as shown in Fig.1.

**Biometric Verification:** Biometric Authentication is the process of comparing data for the person's

characteristics to that person's biometric "template" to determine resemblance. The reference model is the first store in a database or a secure portable element like a smart card. The data stored is then compared to the person's biometric data to be authenticated. Here it is the person's identity which is being verified. The combine of biometric data along with pin number, it may increase the security Divisive Hierarchical Bisecting Min-Max Clustering Algorithm [7]. While the biometric data cannot be stolen or fake, the transaction is very safe and protected. If their chances for the pin number to be created, the operation time of the proposed system is about 10 seconds. It is a better concern since the clients aim at low transaction time and Malware detection in the Android application by rigorous analysis of decompiled source code [8]. The Figure 1 expressed Overall Hardware Design for Multi-Fingerprint System

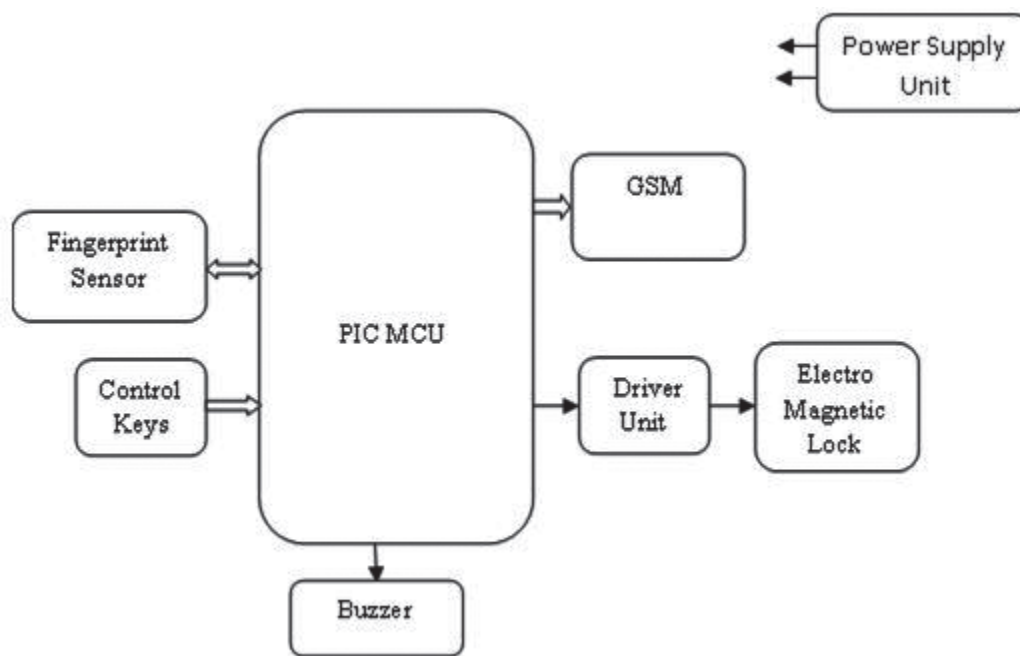


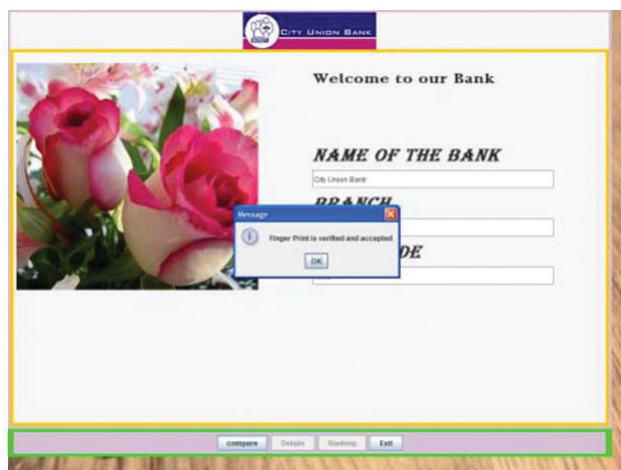
Figure 1: Overall Hardware Design for Multi-Fingerprint System

**Fingerprint Identification:** Biometric single sign-on frees the users from remembering and entering their password every time they log on to their laptop or computers. Instead of entering a password, users simply swipe their fingerprints to authenticate themselves and log on to their accounts. The increased convenience and security that it provides has made biometrics very popular and led to its increased adoption by banks for identity management. It streamlines the authentication process as it can positively verify the user's identity using their unique fingerprint.

Data theft and privacy breaches are essential security concerns not only for corporate entities but individuals as well. When users have multiple accounts and devices, they get fed-up of remembering passwords for all those accounts [2]. Due to this, users may note down their passwords or use the same one for all accounts. It makes them highly vulnerable to hacking attacks and intruders might be able to access their accounts using a variety of methods. The recent spate of hacking incidents reveals that passwords are indeed the weakest link in an organisation's security system.

Banks deal with customer's money and sensitive financial details, and hence they need incredibly reliable methods of access control. Moreover, users might be accessing their accounts from various locations and devices. The staffing is the process of storing data in the database. This process is happening on during the opening of an account. Once a client opening an account, bank branch first needs to fill in with the KYC questions. Then the fingerprint images are also collected in the branch. When all information is collection, and that's data are sent to the central server of core banking [3]. Core business in an intellect a customer can transact with any bank using his identity with which he doesn't hold any contact. During the transaction process, the client may have fed the image at some angle. The angle of the input image may vary a lot. We are using a hit and miss algorithm to find the core point. Thus the core points are identified, and then the processed image is carried out a comparison with the database model. Therefore the Identification is carried out as shown in Figure 2.

## RESULT



**Figure 2: Fingerprint Identification**

## CONCLUSION

In this paper, we proposed it not only collects single fingerprint from the user as a password. Instead, our system will randomly collect few fingerprints from either hand of the user and gives authentication. The images are encrypted earlier to the transmission, and the encrypted images are transmitting to a central server. When encryption occurs as increase the efficiency of the system, data transmission is secured, and power consumption is reduced.

**Ethical Clearance:** Taken from AMET committee

**Source of Funding:** Self

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# Problems and its Analytical Representation in Discrete Mathematics Over Proposition Formulas

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## ABSTRACT

In this paper, we break down and compressed the issues that understudies are inclined to mistake in the educating of discrete science, for example, judgment of suggestions, interpretation of recommendations, development of essential ordinary frame, and operation of aggregate, exceptional components in fractional request and give the comparing measures to taking care of every issue.

**Keywords:** *discrete mathematics, proposition, paradigm, collective*

## INTRODUCTION

Discrete Mathematics is an essential branch of current arithmetic, is the numerical establishments of software engineering, is an expert and original course of the PC claim to fame, it is the premise and the center. The point of this course is to give understudies a chance to face the fundamental information of arithmetic of software engineering and innovation. Discrete Mathematics is explained by [1]. Joined with the application in software engineering with Discrete Mathematics, Students ought to face the essential techniques for preparing the scattered amount, and have the premise learning for the following claim to fame courses. Paradox Box is discussed by [2]. It is excessively raising the capacity of unique ideation, rationale thinking and taking care of practice issue [3]. Thus, it is essential to learn scattered arithmetic well for the understudies who are majoring in software engineering a discrete-time retrieval inventory system with d-map demands. This paper described by [6]. However, the substance of this course are Mary and scattered, Many understudies' understanding of ideas and strategies is insufficient Introduction to Discrete Mathematics Higher Education this paper described by [4], Therefore they can't make a decent utilization of the particular information to take care of down to earth issues Low-temperature method for synthesis of ZnS quantum dots and its luminescence characterization studies this paper described by [5]. The creators locate that a few understudies 'blunder inclined inquiries during the time spent taking part in educating. Here, we make some discourse on a few common fundamental issues [7].

## SEVERAL EXISTING PROBLEMS

**Judgment of proposition:** The fundamental unit is a recommendation in propositional rationale. The recommendation is a critical mode in reasonable considering; it is a proclamation that can ready to judge genuine or false. Be that as it may, the Catch 22, interrogative, necessary, exclamatory and unhindered factors can't be ruled valid or invalid, in this manner can't be called suggestions. The nuclear recommendation is the opinion that can't separate into more straightforward articulation; Atom suggestions are the essential unit of standard rationale. In judging of recommendations, Students regularly see the interrogative, primary, exclamatory and unhindered factors, however, can't acknowledge the oddity.

There are three principle types of the oddity:

1. A declaration is by all accounts wrong; in any case, it's privilege.
2. A declaration is by all accounts right; in any case, it's off-base.
3. An arrangement of thinking looks like fantastic, however, prompt consistently confusing, yet they will prompt coherent mystery.

Ex 1: In the fourth century BC, the Greek mathematician Euclid's: "I'm lying." On the off chance that Euclid honestly is lying, then this announcement is valid, So Euclid did not lie; If Euclid truly isn't lying, then this statement is false, So Euclid is lying. The

judgment of each suggestion requires two conditions: The first is the definitive sentence; the second can decide the genuine or false.

In spite of the fact that Ex 1 is an ultimate judgment, however, it can't choose the real or fake, so it's a mystery, it has a place with the third sort of frame for the conundrum. What's more, the stylish mystery can present: "I just give somebody a hair style that who doesn't give himself a haircut."Etc. Understudies alone handle the intention of a conundrum.

**Propositional Formulas:** The fundamental element of research technique for the Mathematical rationale is symbolizing the different components in dialog and thinking. In propositional coherent, the nuclear suggestion is the primary unit of a propositional recipe. The nuclear recommendations and connectives and brackets constitute a confused idea method. There are some usually utilized connectives, for example, rationale NOT¬, conjunction ∧, disjunction ∨, conditional→, condition ↔, rationale XOR ⊕, and so forth. The principle motivation behind learning propositional reasoning is symbolizing a personal suggestion. We can give potential reality outcomes of recommendations through the same figuring. The path of recommendation is the way to imply coherent connective effectively.

It's anything but difficult to interpret a few connectives, for example, and, or, IF-THEN, if and just if, and so forth. In any case, some different connectives dependable are difficult to get a handle on.

Ex 2: Today I will get down to business unless it downpours.

Understudies translation for "unless" falls in the middle of causality and comparability connection. The issue will explain If they have "unless" as "if not."

P: I will get down to business; Q: it downpours.

Recommendation recipe: ¬ Q→P

**The construction of principal standard form:** The common primary type of suggestion equation is a standout amongst an essential substance in propositional rationale and is critical establishments of arithmetic in a few center subjects, for example, Artificial Intelligence, Software Engineering, Data structure, etc. The standard essential frame is the primary standard type of suggestion

equation. It's critical parts in idea equation mostly are judging likeness two propositional recipes, judging the kind of propositional recipes, giving a truth table, judging the legitimacy of deciding recommendation induction, and so forth. It is troublesome for understudies to build the main disjunctive ordinary frame and key conjunctive typical type of suggestion. There are two constructors for a first disjunctive standard frame and chief conjunctive typical shape, one is truth table, and the other is the utilization of the same recipe. Truth table applies to a couple of variable and straightforward equations, another goes for all recipes, and however, their basic procedures are unpredictable much of the time. Through the hypothesis of truth table strategy, we realize that the entirety of subscripts of mid-term in original disjunctive typical shape and maximal term in first conjunctive ordinary frame levels with to, this conclusion can be effortlessly connected to acquire the other by one of natural Chief shape.

Ex 3: the ultimate disjunctive normal form and first conjunctive normal form of“(P ∧Q)∨R” principal conjunctive normal form:

$$\begin{aligned}
 P \wedge Q \vee R &\leftrightarrow (P \vee R) \wedge (Q \vee R) \\
 &\leftrightarrow (P \vee R \vee (Q \wedge \neg Q)) \wedge ((P \wedge \neg P) \vee Q \vee R) \\
 &\leftrightarrow (P \vee Q \vee R) \wedge (P \vee \neg Q \vee R) \wedge (\neg P \vee Q \vee R) \\
 &\leftrightarrow M_{000} \wedge M_{010} \wedge M_{100} \leftrightarrow \pi(0, 2, 4)
 \end{aligned}$$

So, the expressions that make formula false is

$$\begin{aligned}
 &000, 010, 100; \text{ The right expressions are } 001, 011, \\
 &101, 110, 111.
 \end{aligned}$$

The ultimate disjunctive normal form:

$$\Sigma(1,3,5,6,7) \leftrightarrow M_{001} \vee M_{011} \wedge M_{101} \vee M_{110} \vee M_{111}$$

$$\begin{aligned}
 &\leftrightarrow (\neg P \wedge \neg Q \wedge R) \vee (\neg P \wedge Q \wedge R) \vee (P \wedge \neg Q \wedge R) \vee \\
 &(P \wedge Q \wedge R) \vee (P \wedge Q \wedge R)
 \end{aligned}$$

Thus, we can present a typical primary shape utilizing the proportional equations to start with, and then make utilization of the corresponding subscript to accomplish another. Along these lines, the induction will be extraordinarily improved and never commit errors. Thus it is anything but difficult to be acknowledged by understudies.

## CONCLUSION

In a procedure of discrete science instructing, Students frequently experience different issues, a few issues are individual, and a few issues are all inclusive. In this paper, the creator utilizes particular illustrations break down and examine the blunder inclined inquiries, For instance, the judgment of suggestion, the recommendation equation, the vital disjunctive typical frame and necessary conjunctive ordinary type of proposal, particular components in a halfway request, and so forth gives the arrangements, It is cheerful to do some help and direction in discrete science educating and learning.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Reduced Tree Structure Based Multiplier Design

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## ABSTRACT

Expansion of standard mobile and wireless network communication applications have significant demands on signal processing. Traditional signal processing approaches are filtering, convolution, correlation, and transformation of signals. Among these methods, filters are widely used in wireless mobile and network applications to filter the services of incoming/outgoing users. The primary function of a filter is to selectively allow the desired signals to pass through and suppress undesired signals based on frequencies. In this work, the design of MAC unit by using the modified compound Wallace tree multiplier is presented. This new adder design is performed efficiently regarding the VLSI design environment compare than the traditional multiplier unit. Verilog HDL language is used to implement the proposed design.

**Keywords:** Mobile Networks, Signal Processing, Digital filters, Multiplier and Adder, Hardware Description Language, Very Large Scale Integration.

## INTRODUCTION

The primary objective of this work is to reduce power dissipation by eliminating PMOS tree and also by retrieving the energy stored at the output by reversing the current source direction discharging process instead of dissipation in NMOS network with domino logic, pass transistor logic. Proposed an efficient low power ripple carry adder (RCA) for ultra applications is explained by [1]. The performance of the circuit increases due to an elimination of energy consumption. Further, a comparison of the Low-Power and High-Speed Carry Select Adder circuits with traditional adder circuits has been presented by [2]. Also, a four-bit ripple carries snake was designed using adiabatic logic and is considered as a benchmark circuit for future design. Carry Select Adder (CSLA) is introduced to improve the performance of digital addition operation. On the Power dissipation of 8-bit Ripple Carry Adder using CMOS circuits, Pass transistors and Transmission gates as described by [3], In this work, D-Latch is used instead of RCA in CSLA circuit. Cascade of RCA structures exhibits more delay and area for performing an addition operation. But, D-Latch circuit reduces the area and delay for displaying addition operation. A unique approach is proposed in this article to reduce area, delay, and power of SQR CSLA. Performance Analysis of different Bit Carry Look-ahead Adder using VHDL environment is

discussed by [4]. The proposed SQR CSLA structure is compared with regular SQR CSLA which results in developed architecture, consuming less area and delay than the regular one.

## RELATED WORKS

The Reduced Hybrid Complexity Ripple Carry Look-ahead Adder is proposed by [5]. To design 8-bit ripple carry adder, 1-bit ripple gives snakes are considered as a basement. Schematic design of developed 8-bit adder is converted into layouts for verification. Further, simulation of the schematic designs is performed to check the logic operations. In the end, performance analysis on power dissipation of layout designs is analyzed with previous work. Finally, this work concludes that the CMOS technologies are the most energy efficient for improving the performances of digital circuits. Hence, it is further recommended to use the CMOS logic for the design of portable embedded system industry.

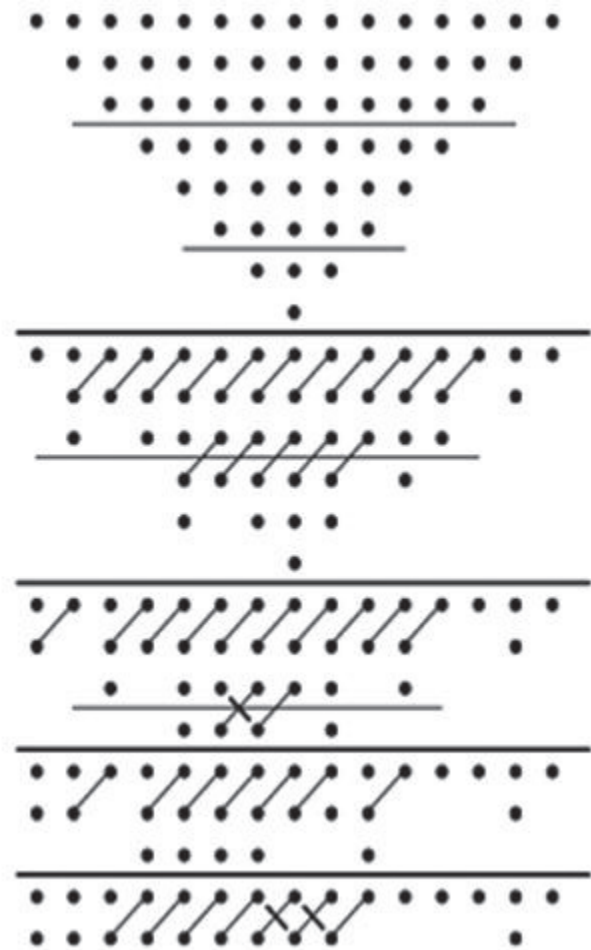
The 4-bit, 8-bit and 16-bit Carry Look-ahead Adder (CLA) using Very High speed integrated circuit Hardware Description Language (VHDL). The design of a Single Input Fuzzy Logic Controller Based SVC for Dynamic Performance Enhancement of Power Systems



is developed by [6]. The propagation delay of RCA circuit has been reduced to this work. It occupies less area regarding LUT, slices and a total number of gate count. As well as delay path also decreased significantly in carrying look-ahead adder when compared to Ripple Carry Adder. Energy efficient voltage conversion range of multiple level shifter designs in multi-voltage domain is discussed by [7]. The main disadvantage of this work is that it is not possible to realize constant delay for wider bit adders because there will be a substantial loading capacitance and hence it consumes more than considerable complexity. An efficient approach for the removal of bipolar impulse noise using a median filter is explained by [8].

The Hybrid Carry Look-ahead Adder (HECLA). A four-bit HECLA has been implemented by using Cadence using 45nm technology. The implementation results show that the 12.2% of Area, 4.6% of power improvement and 14.01% of critical path delay overhead over CLA. Minimum delay full adder achieves this high level of performance. This work would be useful for MAC design of FIR filter, FFT, and other digital signal processing applications. The CLA adder design by using Multi-input Floating Gate (MIFG) is developed. FPGA Implementation of Low Power Data Multipliers and Its Application is presented in this paper [9]. Low voltage and low power circuits are essential for mobile gadgets which have mixed mode circuit structures embedded with analog sub-sections.

**Methodology of Reduced Complex Wallace Multiplier:** A Wallace multiplier is a parallel multiplier, where array multiplication is performed identically. However, the main disadvantage of Wallace tree multiplier is the requirement of more number of full adders in each stage of computation. This problem can be mitigated in reduced complexity Wallace multiplier. In reduced complexity Wallace multiplier circuit,  $N^2$  AND gates are used to generate the partial product results, and they are arranged in an inverted triangular order as shown in Figure 1. The following steps are followed while designing the reduced complexity Wallace multiplier.



**Figure 1: Structure of Reduced Complexity Wallace multiplier**

Step 1: Combination of three bits is added using full adder circuit.

Step 2: Single bits and groups of two bits are moved to the next stage directly.

Step 3: Repeats the step 1 and 2, until two sets of the row are obtained.

Each dot represents partial products of multiplication. The final stage consists of two rows. In the last stage of reduced complexity Wallace multiplier, the efficient adder is required for performing addition process. Hence, proposed modified group structures based SQR T CSLA has been incorporated into reduced complexity Wallace multiplier to improve the performance.

## RESULTS AND DISCUSSION

Simulation result of 8-bit reduced complexity Wallace multiplier has been validated by using ModelSim

6.3C, and synthesis results have been estimated by using Xilinx 10.1i (Family: Spartan 3, Device: Xc3s50, Package: PQ 208, Speed; -5) design tool. The synthesis result of proposed SQRT CSLA based reduced complexity Wallace multiplier are illustrated in Figure 2 respectively to determine the area utilization.

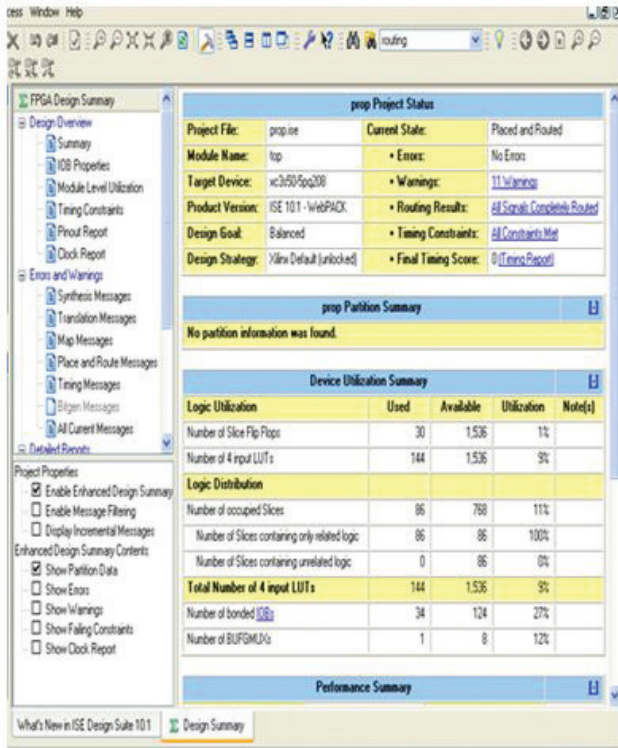


Figure 2: Synthesis result of the proposed reduced Wallace tree multiplier

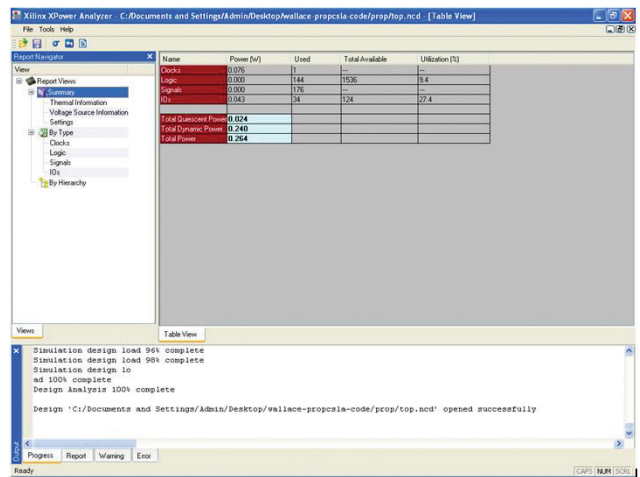


Figure 4: Power utilization of the proposed reduced Wallace tree multiplier

In the case of proposed reduced complexity Wallace multiplier with the help of modified group structures based SQRT CSLA. Delay and Power consumption of proposed reduced complexity Wallace multiplier are illustrated in Figure 3 and Figure 4 respectively.

Table 1: Comparison of both existing and proposed reduced complexity Wallace multiplier

Method	Delay (ns)	LUT	Power (me)
Existing Multiplier	15.879	165	288
Proposed reduced complexity Wallace Multiplier	21.440	144	264

CONCLUSION

In this work, the proposed reduced Wallace tree multiplier is designed efficiently regarding the VLSI design environment. The proposed multiplier is offered area and power reduction compare than the conventional method. This presented multiplier will be suitable for MAC implementation of digital FIR filter. In future, this proposed multiplier will be used in high-speed applications. The simulation of the proposed multiplier is done by using Modelsim XE, and the synthesis of the proposed work is carried out by using Xilinx ISE.

Ethical Clearance: Taken from AMET University.

Source of Funding: Self

Conflict of Interest: Nil

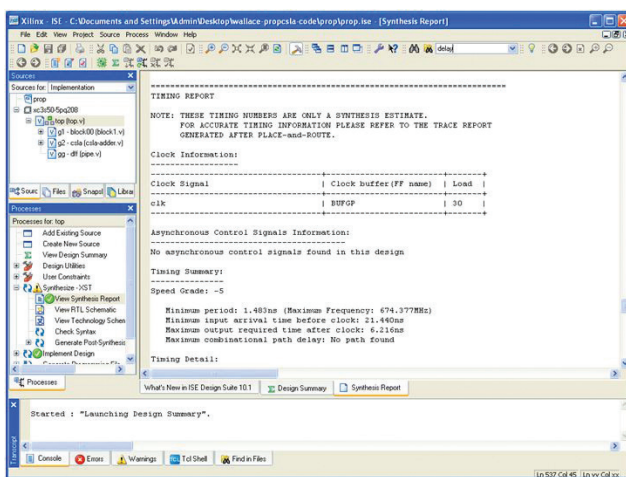


Figure 3: Timing report of the proposed reduced Wallace tree multiplier

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# Retroreflective Using Optical Communication

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## ABSTRACT

This article deals with visible light communication (VLC) based on retroreflective principle. Visible light communication presents great potential in terms of possible communication bandwidth, transmitter localization, spectral, power and spatial effectively and more. In the article, the retroreflective communication itself is introduced and compared to common VLC and RFID systems. Essential parts of power balance are mentioned and discussed. The last part of the article discusses benefits of retroreflective communication for Internet of Things.

**Keywords:** Internet of things, LiFi (Light Fidelity), optical wireless communication, retro reflection, visible light communication.

## INTRODUCTION

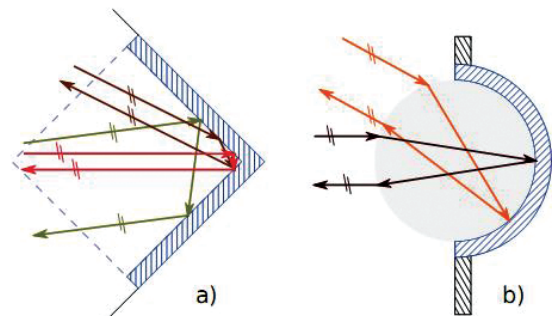
Internet of Things (IoT) is a network of smart embedded devices. Those devices could be either fully autonomous (sensors) or a part of more complicated systems. Its role on the market is growing stronger; Gartner predicts that the Internet of Things (IoT) [1] will include 26 billion units installed by 2020.

The role of Internet of Things is to enable remote access to everyday devices to control them, to read their identity, to harvest statistical or sensor data or to enable communication between each other. The trend is to connect as much devices as possible, to enable remote control above everything [2]. An example - smart home: indoor and outdoor temperature sensors and heating control are connected to the network, allowing remote control and monitoring, e.g. on vacation. A fridge can automatically send a message or even place an order when some food runs out[3].

The information transfer via optical communication system can be performed based on many different principles, each of them having various benefits, disadvantages and requirements. The common drawback is atmospheric attenuation caused especially by fogs and precipitation [4]. This attenuation causes serious limitation in range; many optical systems also presume line of sight operation. On the other side, some of known benefits are non-licensed operation and available bands [5], since so far commonly used radio bands (under 10 GHz) have become insufficient.

The great expansion of LEDs caused that most of today's light sources (indoor and outdoor lamps, car lamps, torches etc.) are based on that technology [3], making them much more energy-efficient and, for our purpose, well suitable for modulation and information transfer [6]. This assumption is utilized in VLC systems, e.g. LiFi (Light Fidelity). This article aims at point-to-multipoint optical wireless communication, with passive retroreflective transceiver.

**Retroreflectors:** An optical retroreflector, Figure 1, is object or device which reflects incident beam back to (and only to) the direction of the transmitter. The reflected beam is parallel to the incident one and shifted. Due to design imperfections, retro-reflectors cause small deviation and attenuation to the reflected beam. Retroreflectors are utilized in everyday devices around us in form of safety reflective materials used in automotive [4-5]. They are often used for aiming or ranging and can be also used for point to point or point to multipoint optical communication.



**Figure 1: Retroreflector: common shapes. (a) Corner-cube retroreflector, (b) Spherical retroreflector (cat's eye). The sphere is from material with higher refractivity index.**

**Retro Reflective Communication:** The active transceiver emits modulated optical beam, which is then detected by remote devices (passive transceivers)<sup>[6]</sup>. This direction is called downlink. The passive transceiver responds by modulating incident optical carrier either by letting the incident beam to hit the retroreflector and to bounce back (logical "1") or by masking the beam (logical "0"). The passive transceiver itself thus does not radiate any electromagnetic wave and can save a lot of energy. This principle is very similar to RFID systems<sup>[7]</sup>. The retroreflector which is able to modulate reflected beam is called modulated retroreflector (MRR). Channel Assignment in Ad-Hoc Network for allocating the channel for each user.

**Power Balance:** Equation shows simplified downlink power balance of retroreflective link. Stands for the power received on the passive receiver, is power transmitted by the transmitter. The crucial part of the power balance is propagation loss, which introduces losses caused by beam divergence and attenuation of the environment in Optimal Scheduling Based On Instance Niche. The path loss is dependent on the distance between transmitter and receiver and on the profile of the emitted beam. Those losses are related to the second power of the distance between transmitter and receiver. On receiver, the incident beam is also affected by receiving optical system (if present) and coupling to the photodiode, these contributions are summarized in Fuzzy C strange points clustering algorithm (can be negative).

$$P_{rxd} = P_{tx} - L_p - L_{rx} \text{ [dB]}$$

**Active Transceiver:** Active transceiver is assumed to be a device with line-of-sight route to remote devices and which is able to emit and detect light of appropriate intensities. The transceiver can work either as a static access point to the VLC network or as standalone mobile communicator. The device contains both fully featured VLC transmitter and receiver. In the uplink, the active transceiver is both the originator and the receiver of the light and controls the power margin of both directions of communication. The received beam intensity is at its lowest value and the quality and sensitivity of the receiver is thus fundamental. In the design of retroreflective VLC system, it is also essential that the active transceiver have sufficient area of coverage.

**Passive Transceiver:** The incident beam is processed in parallel both in the receiving and the transmitting circuit.

The sensitivity of the receiving circuit is not as crucial as for active transceiver since the incident beam is of higher intensity. Since the device itself does not emit anything, its power consumption can be very low, depending on the MRR modulation principle and digital processing front-end. By use of solar cells, the device can be even fully solar-powered. In battery less retroreflective tag is discussed. It is a matter of compromise between device power and size - small, simple devices, e.g. retroreflective identification tags will have low power consumption and the solar cell could be of small area whether smarter devices would require larger area of solar cells in vector machine and principle component analysis for IDS.

**Modulation Principles:** The passive transceiver modulates the backscattered carrier beam either by letting the beam reflect towards opposite transceiver or by causing beam extinction. Three methods for driven beam extinction are discussed: Mirror deflection, transmissive LCD display shutter and multiple quantum well modulator shutter.

**Retroreflective VLC in IOT:** Optical communication brings several ideas making IoT devices even more accessible. There are many devices around us, which can be used as an active transceiver without any hardware modification. Most nowadays smart phones contain a camera and a LED "flash", these are thus great adepts to take role of mobile active transceiver. In automotive, cars contain onboard camera to record the traffic in case of an accident or to control the matrix beam system, headlamps are moving to LED technology. This opens the door to VLC in car to car communication.

**Security:** With control and sensor devices being connected to the global network, one is exposed the risk of being attacked. By infiltrating the network, an attacker could either gain control.

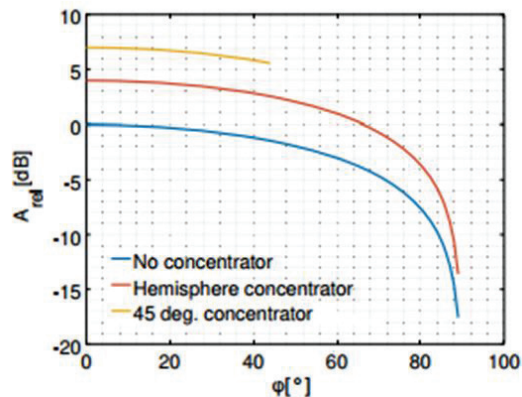
E.g. over the home automation or gather sensitive data and abuse them.

Since the visible light is well absorbed by opaque objects, its range is limited only to one room - which one the light was originated in. For sniffing this communication, the attacker is able to listen the downlink communication with visual contact with the active transceiver. In retro-reflective communication, the uplink channel is additionally narrowed, reducing the sniff able camera to narrow cone around the connecting line between the two communicating devices.

**Localization:** The active transceiver with matrix photo detection (camera) gains the ability to localize and distinguish opposite transmitters. This can extend augmented reality systems - just by opening the camera application on the smart phone, user could be for example able to read the state of charging of laptop by pointing the camera on it, Wi-Fi access points can share their SSID etc.

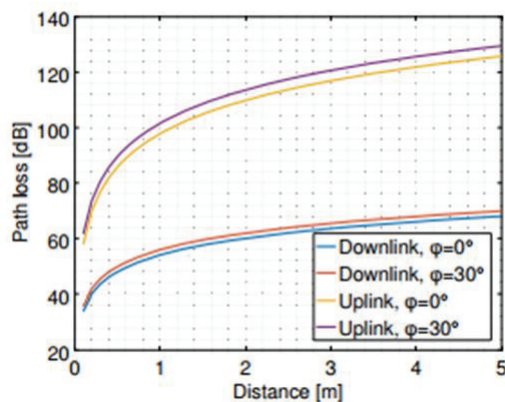
## RESULTS AND DISCUSSION

Figure 2 shows the relative effective area of the photo detector as a function of incident beam angle.



**Figure 2: Relative effective area of the photo detector as a function of angle between incident beam and the normal of the photo detector surface**

The shape of the concentrator is chosen depending on the angle of operation. It is preferable to utilize a high-gain narrow optics for - directional links. Links with wide angle of operation use hemisphere concentrator with 90 Degree. Retro reflective links for IoT are to be able to operate from wide angle, which is however limited by the operating angle of the retro reflector, not exceeding 90 degree.



**Figure 3: Path loss of the uplink and downlink channel for incident angle of 0 degrees and 30 degrees**

Figure 3 illustrates the simulation of path loss as a function of distance between the transmitter and the receiver for incident angles of 0 degrees and 30 degrees. The downlink is modelled by Lambertian beam (divergence of 60 degree), a photo detector with active surface of 5mm<sup>2</sup> and a glass hemispherical receiving optics with refractive index  $n=1.58$ . The path loss of uplink channel is a sum of path loss of downlink and ascendant path loss with reflected beam with divergence of 15 degree.

## CONCLUSION

The retroreflective optical communication is introduced and compared to common communication principles, with its benefits and disadvantages being discussed. The article shows possible system design of retroreflective communication link, including crucial parts of the power balance. The third section mentions importance of presence of receiving optics of photo detectors and an effect of its shape.

The retroreflective communication puts together spectral and spatial benefits of VLC communication and minimal power consumption of passive retroreflective transceivers, making them suitable for simple autonomous measuring devices and general IoT applications. It was shown that retroreflective communication suffers from significant path loss of the uplink channel. To ensure sufficient quality of the link, it is required either to mitigate the path loss by shortening the distance between communicating devices or by use of light source of high power. The last section highlights benefits of retroreflective communication for IoT upon common radio frequency systems.

**Ethical Clearance:** Taken from AMET University

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# Secondary Route Establishment for QoS Routing Using Genetic Algorithm Underwater Sensor Networks

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## ABSTRACT

Network topology changes frequently due to dynamic nature and leads to frequent link failures, reliability problem, also causes stability issues. To overcome the issues and to increase the link reliability various routing methods such as multi-path routing, on-demand routing and backup path routing are developed. A primary back up route establishment for QoS routing protocol is designed to detect the potential failures of nodes in the network. For detection of failures, a path evaluation function is determined based on the metrics energy drain rate and interference, congestion status are measured. Once failure is detected, back up routes are established and transmission is redirected on these back up routes. Simulation results show that the proposed protocol has reduced recovery delay and improved throughput as compared with the existing protocol.

**Keywords:** MANET, Round Trip Time (RTT), Multipath disjoint routing (MDR), QoS, Adhoc.

## INTRODUCTION

MANET is a self-ruling group of mobile systems that exchange information over bandwidth constrained wireless links. Network topology changes rapidly and randomly with time as the nodes are mobile <sup>[1]</sup>. The network is decentralized, where network activity such as discovering the topology and delivering messages are executed by the node themselves that means routing functionality has to be integrated in mobile nodes <sup>[2]</sup>. High mobility and frequent link failures in MANET infrastructure results in low throughput and high delay. Due to high demand of MANETs for transferring multimedia applications leads to the need to provide QoS support <sup>[3]</sup>. The characteristics of MANETs such as their dynamic topology coupled with the characteristic of the wireless communication medium make Quality of Service condition a complicated challenge <sup>[4]</sup>. In conventional routing, the objective of routing algorithm is to discover the least-cost path from source to destination. The primary objective is to locate the path that meet with QoS requirements called as possible paths. The instant aim is to optimize the overall network resource utilization hence QoS request as possible <sup>[5]</sup>. These two objectives effectively included to discover the best routing path for data communication.

## RELATED WORKS

A routing algorithm, called Load Balancing and Energy aware ARAMA (LBE-ARAMA) was proposed. This algorithm was based on Swarm Intelligence approach by using this minimum multipath disjoint routing (MDR) for load balancing and energy conservation was created. The Round Trip Time (RTT) delay is calculated along the path from source to destination. Canales et al. <sup>[6]</sup> have proposed a disseminated adaptive access control process based on a cross-layer QoS routing for estimating available bandwidth. They have urbanized an effective TDMA MAC etiquette which allows to carryout timely resource hesitation for point-to-point interactions. Then, a circulated admittance control based on the joint process of a modified Adhoc on demand distance vector with the TDMA MAC structure was proposed in order to guarantee QoS stipulation with a suitable adaptation to the unpredictability of MANETs. The shortcoming of this protocol is the unavailability of guaranteed bandwidth for new resources. Ya-li et al. <sup>[7]</sup> An improved Ant Colony-Based Multi-Constrained QoS Energy-Saving Routing Algorithm (AMQER) was proposed to improve the presentation of network in multi-controlled QoS routing based on the restricted node in sequence such as node tailback length, number of information packets forwarded and node remaining energy. To



diminish the average energy expenditure, the algorithm regulates the nodes transmit power energetically according to the dissimilar remoteness between two nodes. For the high network load and more complete network topology this method does not suits well. In [8], two schemes such as, AODV-ABR and AODV-ABL were urbanized to amplify the revision of routing protocols to topology changes by adjusting AODV-BR. However this method does not consider the QoS issues but one of the significant issues for the contemporary networks is the QoS. A multipath routing scheme is designed to offer better presentation and scalability by calculating numerous routes in a single route discovery. Also, it reduced the routing overhead by using resultant paths [9]. This method computes grouping of the node-disjoint path and fail-safe paths for numerous routes and make available all the relay nodes of the primary path with multiple path to destination. In sufficient security is the major drawback multipath routing scheme.

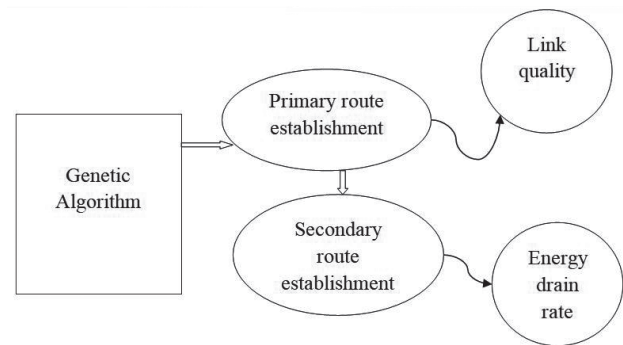
**Secondary Route Establishment for QoS Routing:** Secondary route establishment method for QoS routing protocol is proposed. Using genetic algorithm the primary path is selected by modifying the fitness function integrating node’s static resource capacity and link quality. Then, the backup or secondary path is established using the path evaluation utility considers energy drain rate [10]. Every relay node comes under primary path is validated using path evaluation function and the second path is established if any nodes are depleted based on the path evaluation function.

Bi-phase routing technique is established in this proposed method. Bi-phase routing contains primary route establishment and secondary route establishment. Genetic algorithm is applied to discover the primary route in the first phase so that the probable breakdown occurs in the primary path is detected. To overcome the primary route failure secondary or backup route is established and the data transmission over the primary route is redirected on these established secondary routes.

**Genetic Algorithm for Route Establishment:** GA is utilized to find the possible number of routing paths based on the link metrics. Population is initialised and fitness function for each path is calculated based upon node’s resource capacity and link quality. Crossover operator function is implemented to create new population and the fitness value is computed for all the population. The nodes with lowest fitness value are replaced with newly

generated nodes. By employing this method, QoS values on links gets maximised from source to destination and increasing the prospect for the path to assure the given QoS requirement.

**Secondary Path Selection by Path Evaluation:** The route failure is tested by the path evaluation utility to establish the secondary route which is chosen as a secondary path for the data session. Path evaluation presents the performance of route from source node to destination node and it is evaluated using the metrics energy drain rate and delay. Figure 1 explains systematic workflow of secondary route establishment for QoS routing



**Figure 1: Secondary route establishment for QoS routing**

**Energy Drain Rate:** Every node n monitors its energy consumption  $E_i$  utilised for data transmission, reception and overhearing actions and computes the energy drain rate ( $E_d$ ) by

$$E_d = (\text{current energy} - \text{initial energy})/\text{time} \quad \dots(1)$$

The residual energy present in the node is considered to be  $E_d$  and it is determined by the difference between the current energy and the previous energy of the exacting node.

**RESULT AND DISCUSSION**

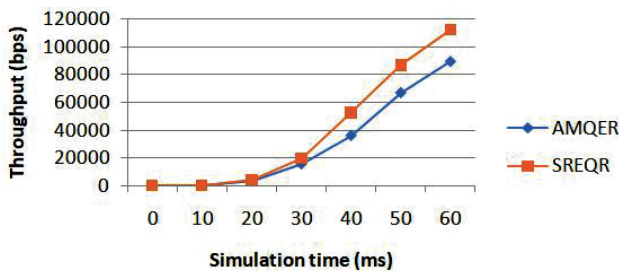
The nodes are dispersed in the simulation atmosphere and moves randomly according to its direction of motion. The nodes encompass to be configured as portable nodes by means of the node-config command in NS2. Network simulator is a distinct occurrence time driven simulator which is used to chiefly mold the network protocols. The simulation analysis is considered for existing system AMQER and the proposed system SREQR. The parameters used for proposed scheme SREQR simulation are tabulated below in Table 1.

**Table 1: Simulation Parameters**

Parameter	Value
Channel Type	Wireless Channel
Simulation Time	20 ms
Number of nodes	39
MAC type	802.11
Traffic model	CBR
Simulation Area	1000 × 1000
Transmission range	230m
Network interface Type	WirelessPhy
Mobility Model	Random Way Point

**Throughput:** The average successful transmissions delivered to the destination are defined as the throughput. Throughput estimation is done using equation 2,

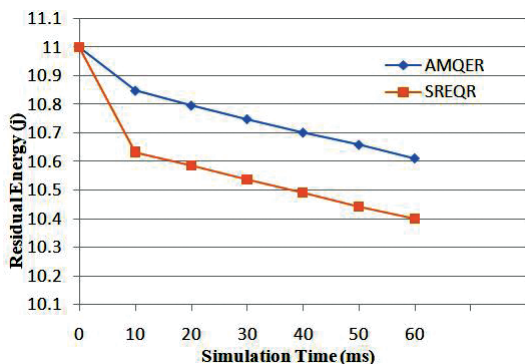
$$Throughput = \frac{\sum_0^n Pkts Rcvd * Pkt Size}{1000} \dots(2)$$



**Figure 2: Throughput**

Figure 2 shows that proposed scheme SREQR has greater average throughput when compared to the existing scheme AMQER.

**Energy Consumption Rate:** The amount of energy consumed by a node at the current instance of time is defined as energy consumption rate. Accuracy of outstanding energy gives the rate at which energy is consumed by the system operations. Figure 3 displays energy consumption rate.



**Figure 3: Energy Consumption Rate**

**CONCLUSION**

A primary back up route establishment for QoS routing protocol is designed to detect the potential failures of nodes in the network. For detection of failures, a path evaluation function is determined based on the metrics energy drain rate and congestion status. Back up routes are established once the failure is detected and the transmission is redirected on these back up routes or secondary routes. Simulation results show that the proposed protocol has reduced energy and improved throughput as compared with the existing protocol AMEQR.

**Ethical Clearance:** Taken from AMET committee

**Source of Funding:** Self

**Conflict of Interest:** Nil

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# A Comparative Study on Stigma toward Disability in Koreans

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## ABSTRACT

This study was conducted to investigate the stigma of parents who raise children with disabilities in Korean society. Also, the purpose of this study explores the degree of stigma of parents who raise children with disabilities and compare them with those of ordinary people. The statistical analysis results of the questionnaire that was conducted on a total of 283. The results of the study are as follows. There were 283 participants in the study. Parents who raise children with disabilities are 96. And there were 187 nursing students as general subjects. The mean of total stigma for the disabled was 80.32. The mean of stigma parents who raise children with disabilities was 90.81, the mean of stigma nursing students was 74.93. The mean analysis of the two groups showed significant difference and the parents group was higher ( $t=-6.378$ ,  $p=.000$ ). Therefore, nursing interventions should be provided to reduce the high level of stigma experienced by parents with a child with a disability.

**Keywords:** *Korean society, disability, stigma, parents who raise children with disabilities, nursing students.*

## INTRODUCTION

Living as the parents of disabled children in the Korean society is not easy. Based on the results presented in many previous studies targeting the parents of disabled children, they are reported to experience more difficulties than parents with normal children, due to various variables<sup>1</sup>.

A typical variable among the factors that the parents of disabled children experience is a negative social stigma. Social stigma negatively affecting the parents of disabled children is a social and psychological concept and a phenomenon of values based on changing social identity. Social stigma is correlated with emotions, recognitions, and behavioral responses, and is a complex concept of the cultural context and situational meanings like society's stereotype, values, and ideology. Social stigma is also the characteristics of situation affecting the meanings.<sup>2</sup> Therefore, there is a need to consider the effects of stigma shaped in the Korea's unique cultural area on the parents raising disabled children; especially, the parents of disabled children are analyzed to experience more pain, because of the cultural characteristics by the values putting importance on honor.<sup>3, 4, 5, 6, 7, 8, 9</sup>

According to Goffman (1963)<sup>10</sup>, stigma includes perception that people have on some attributes, attitudes with negative emotions, and resulting discriminations.

There can be disgust in deformity or defect due to disability, a stigma on mentally disabled people with individual defects, homosexuals, and criminals of undesirable characteristics, and a stigma due to race or nationality.

From the perspective above, the negative life experiences of the parents of disabled children can be predicted to have high correlations with the social stigma. In reality, pain due to negative social perception on the parents of disabled children is addressed repeatedly as important in many studies in the Korean society.

Such a phenomenon can be understood as modified stigma theory. Parents of disabled children learn perception on disabled people in the socialization process, and through which a series of belief in disabled people is formed.<sup>11</sup> When the children are diagnosed as the disabled, and stigma is shaped and internalized, due to the belief in disabled people, the parents experience a stigma, and feel they are also discriminated through the internalization process, or the parents lead a life in which the stigma is consolidated through such an experience. Consequently, a stigma is regarded as the most intolerable problem of pain that disabled children's mothers suffer<sup>5</sup>, and a stigma is reported to negatively affect mothers' caring activities.<sup>12</sup> Such a phenomenon can be explained by Goffman (1963) asserting that people close to those

who were stigmatic have a trait sharing such a stigma. Based on this, the parents of disabled children have a high possibility to experience a stigma at the level that disabled people experience in society. As a result, the stigma experienced by parents is projected to be a negative factor affecting parents' roles.<sup>10</sup>

Heatherton et al. (2000) reported that cognitive response to stigma can be changed by learning and experience, and the result plays an important role in behavioral responses.<sup>2</sup> According to them, those who experience such a stigma recognize society's negative stereotype, name tag, low evaluation, discrimination, and social rejection, and they isolate themselves from society and feel ashamed, due to the perception of such a social stigma, and negative identity including low dignity and depression is formed.<sup>13, 14</sup> In this regard, the stigma on disabled people is formed more strongly than other cultures, because Korea belongs to a cultural area having values putting importance on honor or face to others. Therefore, the pain of disabled children's parents in Korea is judged to be bigger than in other cultural areas.

Although studies on the parents of disabled children show such a result in reality, and many studies showed such a result repeatedly, it is difficult to find any study reporting concrete level of pain. In this regard, precise identification of specific pain level of the parents, who were stigmatic, is demanded for realistic intervention strategy development, and active intervention is required.

Stigma, a social concept, becomes different according to culture and era, and is an acquired concept from social interactions, rather than an innate concept. Therefore, attributes that can be modified, due to social effects exist<sup>15</sup>, and thus nursing intervention should be carried out. Consequently, intervention strategies that can reduce the stigma that those parents experience are required. This study aims to investigate the level of stigma on disabled people experienced by the parents of disabled children in the Korean cultural area, to comparatively analyze with previous studies on disabled people groups, and to build baseline data for intervention strategy development to reduce stigma targeting the parents of disabled children.

## MATERIALS AND METHOD

**Research Design & Model:** This study is a predicative study designed to explore the level of stigma on disabled

people of disabled children's parents, to compare with the stigma on disabled people experienced by nursing students, and to ascertain the differences.

**Subjects and Data Collection:** This study collected data from the disabled children's parents, who were the subjects of this study and who raised children diagnosed as having disabilities. The subjects to compare stigma values were the nursing students, who were enrolled in the Nursing Department of D college located in Daejeon. To collect data from the parents raising disabled children, I visited rehabilitation hospitals for children and special treatment facilities, explained the purpose and method of this study to the parents of disabled children and gained consents to participate in this study, after getting a permission from the facility heads. In this manner, data collection was carried out. The data collection period was from November 2013 to May 2014, and I collected data through a questionnaire survey. A total of 96 copies of the questionnaire responses were collected.

As for the data collection targeting nursing students, the purpose and method of this study were explained to the nursing students of Nursing Department at D college in Daejeon, and their consents to participate in this study were gained. Data were collected from 187 students who released their intentions to participate. Data collection period was October to November 2013. The participants in this study were 96 parents of disabled children and 187 nursing students, namely a total of 283 people participated in this study. All of their questionnaire answers were used for the data analysis.

**Statistical Method:** This study produced the participants' general characteristics using the SPSS. 19 program, and the stigma scores on disabled people were checked through independent t-tests.

**Survey Tools:** As for the tools used in this study, questions on the general characteristics of the participants and a stigma tool developed to measure stigma on disabled people were used.

**Stigma Tool:** The stigma tool used to measure the stigma that the parents of disabled children experience is PPS (perceived stigma scale) that was developed by Lee (2007) and used in a study of Jung and So (2008) on comparison of stigmas between disabled people and normal people. PPS consisted of 25 questions. The tool is also divided into devaluation (10 questions), avoidance

(6 questions), and discrimination (9 questions) as sub-factors. As a 6-point Likert scale, as the score is higher, perceived stigma tendency is higher, while the score is distributed from 25 points to 150 points. The Cronbach  $\alpha$  of the total tool was .95. The Cronbach  $\alpha$  of the devaluation, avoidance, and discrimination was .87, .81, and .86, respectively, in terms of reliability in each area.

## RESULT OF STUDY

**General Characteristics of Subjects:** The subjects of this study were 283 in total: 96 parents raising disabled children. By gender, mothers were 89 (87.3%) and

fathers were 7 (6.9%), and thus mother's participation rate was higher. Given that the place where the data of disabled children's parents were collected was rehabilitation treatment facilities, mothers were mainly in charge of rehabilitation treatment; therefore, mothers' participation rate was interpreted to be higher. 187 nursing students participated in this study: 16 were males (8.6%) and 171 were females (91.4%), and thus female students' ratio was higher. Concerning the distribution by grade, first year students were 48 (23%), second years students were 38 (20.3%), and third year students were 106 (56.7%); thus, the third year students' participation ratio was highest (Table 1).

**Table 1: General Characteristics of Study Patricians (N = 283)**

Subject	Characteristics	Categories	n	%
Parents	Gender	Male	7	6.9
		Female	89	87.3
Student	Gender	Male	16	8.6
		Female	171	91.4
	Grade	1 grade	43	23
		2 grade	38	20.3
		3 grade	106	56.7

**Stigma for the Disabled People:** As a result of participants' stigma analysis on the disabled people, the mean stigma score, standard deviation, maximum value, and minimum value of the total participants were 80.32, 21.17, 150, and 35, respectively. Regarding the stigma scores on disabled people by participant, the mean, standard deviation, maximum value, and minimum value were 90.81, 21.19, 150, and 35 in the group of the parents raising disabled children. Concerning the stigma score on disabled people of the group of nursing students, the mean, standard deviation, maximum value, and minimum value were 74.93, 19.08, 143, and 37, each (Table 2).

**Table 2: Stigma for the Disabled Persons (N = 283)**

Stigma	M $\pm$ SD	Max	Min
Stigma total	80.32 $\pm$ 21.17	150	35
Parent's stigma	90.81 $\pm$ 21.19	150	35
Student's stigma	74.93 $\pm$ 19.08	143	37

**Stigma sub-scale results:** The results of the analysis of the stigma sub-scale of the study participants are shown in (Table 3). Stigma sub-scale was higher in parent group.

**Table 3: Stigma sub factor (N = 283)**

Stigma	Devaluation M(SD)	Avoidance M(SD)	Discrimination M(SD)
Stigma total	33.37(8.61)	19.19(5.25)	27.75(8.08)
Parent's stigma	37.38(9.08)	21.78(5.04)	31.64(7.75)
Student's stigma	31.31(7.60)	17.86(4.86)	25.75(7.51)

**Comparison of Stigmas:** Significant differences in stigma scores were shown between the two groups (parents of disabled children and nursing students) according to the independent t-test results, and the parents' stigma was higher ( $t=-6.378$ ,  $p<.000$ ). Therefore, the stigma of parents raising disabled children on disabled people was more highly perceived than that of the nursing students, and significant differences were revealed between the two groups in terms of perceived stigma (Table 4).

**Table 4: Results of comparison Stigma (N = 283)**

Subject	Stigma	Levene's test	t (p)
	M $\pm$ SD	F (p)	
Parents	90.81 $\pm$ 21.19	1.495(.223)	-6.378* (.000)
Student	74.93 $\pm$ 19.08		

\* :  $p<0.01$

## CONCLUSION & DISCUSSION

This study was carried out to check social stigma level experienced by the parents raising disabled children and to compare the values with those of general group. The participants in this study were 96 parents of disabled children and 187 nursing students, namely they were 283 in total. As a result of data analysis on the stigma on disabled people, the stigma perceived by the parents of disabled children was significantly higher than that perceived by nursing students. Discussions were undertaken in comparison with existing studies based on the results of this study.

The stigma of disabled children's parents was analyzed as higher than that of general people, and such a result is interpreted as presenting the basis of the study results<sup>3, 5, 6</sup> related with stress on the social perception of disabled children's parents presented in existing previous studies. The disabled children's parents suffer from the negative perception and responses on disability, and this supports the previous study results<sup>7, 12</sup> reporting that such pain negatively affects child rearing and caring activities.

The mean stigma score of disabled children's parents was 90.81, and this results showed a similar score; namely mean stigma score 96.3 measured targeting physically disabled people in the previous studies using the same tool as used in this study was shown. In comparison with 88.93 points, the mean stigma score of physically disabled people, presented in the studies comparing stigmas between physically disabled people and normal people, normal people were confirmed to experience rather higher stigma than disabled people.<sup>15</sup> <sup>16</sup> Such a result means more than simply higher stigma of the parents of disabled children, and this supports the assertion of Goffman (1963)<sup>10</sup> that people close to those who experience a stigma share the stigma (1963)<sup>10</sup>, which is a meaningful result in understanding the parents of disabled children. In other words, parents raising disabled children experience higher social stigma than general people, due to children's disabilities, and they also can be analyzed to experience the stigma at the level that disabled people experience. It shows the result that disabled children's parents experience a stigma similar to the stigma level of disabled people, although their children are disabled people and they are normal people.

In conclusion, the parents of disabled children experience high level of social stigma experienced by disabled people, due to children's disability. As a result, their quality of life degrades, they experience depression,

and such a stigma is a stress factor alienating them socially. And, the stigma negatively affects the parents of disabled children.<sup>4, 5, 6, 7, 17</sup>

Based on the results of this study, disabled children's parents can be interpreted as experiencing and perceiving social stigma on negative social perception, avoidance, discrimination, and low evaluation on disability at the same level as their children experience, even though they do not have disabilities. Such a result is analyzed to reveal the basis supporting the results on the disabled children's parents' lives from negative perspective shown in the previous studies. Namely, understanding on the stress mentioned in the studies on disabled children's parents can be expanded, and intervention strategies to reduce social stigma level experienced by the parents of disabled people are important, and it should be essentially addressed.

The mean stigma score of nursing students as another group was 74.93, which was similar to the mean stigma score 76.3 on disabled people experienced by normal people revealed in previous studies, and thus it can be evaluated as the social stigma score of normal people in general.<sup>15</sup> As shown from the results above, the high stigma score of the parents who are not disabled people needs to be interpreted as a meaningful result. The social stigma on disabled people experienced by the parents of disabled people is a major variable negatively affecting their lives, and it should be addressed importantly in the intervention strategies.

Perception on disabled people in the Korean society still remains as a social issue, although many policies and systems have been adopted in view of cultural characteristics in which values putting importance on honor or face are dominant.<sup>9, 8, 19</sup> In this context, strategies considering Korean society's cultural characteristics are demanded in developing intervention strategies to reduce social stigma. Also, there is a need to develop specific strategies to reduce the stigma and apply them to disabled children's parents, through repetitive studies confirming negative effects of high level stigma experienced by the parents of disabled children.

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# The Effects of Family Support and Activities of Daily Living on Depression for Elderly Patients in Nursing Homes

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## ABSTRACT

The increase in prevalence of chronic diseases in the elderly population can lead to more elderly patients staying in nursing homes and patients being separated from their family which can result to patients experiencing depression for various reasons. This study aimed to identify the factors related to depression, family support, and activities of daily living (ADL) for elderly patients staying in nursing homes, according to the long-term care insurance system for the aged, and analyze the factors affecting depression.

For data collection, a survey using a structured questionnaire was conducted among 204 elderly patients staying in nursing homes by nurses trained in data collection over a month in 2016. Depression, family support, and ADL tools were used to collect data, which were then analyzed by using an SPSS 23.0 Window program.

Depression differed significantly by gender, age, education, and ADL. It was significantly and positively correlated with family support and had no correlation with ADL. The factor most significantly affecting depression was family support, followed by ADL, education, age, then gender.

The results of this study confirmed the need for customized nursing interventions to understand the burden for primary caregivers in a family and take family support into account because the higher the level of family support is, the lower the level of depression becomes. It is also necessary to work with governmental policies and community-connected service with the objective of lowering the level of depression for elderly patients, who need long-term care service, and of developing customized family support improvement programs.

**Keywords:** *elder, nursing home, family support, activity of daily living, depression*

## INTRODUCTION

The higher prevalence of chronic conditions, which has been caused by a rapid increase in the elderly population, leads to the need for long-term hospitalization, increases the financial burden of medical expenses for the people, and causes serious social problems. The clinical characteristics of geriatric diseases that require long-term hospitalization include depression, as well as many different symptoms. Concerns for the elderly in South Korea are mostly health problems and depression in the elderly population is becoming an important health problem, which leads to role loss and a dependent life<sup>1</sup>.

Depression for elderly patients staying in nursing homes has important implications in understanding depression for the elderly hospitalized for a long time on

the basis of their emotional, physical, and social conditions. In particular, it has been found that depression for the elderly is caused by physical conditions, increased chronic diseases, death of spouse and intimate ones, a sense of loss, a worsened economic situation, the level of social and family support, lack of self-control in daily living, etc<sup>2</sup>. Depression for the elderly is an important variable to measure psychological well-being for elderly patients and is significant enough to become one of the areas to be considered when assessing the general health status in old age and the quality of long-term care service necessary<sup>3,4</sup>.

A diversity of physical, emotional, and socio-psychological causes of depression are found in old age and this age group is characterized by the properties of depression as a physical symptom, contrary to the other age groups. This is because depression is expressed in

Asian cultures, including South Korea. Kanowski et al. (1994) indicates the possibility that depressive symptoms in the elderly can be neglected and that their depressive symptoms can easily be regarded as a normal course of aging. He also warns that failure to give good timely treatment can not only do damage to their mental well-being and increase the risk of other physical problems but can also lead to fatal results, including being a primary cause of suicide among the elderly population<sup>5, 6, 7</sup>.

Both as a unit that includes an elder provided with long-term care service and as a basic component of a social support system, *family* has been presented as a factor affecting the level of depression for the elderly provided with long-term care. It was reported that family support, which is a principal action that elderly patients feel from their family members, might be a factor to allow them to cope with risks and changes. It is necessary to help elderly patients use the support they personally perceive and lead a satisfactory life through positive interactions with family, friends, community residents, and neighbors so that they can lead a healthy life. A mechanism of helping them prevent exposure to the risk of depression in old age can function through social relationships; most of all, intimate family support based on relationships with parents or children can help prevent elderly patients from becoming depressed. Family support is negatively correlated with depression for elderly patients and a study on a sense of depression and family support for the elderly, with functional impairment indicated that family support was a variable significantly affecting depression. Considering the finding that a strong bond with family significantly affected depression in old age, two variables—depression and family support—are strongly correlated with each other and can be used as basic information sources in a clinically important way with the objective of assessing, planning, and evaluating nursing service for senior health.<sup>8</sup>

The elderly for long-term care are characterized by lowered quality of life, decrease in physical activity, getting tired easily, and complaint of physical pain. Functional loss of daily living for the elderly can be presented as an indicator to determine their health status.

However, most of the previous studies examined the associations with some variables for the elderly at home, senior citizen centers, and communities but no in-depth research has been conducted on the factors affecting depression for elderly patients staying in nursing

homes according to the coverage of the long-term care insurance system for the elderly, which was enforced by the government in July 2008, or on the factors affecting the associations among depression, family support, and ADL. Depression, family support, and ADL are significant factors that can affect the health of the elderly for long-term care. While depression in old age is on the rise and causes serious social problems, very few comprehensive studies have been conducted to identify the factors affecting depression, family support, and ADL among elderly patients for long-term care in South Korea. Depression among elderly patients who require long-term care service should be treated as a health problem with a diversity of complicated aspects; in this respect, efforts should be made to determine depression and family support for the elderly and analyze the factors affecting depression<sup>9, 10</sup>.

This study aimed to identify the factors related to depression, family support, and ADL among elderly patients staying in nursing homes according to the long-term care insurance system for the aged and analyze the factors affecting depression. It intended to determine general well-being status for elderly patients staying in nursing homes according to the long-term care insurance system for the aged and provide basic data necessary to develop customized long-term care service programs.

This study aimed to determine the level of such principal health variables as depression, family support, and ADL for institutionalized elderly patients and identify the factors affecting depression. The specific objectives are as follows:

- To determine the level of depression, family support, and ADL for institutionalized elderly patients
- To determine the associations among depression, family support, and ADL for institutionalized elderly patients' general characteristics
- To identify the factors affecting depression for institutionalized elderly patients

## MATERIALS AND METHOD

This is descriptive correlation research aimed at determining the associations among depression, family support, and ADL for institutionalized elderly patients and at identifying the factors affecting depression.

**Research Subjects and Data Collection:** This study was conducted among the elderly staying in nursing homes in Seoul and small and medium cities in Gyeonggi and Jeolla Provinces, which were randomly sampled. Data were collected from persons aged  $\geq 60$ , capable of verbal and nonverbal communication and able to complete a questionnaire or be interviewed, and who understood the purpose of the research and consented to participate in the research from October to November 2016.

The researcher and the trained nurses at each facility were asked to explain the purpose of the research to the institutionalized elderly patients and to collect data from them. Before the survey, the nurses at each facility were taught the data collection method, which involved an ethical issue for the elderly patients, and used a structured questionnaire to interview them personally. The frequency of using common words in each item among the data collectors was analyzed through a preliminary gathering to improve reliability among them and reliability was estimated at  $\geq 99\%$ , demonstrating reliable communication. 236 out of 250 questionnaires were returned and 204 (86.4%) copies were finally analyzed, with the exception of those reflecting inappropriate responses.

**TOOLS**

**Depression:** The Korean version of the short-form depression inventory for the aged, as developed by Kee (1996), was used to measure depression. This tool is composed of 15 items with  $\geq 0.6$  factor loading for factor analysis among 30 items in GDS-K. The total score is out of 15 in a dichotomous scale of Yes/No. For reliability, Cronbach’s  $\alpha$  was .88 at the time of its development and .90 in this study.

**Family Support:** The five-point scale with 11 items, as developed by Kang (1985), was used to measure family support; the higher the score, the higher the level of family support. For reliability, Cronbach’s  $\alpha$  was .89 at the time of its development and .91 in this study.

**Activity of Daily Living (ADL):** A three-point scale with 12 items for physical function evaluation in the long-term care certification examination table of the long-term care insurance system for the aged was used to measure ADL; the higher the score is, the higher the level of dependence in ADL. Cronbach’s  $\alpha$  was .85 in this study.

**Statistical Analysis:** The collected data were analyzed by using SPSS/WIN 23.0. The subjects’ general and health-related characteristics, depression, family support, and ADL were analyzed by using descriptive statistics. Depression, family support, and ADL by socio-demographic characteristics were analyzed by t-test and ANOVA and the correlations among depression, family support, and ADL were analyzed by Pearson Correlation Coefficient. Stepwise multiple regression was performed to identify the factors affecting depression.

**RESULTS AND DISCUSSION**

**Table 1: General Characteristics (N = 204)**

Variables	Characteristics	Frequency(%)
Gender	Female	140(68.6)
	Male	64(29.6)
Age	60-64	62(28.7)
	65-79	119(58.3)
	Over 80	23(10.6)
Religion	Protestant Christian	62(30.4)
	Catholic Christian	42(20.6)
	Buddhist	48(23.5)
	Won Buddhist	3(1.4)
	None	49(22.7)
Beds	1-3	36(16.7)
	Over 4	168(82.4)
Education level	No schooling	148(72.5)
	Elementary school	38(18.6)
	Middle school	11(5.4)
	$\geq$ high school	7(3.4)
Living together before of institutionalization	Alone	29(14.2)
	Children	137(67.2)
	Spouse	34(16.7)
	Others	4(1.9)
Decision for institutionalization	Self	28(13.7)
	Children	131(64.2)
	Spouse	41(20.1)
	Others	4(1.9)
depression	Normal	15(7.4)
	Mild	118(57.8)
	Severe	71(34.8)

**General Characteristics:** As for the subjects' general and health-related characteristics, 140 patients (68.6%) were female and 64 (31.4%) were male. The mean age was 68.5 years, ranging from 60 to  $\geq 80$  years. 51 patients (77.3%) were religious and 49 (22.7%) had no religion. The facilities had 1-3 beds per room for 36 patients (16.7%) and almost  $\geq 4$  beds per room for 168 (82.4%). 148 patients (72.5%) were at lower education levels than elementary school graduates, whereas 38 (18.6%) were elementary school graduates, 11 (5.4%) middle school graduates, and 7 (3.4%) high school graduates and at higher education levels.

Before institutionalization, 137 patients (67.2%) lived with their child, 34 (16.7%) with their spouse, and 29 (14.2%) alone. Institutionalization was decided by children for 131 patients (64.2%), by the spouse for 41 (20.1%), and by the patients themselves for 28 (13.7%). On the basis of 5 for the cutting point of the short-form depression inventory for the aged, 15 patients (7.4%) were normal, scoring  $< 5$ ; 118 (57.8%) were mildly depressed, scoring 5-9; and 71 (34.8%) were severely depressed, scoring  $\geq 10$  [Table 1].

**Table 2: Difference of Depression, Family support, ADL by characteristics**

Variables	Characteristics	Depression		Family Support		ADL	
		M $\pm$ SD	t/F	M $\pm$ SD	t/F	M $\pm$ SD	t/F
Gender	Female	3.7 $\pm$ 0.5	4.21*	2.9 $\pm$ 0.8	2.76	2.1 $\pm$ 0.2	0.24
	Male	3.6 $\pm$ 0.2		2.8 $\pm$ 0.7		1.9 $\pm$ 0.4	
Age	60 ~ 70(a)	3.1 $\pm$ 0.1	2.94* a, b<c	2.7 $\pm$ 0.4	1.81	1.9 $\pm$ 0.8	3.21
	70 ~ 80(b)	3.2 $\pm$ 0.4		2.6 $\pm$ 0.3		2.3 $\pm$ 0.2	
	over 75(c)	3.3 $\pm$ 0.5		2.8 $\pm$ 0.8		2.4 $\pm$ 0.5	
Religion	Yes	3.9 $\pm$ 0.2	0.81	2.7 $\pm$ 0.6	2.31	1.5 $\pm$ 0.5	0.38
	No	3.7 $\pm$ 0.3		3.7 $\pm$ 0.5		1.6 $\pm$ 0.6	
Beds	1-3	3.2 $\pm$ 0.2	1.46	2.9 $\pm$ 0.6	0.28	1.8 $\pm$ 0.6	1.26
	Over 4	3.3 $\pm$ 0.3		3.0 $\pm$ 0.5		3.0 $\pm$ 0.5	
Education level	No schooling	3.5 $\pm$ 0.1	0.94		2.58	1.1 $\pm$ 0.5	1.85
	Elementary school	3.5 $\pm$ 0.7		2.8 $\pm$ 0.3		1.2 $\pm$ 0.8	
	Middle school	3.4 $\pm$ 0.6		2.5 $\pm$ 0.5		1.3 $\pm$ 0.1	
	$\geq$ high school	3.1 $\pm$ 0.4		2.4 $\pm$ 0.8		1.4 $\pm$ 0.8	
Living together before of institutionalization	alone	3.5 $\pm$ 0.6	2.62	3.0 $\pm$ 0.5	1.07	2.3 $\pm$ 0.2	1.05
	Children	3.6 $\pm$ 0.7		3.1 $\pm$ 0.6		2.4 $\pm$ 0.9	
	Spouse	3.7 $\pm$ 0.5		3.0 $\pm$ 0.4		2.2 $\pm$ 0.6	
	Others	3.4 $\pm$ 0.4		2.9 $\pm$ 0.4		2.1 $\pm$ 0.2	
Decision for institutionalization	Self	3.5 $\pm$ 0.5	0.64	2.8 $\pm$ 0.5	1.86	2.0 $\pm$ 0.8	2.40
	Children	3.7 $\pm$ 0.2		3.0 $\pm$ 0.6		2.5 $\pm$ 0.6	
	Spouse	3.6 $\pm$ 0.8		2.9 $\pm$ 0.4		2.3 $\pm$ 0.2	
	Others	3.3 $\pm$ 0.3		2.7 $\pm$ 0.5		2.1 $\pm$ 0.4	

**Depression, Family Support, ADL by General and Health-related Characteristics:** They scored an average of 5.87 (0-15) for depression, which differed significantly by gender, age, education, and ADL among the general and health-related characteristics. Men were more likely to have depression affected by gender (F=4.21,  $p < .05$ ) than women were and depression differed significantly by age (F=2.94,  $p < .05$ ): 3.1 for

60-64 years, 3.2 for 65-79 years, and 3.3 for  $\geq 80$  years. Depression differed significantly by education (F=3.41,  $p < .05$ ): college graduates and those at higher education levels were more likely to become depressed than high school graduates and those at lower education levels were. Family support was at a level higher than normal, scoring an average of 3.42 (1-5). ADL scored an average of 2.14 (1-3) [Table 2].

**Correlation among Depression, Family Support, and ADL:** The correlation among their depression, family support, and ADL is as presented in Table 3. Depression was significantly and positively correlated with family support ( $r=.68, p=.001$ ) [Table 3].

**Table 3: Correlation Matrix among Depression, Family Support, ADL**

	Depression	Family Support	ADL
Depression			
Family Support	.68*		
ADL		.21	

**Factors Affecting Depression:** The results of the stepwise multiple regression analysis with depression as a dependent variable and family support and ADL and gender, age, and education, which made statistically significant differences, as independent variables are as presented in Table 4. The stepwise multiple regression analysis found that  $R^2$  in the entire regression model was .267 ( $F=2.484, p<.001$ ), with the measurement variables accounting for 27% of depression. Family support ( $\beta=1.576, R^2=.208$ ) had the most significant effect on depression, followed by ADL ( $\beta=.845, R^2=.109$ ), education ( $\beta=.359, R^2=.094$ ), age ( $\beta=.168, R^2=.089$ ), then gender ( $\beta=.091, R^2=.062$ ) [Table 4].

**Table 4: Influencing Factors on Depression**

variables	$\beta$	t	$R^2$	F(Sig)
Family Support	1.576	1.957	.208	.000
Gender	0.091	0.958	.062	.001
Age	0.168	1.295	.089	.001
Education level	0.359	1.273	.094	.000
ADL	0.845	1.918	.109	.000
$R^2=.267 F=2.484 p=.000$				

**CONCLUSION**

This study aimed to identify and analyze the factors related to depression, family support, and ADL among the elderly patients staying in nursing homes according to the long-term care insurance system for the aged. It intended to determine the general well-being status for elderly patients staying in nursing homes according to the long-term care insurance system for the aged and provide basic data necessary to develop customized long-term care service programs. The main results of this study can be summarized as follows:

First, depression differed significantly by age ( $F=2.94, p<.05$ ) and gender ( $F=4.21, p<.05$ ) among the subjects' general characteristics. Second, depression was significantly and positively correlated with family support ( $r=.42, p=.001$ ). Third, the multiple regression analysis performed to identify the factors affecting depression found that it had the explanatory power of 27% with the significant regression model ( $F=2.484, p<.001$ ). Family support had the most significant effect on depression, followed by ADL, education, age, then gender

These results confirmed the need for customized nursing interventions to understand the burden for primary caregivers in the family and take family support into account because the lower the level of depression is, the higher the level of family support. It is also necessary to work with governmental policies and community-connected service with the objective of lowering the level of depression among elderly patients, who need long-term care service, and of developing customized family support improvement programs.

On the basis of these results, the following suggestions can be made:

1. Since this study was conducted among 204 elderly patients staying in nursing homes in some regions, it is necessary to conduct repetitive research in a wider range of subjects.
2. It is necessary to determine the association between family support and depression by the levels of diverse family members in setting the variable of family support.

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# The Factors Affecting the Turnover Intention of Nurses at a Hospital

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## ABSTRACT

The ethical issues nurses forming  $\geq 40\%$  of the entire manpower at healthcare institutions experience and their emotional recognition can cause their burnout, which can lead to turnover. This study aimed to determine the associations of turnover intention, develop turnover intervention programs for hospital nurses, and provide basic data necessary to manage human resources efficiently. Data were collected from 154 nurses working at a single university hospital with the approval of the institutional review board over a month of May 2015. The data were collected by using tools to measure ethical situation, emotional recognition, and turnover intention and such data were analyzed through the SPSS 23.0 Window program. The nurses were at severe or higher levels of an ethical situation, emotional recognition, and turnover intention. Their turnover intention was positively correlated with negative therapeutic behavior, irrational organizational administration, and negative nursing behavior, lack of respect for patients' autonomy, excessive financial burden, or emotional recognition. The factor most significantly affecting turnover intention was emotional recognition. As nurses play more roles in healthcare practice, they experience an emotional state in which they have their decision-making emotionally controlled by emergency, ethical situations, and institutional pressure, which render them unable to control negative and distressful feelings. This situation places them at higher risk of turnover. It is therefore necessary to provide good manpower management, with the objective of preventing quantitative workload on nurses, and to develop intervention programs in pursuit of turnover prevention.

**Keywords:** turnover intention, ethical situation, emotional recognition, nurse

## INTRODUCTION

Nurses who have been responsible for respecting and protecting human rights and provided advanced practical nursing have recently been more likely to participate in important decision-making areas in healthcare practice due to the growth of advanced practical nursing and the expansion of their roles. Nursing manpower management forms a crucial part in managing healthcare institutions because nurses among human resources are professional manpower playing a central role in treating patients, along with doctors, rendering nursing manpower to significantly affect the organization of healthcare institutions<sup>1</sup>.

Nurses, forming 30-40% of manpower at healthcare institutions, are aware of what is right in a nursing situation, which involves ethical issues, but may

experience distress or psychological imbalance when they fail to pursue what is right due to some restrictions, such as a supervisor's objection, institutional policies, and legal considerations<sup>2</sup>. The ethical issues in clinical practice can not only have physical and psychological effects on individual nurses but also can lead to their absence and turnover, consequently exerting serious effects even on the hospital organization due to socio-economic loss: loss of work hours or financial loss and qualitative decline in patient nursing<sup>3,4</sup>.

Turnover occurs for diverse reasons and one of the issues in nursing practice is insufficient nursing manpower. The most important issues causing a high turnover rate are qualitative and quantitative changes in nursing<sup>5</sup>. These factors can lower the morale of the remaining nurses, increase their workload, and adversely affect patient nursing. The constant changes of employees

can lead to loss of work control, isolation, higher tendency toward negative thinking, and loss of energy and goals, resulting in loss of interest and motivation in occupation, drop in productivity, inflexibility, and adverse effects on colleagues. Although turnover behavior is not directly exposed, the existence of turnover intention can serve as a negative factor for an organization; thus, the analysis and management of turnover intention are more important to an organization than turnover management because employees with strong turnover intention cannot be loyal to their duties<sup>6,7,8</sup>.

It has been found that a will to make a turnover is significantly associated with turnover behavior and the most effective method for a nursing manager to cope with the turnover of nurses is to identify the factors for their turnover and cope with them positively since lack of nurses can ultimately cause moral distress and induce turnover and an increase in turnover can drop the quality of nursing, lower professional autonomy to provide the best nursing to patients, and increase moral distress in a vicious cycle<sup>9, 10</sup>. It is necessary to give much consideration to moral distress, which can cause nurses to become dissatisfied with their job, be strongly related with burnout, and cause them to leave their job. This study aimed to identify the factors affecting turnover intention, develop intervention programs in pursuit of turnover prevention among hospital nurses, and provide basic data necessary to manage human resources efficiently.

## MATERIALS AND METHOD

This study is a descriptive research aimed at investigating nurses' ethical situations, emotional recognition, and turnover intention at a single hospital and at identifying the factors affecting their turnover intention.

**Study Population and Sampling:** The sample consisted of 154 nurses working at H University Hospital in S City. G\*power based on the sample size estimation for multiple regression analysis was used to determine if the sample size was proper. As a result, it was found to be sufficient, compared with 111 persons with the .05 significance level for F-test, 90% testability, and the effect size of .15 (based on regression analysis).

## TOOLS

**Ethical Situation:** The moral distress inventory developed by Yu (2003) was used to measure an ethical situation in four areas—situational, cognitive, behavioral, and emotional—and the situational area was chosen according to the results of the factor analysis in Han (2012), with the tool revised and complemented. The area of an ethical situation with a total of 30 items refers to a nursing situation, which involves moral issues and has five areas: negative therapeutic behavior with 12 items, negative nursing behavior with 12 items, lack of respect for autonomy of patients with 4 items, excessive financial burden with 4 items, and irrational organizational administration with 3 items. It is a 5-point Likert scale, ranging from 1 (*totally disagree*) to 5 (*totally agree*), with a higher score meaning a higher level of an ethical situation. For reliability, Cronbach's  $\alpha$  of an ethical situation was .942 in Yu (2003) and .921 in this study.

**Emotional Recognition:** The moral distress inventory developed by Yu (2003) was used to measure emotional recognition in four areas—situational, cognitive, behavioral, and emotional—and the situational area was chosen according to the results of the factor analysis in Han (2012), with the tool revised and complemented. The area of emotional recognition is composed of 13 items in total, showing negative emotional responses. It is a 5-point Likert scale, ranging from 1 (*totally disagree*) to 5 (*totally agree*), with a higher score meaning a higher level of emotional recognition. For reliability, Cronbach's  $\alpha$  of emotional recognition was .904 in Yu (2003) and .907 in this study.

**Turnover Intention:** Turnover intention is the employees' intention to abandon their organizational membership and leave their current job and their thoughtful and considerate idea of leaving the organization (Tett & Meyer, 1993). The questionnaire Cheon (2005) applied to hotel employees was revised and complemented on the basis of content validity through the preliminary survey among five hospital nurses. For reliability, Cronbach's  $\alpha$  of turnover intention was .84 in Cheon (2005) and .83 in this study.

**Data Collection and Statistical Analysis:** To give ethical consideration to the respondents, the Institutional Review Board (IRB) of the researcher's hospital was given the plan concerning the purpose and progression of the research, and approval was obtained following deliberation (IRB No. 2013-03-22). The research was conducted from May 1 to 27, 2015. With the approval of the nursing department at the hospital, the researcher personally explained the purpose of the research, contents of the questionnaire, and method in making a



written consent to the department. The respondents were asked to complete a self-administered questionnaire personally, which took about 10-15 minutes to fill out. A total of 160 questionnaires were distributed; then, 154 copies were finally analyzed, with the exception of those with inappropriate answers. The collected data were statistically processed through the SPSS 23.0 Window program. The respondents' general characteristics, ethical situations, emotional recognition, and turnover intention were determined by using descriptive statistics, including the mean, standard deviation, and percentage. T-test and ANOVA were performed to determine the differences in ethical situations, emotional recognition, and turnover intention by the general characteristics. Pearson's Correlation Coefficient was estimated for correlation among ethical situations, emotional recognition, and turnover intention. Multiple regressions was used to analyze the factors affecting turnover intention.

## RESULTS AND DISCUSSION

**Differences in Ethical Situation, Emotional Recognition, and Turnover Intention by General Characteristics:** Age among their general characteristics scored  $2.48 \pm 0.43$  for an ethical situation; the university graduates and those at higher education levels ( $2.52 \pm 0.44$ ) scored slightly higher than the college graduates ( $2.45 \pm 0.43$ ). The religious respondents ( $2.45 \pm 0.44$ ) scored slightly lower than those with no religion, while the unmarried ( $3.84 \pm 0.12$ ) scored higher than the married. The respondents with <1 year of working career ( $2.28 \pm 0.43$ ) scored lowest and those with  $\geq 5$  years of working career ( $2.57 \pm 0.44$ ) scored highest. Having no advanced practical nursing experience scored  $2.44 \pm 0.40$  and having advanced practical nursing experience scored  $2.48 \pm 0.44$ ; those about to leave the job ( $2.50 \pm 0.43$ ) scored slightly higher. As for the motivation to choose a nursing college, to help others ( $2.50 \pm 0.40$ ) scored highest and to get employed after graduation ( $2.39 \pm 0.60$ ) scored lowest.

Age among their general characteristics scored  $3.50 \pm 0.55$  for emotional recognition; the university graduates and those at higher education levels ( $3.44 \pm 0.56$ ) scored slightly lower than the college graduates ( $3.54 \pm 0.54$ ). The religious respondents ( $3.53 \pm 0.55$ ) scored slightly higher than those with no religion, while the married ( $3.62 \pm 0.60$ ) scored higher than the unmarried. The respondents with <1 year of working career ( $3.62 \pm 0.42$ ) scored highest and those with 3-<5 years of working career ( $3.45 \pm 0.53$ ) scored lowest. Having no advanced practical nursing experience ( $3.56 \pm 0.35$ ) scored higher than having advanced practical nursing experience; the respondents about to leave the job ( $3.51 \pm 0.48$ ) scored insignificantly higher than those willing to be kept employed for a long time ( $3.50 \pm 0.60$ ). As for the motivation to choose a nursing college, to get employed after graduation ( $3.55 \pm 0.40$ ) scored highest and being recommended by family and acquaintances ( $3.48 \pm 0.52$ ) scored lowest.

Age among their general characteristics scored  $3.27 \pm 0.65$  for turnover intention; the university graduates and those at higher education levels ( $3.19 \pm 0.72$ ) scored lower than the college graduates ( $3.31 \pm 0.61$ ). The religious respondents ( $3.26 \pm 0.62$ ) scored insignificantly lower than those with no religion ( $3.27 \pm 0.69$ ), while the unmarried ( $3.28 \pm 0.65$ ) scored higher than the married. The respondents with 3-<5 years of working career ( $3.33 \pm 0.73$ ) scored highest and those with <1 year of working career ( $3.08 \pm 0.66$ ) scored lowest. Having no advanced practical nursing experience ( $3.12 \pm 0.61$ ) scored lower than having advanced practical nursing experience; the respondents about to leave the job ( $3.25 \pm 0.61$ ) scored lower than those willing to be kept employed for a long time ( $3.28 \pm 0.68$ ). As for the motivation to choose a nursing college, to get employed after graduation ( $3.80 \pm 0.74$ ) scored highest and being recommended by family and acquaintances ( $2.99 \pm 0.60$ ) scored lowest, showing statistically significant difference [Table 1].

**Table 1: Differences in the turnover intention and Ethical situation, emotional cognitive by General Characteristics**

Characteristic	Categories	Ethical situation		Emotional, cognitive		Turnover intention	
		Mean $\pm$ SD	t or F( $\rho$ )	Mean $\pm$ SD	t or F( $\rho$ )	Mean $\pm$ SD	t or F( $\rho$ )
Age	> <sup>a</sup> 25	2.43 $\pm$ 0.43	3.78(.025) *	3.54 $\pm$ 0.55	.8 98(.410)	3.28 $\pm$ 0.64	0.02(.980)
	26~30 > <sup>b</sup>	2.62 $\pm$ 0.45		3.44 $\pm$ 0.62		3.26 $\pm$ 0.71	
	31 < <sup>c</sup>	2.68 $\pm$ 0.43		3.63 $\pm$ 0.35		3.27 $\pm$ 0.65	
Education	Bachelor Bachelor' or higher	2.45 $\pm$ 0.43	-.944(.347)	3.54 $\pm$ 0.54	1.018(.310)	3.31 $\pm$ 0.61	1.049(.296)
		2.52 $\pm$ 0.44		3.44 $\pm$ 0.56		3.19 $\pm$ 0.72	

Conted...

Religion	Yes No	2.45±0.44 2.50±0.43	-.738(.462)	3.53±0.55 3.48±0.55	.552(.582)	3.26±0.62 3.27±0.69	-.127(.899)
Marital Status	Unmarried Married	3.84±0.12 3.71±0.04	-.175(.862)	3.50±0.55 3.62±0.60	-.673(.502)	3.28±0.65 3.10±0.67	.858(.392)
Total work (year)	> <sup>a</sup> 1yer 1-3yer > <sup>b</sup> 3-5yer > <sup>c</sup> < <sup>d</sup> 5yer	2.28±0.43 2.45±0.43 2.52±0.42 2.57±0.44	1.914(.130)	3.62±0.42 3.50±0.58 3.45±0.53 3.52±0.56	.369(.775)	3.08±0.66 3.31±0.66 3.33±0.73 3.20±0.53	.805(.493)
Nurse Practitioner	No Yes	2.44±0.40 2.48±0.44	-.426(.670)	3.56±0.35 3.49±0.58	.499(.618)	3.12±0.61 3.29±0.65	-1.197(.233)
Employment Period will	Will soon quit. Will carry for a long time.	2.50±0.43 2.46±0.44	.578(.564)	3.51±0.48 3.50±0.60	.122(.903)	3.25±0.61 3.28±0.68	-.329(.743)
Nursing Selection motives	The advice of friends and family To help others Guarantee of employment after graduation	2.46±0.46 2.50±0.40 2.39±0.60	.305(.737)	3.48±0.52 3.52±0.58 3.55±0.40	.125(.883)	2.99±0.60 3.41±0.60 3.80±0.74	11.591 (.000) **

**Level of Ethical Situation, Emotional Recognition, and Turnover Intention:** The respondents scored 2.53±0.44 out of 5 for an ethical situation, 3.50±0.55 for emotional recognition, and 3.27±0.65 for turnover intention. The area of an ethical situation scoring highest was negative nursing behavior (2.73±0.57), followed by negative therapeutic behavior (2.56±0.52), excessive financial burden (2.47±0.56), lack of respect for autonomy of patients (2.46±0.60), and irrational organizational administration (2.27±0.56) [Table 2].

**Table 2: Level of Ethical situation, emotional recognition, Turnover intention**

Variables	Mean	SD	Range
negative medical behavior	2.56	0.52	1.42-3.92
negative nursing behavior	2.73	0.57	1.29-4.29
lack of respect for autonomy of patients	2.46	0.60	1.00-3.75
excessive economic load	2.47	0.56	1.00-3.75
irrational organization administration	2.27	0.56	1.00-4.00
Total ethical situation	2.53	0.44	1.53-3.63
emotional recognition	3.50	0.55	1.77-4.69
turnover intention	3.27	0.65	1.40-5.00

**Correlation among Ethical Situation, Emotional Recognition, and Turnover Intention:** The level of the nurses' turnover was positively correlated with negative therapeutic behavior ( $r = 1.00$ ), irrational organizational

administration ( $r = .65$ ), negative nursing behavior ( $r = .64$ ), lack of respect for autonomy of patients ( $r = .62$ ), excessive financial burden ( $r = .58$ ), or emotional recognition ( $r = .26$ ) [Table 3].

**Table 3: Descriptive statistics and Pearson correlations among variable**

Variables	1 r(p)	2 r(p)	3 r(p)	4 r(p)	5 r(p)	6 r(p)	7 r(p)
1.Negative Care Act	1.000 (<.001)						
2.Negative Nursing care	.643(<.001)	1.000					
3.Patient autonomy Lack of respect	.621(<.001)	.679(<.001)	1.000				
4Heavy Economic burden	.583(<.001)	.518(<.001)	.625(<.001)	1.000			
5.Irrational Systemic administration	.656(<.001)	.598(<.001)	.646(<.001)	.579(<.001)	1.000		
6.emotional cognitive	.264(<.001)	.330(<.001)	.219(.006)	.208(.010)	.268(.001)	1.000	
7Turnover Intention	.292(<.001)	.239(.003)	.168(.038)	.095(.241)	.136(.093)	.402(<.001)	1.000

**Factor Affecting Turnover Intention:** The principal variables affecting turnover intention were significant (F= 2.227, p<0.05, p<0.001) and the explanatory power was estimated at .27. The factor most significantly and positively affecting turnover intention of the nurses was emotional recognition ( $\beta=.371$ ), followed by negative behavior ( $\beta=.378$ ). Irrational organizational administration ( $\beta=-.168$ ) and excessive financial burden ( $\beta=-.878$ ) negatively affected the turnover intention. The explanatory power was estimated at .16. The motivation to choose a nursing college ( $\beta=.153$ ) significantly and positively affected the turnover intention, while advanced practical nursing status ( $\beta=.093$ ) positively affected the turnover intention, with the explanatory power estimated at .04 [Table 4].

**Table 4: Results of hierarchical regression on Turnover Intention**

	Model 1		Model 2		Model 3	
	$\beta(p)$	t	$\beta(p)$	t	$\beta(p)$	t
Specialty nurse	.087(.295)	1.051	.073(.363)	.912	.093(.215)	1.246
Education	-.097(.408)	-.830	-.087(.296)	-1.049	-.039(.619)	-.499
Nursing Selection motives	.138(.097)	1.670	.152(.058)	1.911	.153(.042)	2.057*
Negative Care Act			.401(.001)	3.338**	.378(.001)	3.381**
Negative Nursing care			.117(.317)	1.005	.016(.885)	.145
Patient autonomy Lack of respect			-.031(.810)	-.241	-.008(.948)	-.066
Heavy Economic burden			-.083(.448)	-.761	-.089(.381)	-.878
Irrational Systemic administration			-.124(.286)	-1.070	-.168(.124)	-1.549
emotional cognitive					.371(.000)	4.748**
R <sup>2</sup>	.041		.162		.279	
Adjust R <sup>2</sup>	-.012		.084		.206	

## CONCLUSION

This study aimed to analyze the correlation among ethical situation, emotional recognition, and turnover intention that nurses experienced at a single hospital, along with the factors affecting the turnover intention, in order to provide basic data necessary to manage nursing manpower efficiently. The areas of an ethical situation and emotional recognition differed by age, education, marital status, and duration of being employed at a hospital. The finding that the nurses were more likely to experience an emotional recognition than an ethical situation implies that they are likely to have negative and distressful experiences due to the failure to behave ethically in an ethical situation or to change a situation. Negative therapeutic behavior and negative nursing behavior were among the sub-categories of an ethical situation scoring higher than the average in all the items and lack of respect for patients' autonomy, excessive financial burden, and irrational organizational administration scored lower than the average of all the items. It is therefore necessary to make a more intensive intervention on these concepts, which are less adjustable.

The factors most significantly affecting turnover intention was emotional recognition ( $\beta=.371$ ), which could account for 27% of the turnover intention. As nurses play more roles in healthcare practice, they experience an emotional state in which they have their decision-making emotionally controlled by emergency, ethical situation, and institutional pressure and are unable to control negative and distressful feelings due to a failure to change a situation. Therefore, hospital managers need to prevent quantitative workload on nurses and create a positive organizational atmosphere through good communication with other departments, as well as through good manpower management.

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# A Study of Specialized Personnel System for Long-term Care Insurance in Korea

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## ABSTRACT

Korea is expected to have a steady increase in the number of elderly people who are in need of care and special care such as dementia and stroke, as the number of aging population is increased. Therefore, to stabilize supply and demand of long-term care professionals and to improve the quality of long-term care services, it is imperative that measures are taken to train long-term care professionals and diversify the care personnel system. The purpose of this study is to propose a new qualification system for securing the expertise of long-term care professionals and young long-term care professionals in Korea. This study examines both Korean and German case studies on long-term care professionals, including related literatures, regulations and statistical data. It examines the situation of long-term care professionals and their education system in Korea, and also explores the system of long-term care worker and their training system in Germany. For the training of professional care personnel, it is necessary to classify long-term care worker into care worker manager as professional workforce and care worker. Care worker manager get national certifications when they successfully complete a care curriculum at college or university where professional education is available. For this purpose, long-term care-related curriculum for social worker, health and nurse care is opened. Their main tasks include the provisions of basic long-term care services as well as care service guidance for care worker, case managements and counseling support. The introduction of a professional care worker training system enables the provision of high-quality services through the acquisition of long-term care professionalism. They are required for the increasingly diverse and complex long-term care. Also, the divisions of long-term care tasks can help relieve the burden of long-term care workers and improve their treatment of labor. This specialization of the long-term care services can also contribute solving the current aging problem of the care workers by expanding the participation opportunity of the young people, and improving their negative images and treatments.

**Keywords:** *Long-term care insurance personnel, Care professionalism, Care worker education curriculum, Care worker, Professional Care worker*

## INTRODUCTION

The long-term care insurance for the elderly in Korea introduced in 2008, providing the necessary long-term care for the elderly who have difficulties in independent daily lives. 2016 about 520,000 beneficiaries, 7.5% of the elderly were receiving long-term care services. Not only the elderly but also their families were highly satisfied with the system. The qualification system for the care workers who are the main service providers of long-term care insurance had the effect to enhance the long-term care professionalism and service quality, and also social jobs created expanding employment opportunities. Care workers in Korea are certified national workers who were qualified through the training course. They belong

to long-term care institutions to provide long-term care recipients in nursing welfare facilities for the elderly with physical, mental, psychological, emotional, and social cares.<sup>1</sup> In Korea, it is anticipated that there will be steady increases in elderly people who need long-term care services due to aging, the number of elderly people who need special care such as dementia and stroke, and information and counseling requests related to long-term care. Therefore, in the future, the situation will become complicated and more professional workers will need this. At the same time, high care quality will be required. The care worker's expertise is more needed, because the rights of the beneficiaries to the care service were strengthened, the needs in the patient's care services were diversified according to the degree of physical and

mental condition due to aging. And care services at home and facilities are diversified, and improvement of ADL and quality of life in elderly are continuously needed.

According to the mid-to-long-term care worker in Korea, it is expected that about 330,000 people will be required in 2015, about 410,000 in 2020 and about 610,000 in 2030. By contrast, the number of care workers is projected to be 300,000 in 2015, 360,000 in 2020, and about 460,000 in 2030, and the number of care workers is estimated to be lacking by about 50,000 in 2020 and 150,000 in 2030. Therefore, it is time to discuss specialization and diversification of the care workforces along with the continuous expansion of long-term care professionals. In order to supply the necessary manpower in the early stage of the long-term care insurance system, just basic long-term care education was needed to qualify the care workers. As a result, problems are raised including inexperienced care personnel, quality of care service, and low social treatment for care workers. Therefore, it is necessary to nurture care workers with professionalism and to have a variety of care personnel system. In Germany and Japan where the long-term care insurance system was introduced as the social insurance, they also recognized the provision of professional long-term care services and quality assurance as important institutional tasks. To this end, efforts are made to improve the education system and ensure appropriate treatment for the care personnel to supply them with expertise, while they regularly evaluate and publicize the facilities.<sup>2</sup>

However in Korea, care workers provided with care services focusing on basic physical care and housework support despite the diverse and complex needs of

recipients due to lack of expertise. In fact, there is a limitation to provide appropriate responses and quality services due to the characteristics of special recipients such as dementia and stroke patients. Therefore, in order to stabilize the supply and demand of human resources for long-term care professionals, to respond to the changing needs of consumers, and to improve the quality of care services, there are needs to diversify care personnel according to their professionalism and to nurture professionalism of long-term care services. The primary purpose of long-term care insurance is to provide quality care services for the recipient. However, the present care worker training process is 240 hours of theoretical and practical training, so it is difficult to expect the professional worker to secure the expertise and provide quality service. As a result, the social treatment for them is low and with the image deterioration, job preference for the care profession is low, and as younger workers hardly enter, the aging of long-term care professionals is intensifying. The purpose of this study is to examine the current status, role and educational system of long-term care workers in Korea and Germany and to propose a new qualification system for securing the professionalism of long-term care worker and securing young long-term care professionals.

**Long Term Care Worker System in Korean:** As shown in Table 1, about 310,000 care workers worked in the long-term care facilities 2016 in Korea, and accounted for 91% of the total long-term care workforces, which was a major workforce in the long-term care system.<sup>3</sup> Among them, 60,000 (17.1%) were found in 5,187 care facilities and 260,000 (82.9%) were working in 14,211 in-home facilities, indicating that a considerable number of care workers were engaged in in-home facilities.

**Table 1: Long-term care manpower in Korea (in: person, %)**

	2012	2013	2014	2015	2016
<b>Social worker</b>	6,751	7,506	11,298	13,923	14,682 (4.3)
<b>Doctor, nurse</b>	3,877	3,860	4,007	4,134	4,358 (1.3)
<b>Nursing assistant/ dental hygienist/ physical therapist</b>	8,293	9,296	10,059	11,055	11,059 (3.2)
<b>Care worker</b>	233,459	252,663	266,538	294,788	313,013 (90.9)
<b>Nutritionist</b>	835	918	987	1,046	1,130 (0.3)

Long-term Care workers in Korea are major care service workers with national certifications, but in practice, they are primarily engaged in simple physical activities and housework support. Therefore, they cannot work as practical care manager, and the responsible person, the responsibility for the adequacy and effectiveness of the service. The care workers mainly provide tailored services by the subject's situation based on the standard long-term care plan. Care plan preparation, service delivery planning and coordination of long-term care services are carried out by in-house facility representatives and the staff, but they are also hardly agreed as professional workforce. The main aims of care services are self-realization and individuality, including the dignity of care needs and self-reliant life support. Therefore, care services aim to improve quality of life including daily living services, disease management and maintenance, emotional and psychological problems, rather than to provide medical services. However, the Korean care worker training system is limited to basic care services and ADL support focused education.

**Care worker education system:** In order to become a care worker, one must complete the standard curriculum for the care worker at the designated institution and pass the national qualification examination. The qualification examination consists of written and practical exercises, and one must score 60% or more in each. There is no limitation to become a care worker on the age and the academic ability. A large number of students are in their 40s or older, and the average level of education is middle school graduation. Therefore, it is difficult to provide professional long-term care education in the practice. Currently, 240 hours of curriculum for care workers consists of 80 hours of theory and 160 hours of practical training (80 hours of practical training and 80 hours of practicum). And the passing rate of the qualification exam for care workers was about 80 - 89% from 2010 to 2016. There are 1.41 million care workers who have been certified by 2016, of which about 310,000 (22%) are working in the long-term care settings, which is a lower percentage of active care workers. It is difficult to guarantee the professionalism in the long-term care worker education when the education quality difference between the education institutions occurs due to the cultivation of civilian-oriented manpower and the passing rate of 240 hours education and qualification examination is over 80%. Therefore, it is difficult to

provide care services corresponding to the professional and diverse care needs under the current education system. Hence, it is necessary to make an overall improvement in the curriculum and to improve the quality of the training institutions.

In addition to the current care worker education centers, the curriculum related to nursing and care should be added to that of the institutions such as specialized high schools, colleges, and universities, providing young students with the opportunity to be interested about care and to engage in care worker education. This promotes the influx of young people, and at the same time, the quality of the care curriculum should be ensured.

**Main activities of care worker:** In long-term care insurance the main care services at home are physical activity support, cognitive activity support, emotional support, housework and daily life support. In fact, the services provided by care workers are mainly focused on unspecialized basic physical support activities such as walking assistance, toilet use assistance, regular meals, brushing, housework and daily life support. Although it is necessary to provide with professional services to maintain and strengthen survivability as well as daily life support to improve the quality of life of the recipient, the reason why it is difficult to provide is that the average age of care workers is 56 years old with the majority of people being under high school graduates, implicating the limitation in learning and acquiring professionalism. The present care worker training system is not sufficient for the care workers to provide quality long-term care services. The care worker education system in Korea is similar to the home helpers in Japan and the care assistants in Germany in terms of education time and entrance qualification. Japanese home helpers and German care helpers are receiving low wages and social appraisals, and Korean care workers are also experiencing the same.<sup>4</sup>

## PROBLEMS

A major problem with care workers in Korea is lack of expertise in providing care services. As a result, the decline in care professions and low-wage has actually weakened the influx of young people and has turned it into an elderly centered occupation. To solve these problems, it is necessary to prepare a care worker training system with care expertise and to improve treatments. Then long-term care job should be recognized as an

attractive occupation. This can be achieved by the new educational system that enables professional care. Only care workers can provide all the various care services, but in fact, care services are offered mainly in the basic care support with low expertise. So, the professional care worker who receives care training in collage etc. can in the other hand provide specialized care services.

**Long Term Care Worker System in Germany:** German long-term care insurance, which was implemented in 1995 as a social insurance, promotes the development of care insurance through continuous care insurance reform. Especially in 2003, the elderly care job law<sup>5</sup> was enacted to train a dedicated elderly care worker and diversify the care worker by introducing a care supporting worker.

**System and tasks of care workers:** Care workers in Germany are normally divided into professional workforce and helper. Care professional worker should have two years of practical work experiences within the last 5 years with qualifications as elderly care specialist, health and nursing care specialist, or health and pediatric nursing care specialist. Also, responsible care professional workforce should successfully complete over 460 hours of refresher training to take role as a senior in the professional workforce.<sup>6</sup>

**Elderly care worker:** The elderly care specialist is eligible if he/she has completed a three-year care curriculum based on the elderly care profession law and passed a national examination. They can care for or take care of the subject at home and admission facilities. Also, they can also work in rehabilitation institutions, children's hospitals, elderly hospitals, or work independently. They have care-related, psychological, and social expertise and carry out care/psychiatric care as well as therapeutic care in cooperation with other disciplines in the field. They should also be capable of creating care plans and preparing service delivery records.

**Health and nursing care worker:** They are professional careers in the healthcare sector and should pass a three-year curriculum and test at a national accreditation body. In addition to the nursing service and physician assistance in accordance with the physician's instructions, they provide care, observation, caretaking, counseling, preparation of the recording paper, and evaluation of care to the patient or caretaker in the long-term care area.

**Care worker and nursing worker helper:** Care worker helper supports care professional worker at home,

admission facilities, and in hospitals. Under supervision and direction of care professional worker, they perform tasks such as physical care and meal assistance. They also support the daily life of the beneficiaries. The training curriculum is one year, and 700-750 hours of theoretical and practical training with 900 hours of practicum at the nationally recognized care school, and they should pass the national examination.

**Care supporting helper:** The care supporting helper was introduced in 2008 with the reform of the long-term care insurance law to compensate the shortage of long-term care workers and to improve care support of residents. They are particularly engaged in dementia-related abilities, psychiatric disorders or care for psychiatric patients. The curriculum is 4-6 months, consisting of basic practicum (5 days), care support training (100 hours basic course and 2 week care support practicum), 60 hours advanced course. The main task is to support and accompany daily activities for dementia patients in the admission facilities.

Workers in the in-home services facility vary from elderly care worker, health and nursing worker, nursing care helper, and other vocational education graduates. They carry out tasks in accordance with their roles in relation to care as well as basic care tasks. In the in-home services facility, elderly care worker, professional workforce health specialists and personal support workers account for 47% of the total workforce.<sup>7</sup> They are primarily responsible for basic care, followed by guidance for care services. In addition, vocational training for graduates is mainly responsible for housework, administration, and other tasks with low professionalism. The age structure of the workforce in the in-home area is 16% under the age of 30, 48% in the age group of 30-49 and 36% over 50, where the ratio of middle-aged people is high and the percentage of young people under 30 is very low, so that the aging of the workforce is the problem of the manpower structure.<sup>8</sup>

**Professional care worker training system:** The German professional care workforce consists of elderly care worker, nursing care worker and pediatric care worker. This study will focus on the elderly care worker training system. In August 2003, the elderly care job law was enacted and the first unified elderly care education was provided in Germany. With this law, the quality standards of national elderly care education have been laid out, laying the foundation for quality assurance in



long-term care services. It is possible to provide a high level of care service in care facilities. The number of students participating in elderly care education increased by 31% from the previous year to 68,000 at the end of 2015. About 55% of trainees are under 25 years old, about 80% are women and the majority are high school graduates. In addition, the preference for care work and the social recognition are gradually increasing with the strengthening of entrance qualification and the enhanced career education.

**Eligibility and training content:** Care education school entry conditions are vocational high school graduates or equivalent graduates. General high school graduates must have at least two years of vocational education or elderly care helper and nursing helper education. The training period is for three years, and it is conducted with theoretical and practical instruction, and practicum. Theoretical and practical lessons are over 2,100 hours, and there are five major areas including long-term care services, elderly care areas, mental and nervous system damaged elderly care areas, daily life support areas, and occupational self-concept areas. If they normally complete the course, they will receive an annual certificate of education.<sup>9</sup>

**Practicum training:** To strengthen elderly care worker's care expertise, it especially emphasizes hands-on training and focuses on achieving the broad basic qualifications required in the care profession. Practicum training is over 2,500 hours, of which at least 2,000 hours should be practiced at nursing homes, admission facilities and home facilities. In addition, it should be practiced in psychotherapy facilities, geriatric rehabilitation facilities, and public elderly care facilities. For this, the students and the training facility sign a practical training contract.

Also, based on the care professional career required in the care job, it is possible to deepen care expertise through re-education and maintenance education that is fit for the beneficiaries and institutions with special needs.<sup>10</sup> It is possible to strengthen expertise in the fields such as

- In-home and facilities care, supporting, geriatric care, and mental impairment care,
- Joint care, home specialized care, care difficult to institutionalize and
- Beneficiaries management, care management, etc.

## IMPLICATIONS

Germany is also continuing its support and efforts to strengthen the care professional workforce and its expertise in relation to the care workforce. First, diversification of long-term care workers enables strengthening of professionalism and alleviation of work burden through division of care services. Second, since 2003, a professional care workforce training system was implemented to nurture professional elderly care personnel nationwide and strengthen support for students. Since 1990, students from colleges and universities have the opportunity to have professional care qualities centered on elderly care management, care education, and care studies in the curriculum. By strengthening professionalism of such care professions and admission qualification, inflow of young manpower and reliability of care profession are increased, and it is emerging as the promising career group in the future.

**A Proposal of Professional Long-term Care Worker Training System:** As long-term care becomes an important social theme as the population ages, the demands for care workforce in nursing homes and home care facilities are steadily increasing. In Germany, jobs in the health and social welfare sectors are increasing, such as elderly care workers, social workers, nurses, counselors, and physiotherapists. Also in Korea, long-term care will become an important social service in the future and the need for long-term care for people with diseases such as dementia and stroke increases. However, the aging of care workers with lack of expertise in long-term care insurance is the reality in present day. Therefore, for the development of long-term care insurance, it is necessary to propose a positive working condition of long-term care, and care professional improvement is needed. For this, it is required to prepare long-term care needs, improve the image of long-term care job and improve it as a promising career force to attract young people.

In Germany with elderly care job law in 2003, care job was recognized as a health professional job or 'another treatment professional job'. In addition, it has been possible to improve the quality of care practicum and to increase the preference for the care job. In particular, expertise and care response skills are required to improve complexity, often difficult care situations and social environments of people in need of care. In order to improve the quality of life and professional services in

the care recipients, it is necessary to provide a curriculum that covers care services, disease management, and daily living support. For professional care worker training, in addition to the current care worker system, it is necessary to nurture professional workforce in the tertiary education curriculum to divide into care worker and care worker manager, and to improve professionalism and efficiency of care services.

Various training courses and practicum should be done to nurture care worker manager, who as a new professional care worker in long-term care in this study proposed is. And clarification of care work and improvement of treatment of labor based on professionalism and experience must be also guaranteed.

Care worker manager qualification should be granted with successful completion of a curriculum at the college or university where professional education is available. Curriculum for care worker manager should be added to the curriculum of social welfare, nursing, physiotherapy, etc. As shown in table 2, total training time should be 1,140 hours, 900 hours of theory, 240 hours of practical training, with theoretical classes 450 hours of 10 courses related to qualifications of the major, 450 hours of 10 courses related to long-term care including health and nursing fields, totaling 900 hours, and if 240 hours out of 120 hours of major practical training and 120 hours of long-term care training are completed, qualification should be granted.

**Table 2: professional long-term care worker curriculum in college and university (ex.)**

Long-term care curriculum in department of social welfare		Training time
Certificate subject for social worker (10 subject)	Introduction of social welfare, Social politics etc.	450 (45/subject)
Basic subject for long-term care (4 subject)	Long-term Care Insurance, Elderly welfare, Elderly health science, Elderly dietetics	180 (45/subject)
Advanced subject for long-term care (6 subject)	Long-term Care Skills I and II, Care Management, Elderly counseling, Dementia and hospice, Program Development and Evaluation for the Elderly	270 (45/subject)
practicum (2)	Practicum in social welfare institution Practicum in long-term care institution	240 (120/course)
total		1,140

Responsibility for care activities should include not only care service but also the service results and evaluation. Active care activities include care planning, preparation, implementation, documentation of results, and evaluation. These tasks should be addressed in practical training along with the theory.<sup>11</sup> Therefore, it is designed to enable to prepare for actual care situation in field practicum.

**Table 3: proposed care worker system in Korea**

	Care worker manager (new)	Care worker
Educational institution	Collage, university	Permitted educational institution
Educational course	2 – 4 years Theory 900 hours, practicum 240 hours National qualification	Theory 6 weeks/160 hours Practicum 10 days/80 hours National qualification
Main tasks	Long-term care responsibility and management (care service, care plan, case management, counseling etc.)	Basic care services and care worker manager assistant

The qualification of care worker manager should focus on strengthening practical skills and experiences such as case management and counseling through theoretical education and active care. This is highly

relevant to care professionalism. Therefore, as shown table 3, the care worker manager must complete the long-term care-related courses in the collage and have practical experience in long-term care institutions for

more than two years to qualify. In this case, it is possible to manage complicated needs and team activities that meet the basic characteristics of long-term care, and to carry out various academic-based care manager activities. Their main tasks include providing basic care services, as well as specialized areas such as care service guidance, case management and counseling.

### CONCLUSION

The steady increase of elderly people cause the general care need and special care such as dementia and stroke in Korea. Therefore, to stabilize supply and demand of long-term care professionals and to improve the quality of long-term care services, it is imperative that measures are taken to train long-term care professionals and diversify the care personnel system. For the training of professional care personnel, it is necessary to classify long-term care worker into care worker manager as professional workforce and care worker. Care worker manager get national certifications when they successfully complete a care curriculum at college or university. Their main tasks include the provisions of basic long-term care services as well as care service guidance for care worker, case managements and counseling support. The introduction of a professional care worker training system enables the provision of high-quality services and solves the aging problem of the care workers by expanding the participation opportunity of the young people, and also improves the negative images and treatments.

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# Pet Medical Consultation Service Business Model and Platform Case Study-Based on a Business Model Canvas

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## ABSTRACT

Due to the high growth of items and businesses related to pets (along with the segmentation of the related market), there has been an active increase of startups entering the market. With this in mind, this study has selected Company A as a sample study, and based on a business model canvas relating to the pet medical consultation service, examines each compositional element, whilst suggesting a relevant platform for the business model. For late-developing startups participating in this growing market, it has proven relatively easy to satisfy them in terms of partial success in the market, however there is a necessity for the elaboration of both the business model and niche market development in order to construct a continuous growth base and retain a competitive edge. There should be both tactical support and the financial support of business model compositional elements such as: target customers, value propositions, customer relationships, key resources, key activities, expenses, and profit structure. By using an app, Business A offers an online medical consultation service which serves to re-establish the business platform by resetting elements (such as: business model analysis results, customer segmentation, value propositions, key activities, and customer relationships), which serves to provide a differential competitive edge. As an analysis tool for comprehending the overall business elements and tactical direction, the business model canvas is able to confirm whether the business model in question is significant/important to a startup business.

**Keywords:** *Business Model Canvas, Business Platform, Pet, Medical Consultation Service, App*

## INTRODUCTION

The pet-related market has been growing year by year. Of the total number of households in Korea, around 30.9% (5.9 million households) were raising a pet in 2017, and the market scale saw figures of 1.8 trillion Won in 2015, 2.9 trillion Won in 2017, and has projected a yearly growth of 26.3% to 5.8 trillion Won in 2020<sup>1</sup>. Of the total number of households in the USA, around 67.2% were raising a pet (84.6 million households) in 2016, and the market scale predicted figures of 69.4 billion Dollars in 2017, and of the total number of households in Japan, around 24.1% were raising a pet (13.44 million households) in 2016, and the market scale predicted figures of 1.5 trillion Yen in 2017<sup>2</sup>.

As mentioned above, pet-related market is rapidly growing, and is segmented into the following areas: veterinarian treatment, animal food, animal products, healthcare, health insurance, hair salons, cafes, kindergartens, funerals, fashion, and others. Along with this market expansion, the pet-related market

has produced ‘smart’, ‘well-being’, and ‘premium’ trends, along with introducing various products and services. There is a necessity for a competitive edge and differentiation of various business resources alongside the rapid growth of the pet-related market. For the creation of successful business performance and the expansion of a competitive edge in the opportunistic and intimidating market, business models and platforms should be constructed.

In relation to business models, Timmers stated that: “all businesses and business people, and their roles, which include products, services, and the structure of ‘the information flow’, receive potential benefits and are the root of profit”<sup>3</sup>. Johnson defines a business model in terms of customer values, profit formula, key resources, and key processes<sup>4</sup>. Osterwalder and Pigneur presented an analysis tool called the ‘business model canvas’, which is composed of 9 elements<sup>5</sup>. There are various definitions of what a business model is according to the model’s compositional elements and perspective of the study, and it is a method and service for creating profit

for the customer. A good business model should reflect business theory (and related technology), along with the characteristics of the digital economy. Additionally, it should consider the ‘business household’ and potential risks for companies implementing the model, and the competency of the company<sup>6</sup>. With this in mind, this study suggests the establishment of a company platform and business model strategy for Company A, which is promoting a pet medical service implementing a business model canvas, a widely used startup business model.

**MATERIALS AND METHOD**

Market Conditions of the Pet Medical Service

**Pets and Animal Hospitals:** Along with the personification<sup>7</sup> of pets as ‘family members’, the culture of pet health care, which has been receiving a lot of interest in terms of pet medical examinations/checkups and treatment, has been developing. Various ‘care service’ items for pet health are being released, such as ICT, insurance, and medical/health care devices. Pet registration, which began in 2008, has been obligatory in Korea from 2014. For pet registration, there are 3

methods: embedded microchips, external chips, and pet tag, and unregistered pet owners are subject to a set fine. In 2017 there were around 1.07 million registered pets, a figure which is increasing every year, and around 50-60% of pets are estimated to be registered(as shown in Table 1).

**Table 1: State of Pet Registration in Korea (Unit: thousand)**

	2013	2014	2016	2017	CAGR(%)
No. of Registered Animals	696	8878	979	1,071	4.8

In accordance with the increase in pet numbers, the number of animal hospitals is also increasing. Veterinary institutions (animal hospitals) carrying out medical service grew from 3018 (in 2009) to 3640 (in 2014) at a yearly rate of around 4.8%, and the yearly growth rate has been very high at around 24.9%, with animal hospital total sales figures increasing from around 290 million Dollars (in 2009) to 710 million Dollars (in 2014), increasing by 22.9 times(as shown in Table 2).

**Table 2: Number of Animal Hospitals in Korea and Sales Amounts (Unit: Number, billion Dollar)**

	2009	2011	2012	2013	2014	CAGR(%)
Animal Hospital	3,018	3,208	3,323	3,521	3,640	4.8
Sales Amount	2.9	4.0	5.5	6.6	7.1	24.9

Current State of Pet Treatment<sup>1 0</sup>

Treatment fees for pets in Korea are not covered by health insurance, and with this lack of insurance coverage it can be very burdensome for pet owners when their pet gets sick. For cats and dogs in animal hospitals, the number of treatments or vaccinations (in the last 1 and a half years) was as follows: 1 or 2 instances were the most at 32.2% each, with 3 instances at 14.5%, and 5 instances at 7.1% (as shown in Table 3).

**Table 3: Number of Animal Hospital Vaccinations Treatments (2012. 01-2013. 07)**

	1	2	3	4	5	6~10	More than 11	Total
Number	254	254	114	54	56	43	13	788
Composition(%)	32.2	32.2	14.5	6.9	7.1	5.5	1.6	100.0

The reasons for choosing an animal hospital are as follows: the convenience of going to a previously attended hospital was the highest at 61.4%, with the high quality of treatment next at 24.5%, the hospitality of the medical team at 20.1%, worries about treatment fees at 13.3%, and recommendations at 10.3% (as shown in Table 4). The analysis shows that the reasons for choosing an animal hospital are most heavily influenced by the convenience of traffic and distance, with the easiest places to get to being preferred.

**Table 4: Reasons for Choosing Animal Hospitals  
(Within 2 Duplicated Answers)**

Type	Respondents (People)	Composition (%)
Ease of Attending	484	61.4
Quality of Treatment	194	24.6
Kindness of Medical Staff	158	20.1
Reasonable Treatment Price	105	13.3
From Recommendations	81	10.3
Offering Haircuts, Care Service Use	33	4.2
Already Attended Hospital, Place of Adoption	8	1.0
24 Hour Operation	5	0.6
Hospital of an Acquaintance	4	0.5
Miscellaneous	6	0.8
Total	788	100.0

**Business Model Canvas:** The BMC (business model canvas as suggested by Osterwalder and Pigneur) is described in terms of 9 compositional elements of profit creation methodology<sup>5</sup>. The 9 compositional elements are as follows: CS (Customer Segments), VP (Value Propositions), CH (Channels), CR (Customer Relationships), RS (Revenue Streams), KR (Key Resources), KA (Key Activities), KP (Key Partnerships), and CS (Cost Structure) (as shown in Figure 1). The BMC has the advantage of being conveniently and clearly managed, with all analysis results expressed in a table composed of 9 ‘building blocks’<sup>6</sup>, and by locating all of the company’s central keywords to rapidly grasp the current situation, the BMC has the advantage of being able to find the direction which a company should take in order to advance<sup>11</sup>.

**Figure 1: Business Model Canvas****RESULTS AND DISCUSSION**

**Company A Introduction:** Company A is a startup which began in 2016, and offers pet medical service business items through a Smartphone app. The business positioning concept is “the family doctor for my pet”, and the business model is based on the online to offline (O2O) platform of a location based service (LBS). Through the smartphone app, pet owners are directly connected to vets, and can receive solutions to any curiosities or issues that they have relating to the pet’s health and treatment. The Smartphone app has the categories of ‘dog curiosities’, ‘pet zone’, and ‘pet story’, and is a medical counseling service tool for the treatment of pets. In the future, through cooperation with service organizations such as those connected to pet food, pet products, and pet healthcare, the business will diversify and will become a constantly growing specialist pet service company.

**Business Model Canvas:** The Company A business model is a ‘multi-sided market’, with customers being offered medical service by veterinarians, and also allowing pet owners to use the medical service. This business model is similar to that of food delivery organizations where the target market is both general customers ordering food and restaurants offering food to be ordered.

**Customer Segments (CS):** The target customers are pet owners aged 40-50 years old who are mostly freelancers, business managers, and workers in the service industry. The study was focused on 40-50 year olds from a two or more person household, people living in detached residences, or people with children currently in the education system, and elderly households (because they are more likely to possess high financial assets/wages)<sup>2</sup>. Veterinarians offering medical services also participated.

**Value Propositions (VP):** Value propositions refer to the combination of services, products which satisfy the demands of customers, or the solving of customer’s problems<sup>12</sup>. The values offered to pet owners are as follows: offering rapid connectivity with high level veterinarians, and offering information about animal hospitals in the vicinity of the customer’s residence. For veterinarians, the company offers connectivity with new customers, and a systematic management program.

**Channels (CH):** The ‘channels’ refer to the method of effectively connecting target customers with the values of products or services<sup>12</sup>. Through apps, blogs, Face book, YouTube, and other SNS channels, pet owners and

veterinarians are able to be rapidly connected, wherever and whenever, in relation to matters of pet’s health. For veterinarians, the app offers online advertisement and promotional pages, and is able to heighten awareness about medical services whilst continuously offering medical service content relating to the individual veterinarian.

**Customer Relationships (CR):** Customer relationships refer to the type of relationship a company has with a customer. For pet owners, this refers to a quick connection with veterinarians and the ease of solving problems connected to their pets. Additionally, customer relationships offer a medical information service relating to the life cycle of pets (health examination information, animal hospital reservations, etc), and is the construction of a continuous relationship with the service. For veterinarians (according to the type of service), customer relationship is the construction of faithful customers by strengthening the loyalty relating to mileage construction, pet health events/campaigns, and other hospital-related items.

**Revenue Streams (RS):** The revenue streams refer to how profit is created from the target customer base for the continuous growth of the company. Company A does not seeking profit from its current target customers in terms of joining fees and service use, and also does not create profit for individual veterinarians. The company is currently at the investment stage. With this in mind, there should be an examination of profits made through the advertisements and promotion of related organizations (and their fees), along with the promotion of animal hospitals, the alliances of pet organizations.

**Key Resources (KR):** Key resources refer to a company effectively operating and the resources for achieving successful results. Included in this can be the material resources and the intellectual property, human resources, and financial resources of patents/brands in relation to production facilities and logistical systems<sup>12</sup>. The key

resources of Company A can be referred to in terms of various customer management programs relating to pet owners and veterinarians, medical consultation app construction, and veterinarian DB promotion (through the Korea Animal Hospital Association and business agreements).

**Key Activities (KA):** Key activities refer to the method of creating profit or effectively transferring suggested values to the customer or market. Key activities relating to pet owners operates in the following ways: as a customer mileage program, offering medical information in accordance with the problems facing particular pets, promotion of high-level veterinarians, and the effective operation of a medical service system. In relation to veterinarians, it refers to activity relating to: animal hospital operating strategy, hospital promotion and advertising, and medical service platforms such as pet-related events and deploying campaigns.

**Key Partnerships (KP):** Key partnerships refer to the strategic alliance relationship for the creation of successful results and minimization of risk in a company. Key partnerships in Company A refer to the ease of connection of pet owners and veterinarians (through the Korea Animal Hospital Association Veterinarian Society). Secondly, it refers to service organizations related to pets. Key partnerships can increase satisfaction, quality, convenience, and speed for customers when Company A’s service is used for such items as pet adoption, food, funerals, and care services.

**Cost Structure (CS):** Cost structure refers to the expenses incurred by the operation of a business model. In order to create profit, it is important to maintain the lowers possible expenses. In accordance with the pet medical service operation platform, expenses can take the form of: server construction, app operation fees, promotional sales gifts, promotional activities, advertisement costs, and customer management costs(as shown in Figure 2).

Key Partnerships	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Korea Animal Hospital Association Veterinarian Society, Pet Related Manufacture and Service Organization	Offering medical Information related to pet life cycles, Operating customer mileage, Promoting high-level Veterinarians/Hospital Operating Strategy, Advertisements, Events, Campaigns	Rapidly connection with high-level veterinarians for medical consultation, Lifetime per health management/Hospital operation Strategy, Advertisements & promotion, Attracting new customers	Offering a pet medical information service Campaigns and events, Constructing use mileage	Freelances aged 40-50, Business Management figures, Service Industry employees/ Veterinarians

Conted...

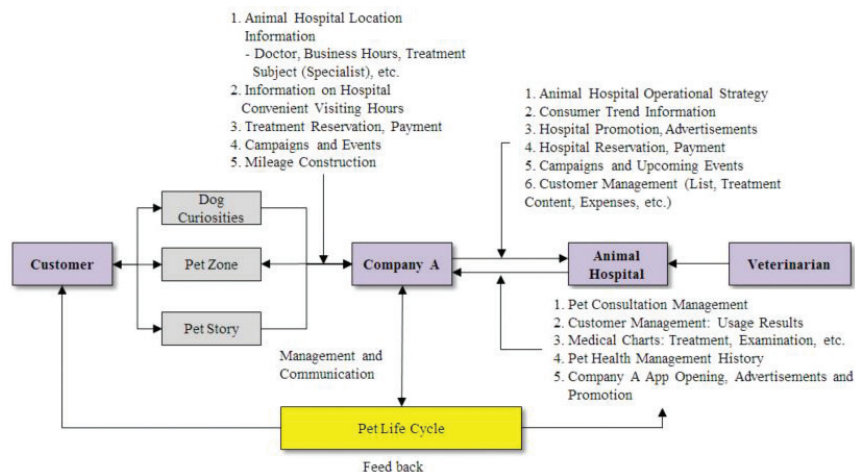
	<p><b>Key Resources</b>                  Korea Animal Hospital Association                  Veterinarian DB,                  Medical Consultation Service App                  Customer Management Program</p>		<p><b>Channels</b>                  SNS-App, Blog,                  Facebook,                  YouTube</p>	
<p><b>Cost Structure</b></p> <ul style="list-style-type: none"> <li>● Constructing a medical consultation service platform, operation</li> <li>● App operation fee, Sales promotion gifts, Advertisements and promotion</li> <li>● Customer Management Expenses</li> </ul>		<p><b>Revenue Streams</b></p> <ul style="list-style-type: none"> <li>● Member joining fee for pet owners</li> <li>● Usage fee for cooperative services of related organization</li> </ul>		

**Figure 2: Company A’s Business Model**

The startup business platform of Company was not clearly defined, and as the business model was similarly unrefined, there was a necessity for a more elaborated business model. The key activities and value propositions of pet owners and veterinarians were of a general nature, especially relating to the segmentation of pet owner customers. With this in mind, the value propositions were newly redefined, and the pet owners and veterinarian customer parameters were readjusted. There was also reestablishment not only in terms of the current activities of key business partners, but also of the diversified company viewpoint, along with the correct readjustment of values proposed by key activities. The analysis of Company A’s business model (using BMC analysis tools) was extremely significant in terms of being able to diagnose business content and reestablish

such items as: values, key resources, and key activities. Due to the inefficiency of everything linked to the know-how and inexperience of startup businesses, establishing a business model strategy was of great significance.

**Medical Consultation Service Platform:** The pet medical consultation service for Company A consists of rapidly connecting pet owners with veterinarians and offering consultation in the event that pets experience health problems or sickness. With this in mind, the medical consultation platform was constructed according to the reestablished business model (as shown in Figure 3). For pet owners, health information is offered relating to the necessary pet health management items: medical content and treatment, treatment fees, and pet life cycle information. For veterinarians, support is offered for the creation of profits gained from offering animal hospital promotion, pet treatment, and hospital operation manuals, etc.



**Figure 3: Company A’s Pet Medical Consultation Service Platform**



## CONCLUSION

This study established a medical consultation business model and platform for Company A in the pet-related market. The barriers for entering the growing pet market in Korea are low, and due to many companies participating in the market, competition is fierce. In order to create successful results and compete in this type of situation, there is a necessity for increased customer values relating to key communication activities and differentiation in business strategy. With this in mind, the business model was reconstructed and the necessity for the reestablishment of target customers, value proposition, key resources, and key activities (amongst others) was checked through the BMC. With this in mind, the medical consultation service platform was established based on this business model. Startup companies entering the market for the first time are bound to be slightly lacking in the areas of internal competency and competitiveness in terms of business model establishment and market analysis. However the construction of the business model meant that many lessons were able to be learned alongside the elaborated business platform construction and business strategy establishment. This points to the significance of adjusting the business strategy in accordance with the construction of the startup business model.

**Ethical Clearance:** Taken from Hansung University

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# The Clinical Practice Experience of Nursing Students

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## ABSTRACT

The purpose of this study is to understand the significance of clinical practice of nursing students by using a phenomenological method, and to provide a basic set of data for clinical practice and training programs for nursing students. The analysis method presented by Van Kaam for phenomenological studies were used as the basis. The number of research participants is reached when no further content comes out in interviewing, namely, repetitive statements on a phenomenon. The result was that of the total of 260 meaningful statements, 32 sub-themes and 5 themes, as well as 2 categories were determined. The results of this study can be summarized as follows: First, it is expected that nursing students will be able to use the experiences of the nursing practitioners and the experiences of patients who have been given medication practice. While reading repeatedly the original data that describes the nursing students' experience of clinical practice, meaningless statements were abandoned.

**Keywords:** *Clinical practice, Experience, Nursing students, Qualitative, Phenomenology.*

## INTRODUCTION

The primary goal of nursing education is to foster professional nurses through theoretical and practical training, who can provide qualitative nursing. To meet this educational goal, clinical practice is essential as it is the stage where the theory learned in lectures is acted upon in specific and practical ways<sup>1</sup>.

Through clinical practice, students learn complex cognitive techniques required for nursing practice, communication skills, critical thinking, self-respect, guiding abilities, autonomy in carrying out tasks, cooperation with other organizations, knowledge on nursing study curriculum and application of resources.

However, there is a lack of connection between the theory and clinical practice education given to nursing students. The students lack the opportunity to acquire nursing skills. The insufficient number of practice instructors and undermined motivation of students have led to various nursing activities not being experienced properly by students.

Such issues in clinical practice training obstructs the nursing students from experiencing nursing behaviors required to work as a beginning nurse, which leads to them feeling restricted in their use of knowledge or

implementation of patient nursing. This also causes the issue of graduates not being able to put to task immediately following school but being retrained which takes a lot of time and money.

As such, more qualitative clinical practice training needs to be provided to nursing students to allow them to experience better quality nursing activities. What constitutes proper content and methods of clinical practice training has been a widely discussed topic in the nursing education field among school administrators, students and those in the clinical field<sup>2</sup>.

Clinical practice training is emphasized as an essential field to promote the ability to compile nursing knowledge to solve problems on clinical sites. More opportunities need to be offered to verify the factors that may affect the improvement of clinical skills and meet related needs.

Preceding studies on nursing students' clinical practice ability had a tendency to look at the issue in a one-dimensional manner by focusing on individual factors of clinical practice training.

Self-respect in clinical training education of nursing students was noted to have a high correlation with clinical practice stress and many preceding studies have reported

that a higher level of critical thinking is associated with a higher level of clinical practice ability<sup>3</sup>.

Moreover, correlation has also been found between a nursing student's tendency to think critically and her clinical practice ability, as well as between instruction efficiency and clinical practice ability. It was noted that for the efficiency of clinical practice instructor, it is important to encourage students and that evaluation skills and nursing implementation ability were the most important fields among the instruction efficiency factors of the nursing educator<sup>4</sup>.

There was a correlation between instruction efficiency of clinical practice education evaluated by nursing students and clinical practice ability.

Nursing students have the opportunity to learn about the drug theoretically, to learn safe medication in school practice, and to administer medication to the actual patient in clinical practice. Although 75.7% of the nursing students experienced the medication directly, the parenteral medication was performed significantly less than the oral medication<sup>5</sup>. Nursing student medication practice requires nurse supervision, but lacks sufficient supervision in the clinical setting, which may result in a mismatch error that is found before a medication error or error that affects the patient affects the patient.

In contrast, there are a number of quantitative researches on qualitative research, clinical practice satisfaction, critical thinking, and self-initiative in nursing students.

The nursing education program is continuously improved based on the performance - oriented education system so that the nursing students are equipped with the nurses' competence required in the healthcare field. The Korea Nursing Education and Training Institute designated core basic nursing skills required in clinical practice in order to assure competence as a professional nurse in the clinical field and evaluated the degree of achievement during graduation to secure the clinical performance ability of nursing students. Nursing education provides qualitative nursing and professional nurses. In order to achieve the goal of cultivating the students, they need an integrated curriculum including clinical practice that can improve concrete and practical behavior based on theoretical knowledge<sup>6</sup>.

As such, most studies have been on the correlation between individual factors and clinical practice ability.

This study seeks to identify the content of nursing activities experienced by nursing students through the course of clinical practice and their implementation confidence levels to provide a basic set of data for the development of a training program for new nurses that can help improve the content of clinical practice training.

The purpose of this study is to understand the significance of clinical practice of nursing students by using a phenomenological method, and to provide a basic set of data for clinical practice and training programs for nursing students.

## RESEARCH METHOD

**Study method:** The human thought system varies depending on one's cultural background. As such, it would be a stretch to discuss the stress felt by nursing students in clinical practice, when they have different cultural backgrounds. This researcher felt the need for an in-depth study that takes into account Korean culture and thus opted for a phenomenological method among the qualitative study methods.

The purpose of this study was to investigate the relationship between the purpose of sample selection and nursing student 's grade, clinical practice period, practice department, parenteral medication experience, The results of this study were as follows: First, the participants of the study were selected as nursing students who graduated from the university, and they completed clinical practice of more than 1 year, They were directly exposed to parenteral medication, observed medication accidents, or selected nursing students<sup>7</sup>.

In recent years, the field of nursing studies has seen an increase in qualitative studies that seek to overcome the limits of existing quantitative methods in studying the innate nature of the human experience.

In particular, phenomenological methods are about describing human experience and takes a comprehensive approach to understand an experience in a given situation or environment.

This emphasizes the correlation of the subject's experience. Nursing studies take interest in the subject's experience and as such, this method is a promising study method appropriate for studying the concept of nursing.

This researcher used phenomenological methods to analyze the feelings and reactions of nursing students shown during clinical practice.

In doing so, the researcher sought to help them understand the meaning of the phenomenon and to provide a basic set of data for the training and counseling of nursing students.

A phenomenological approach excludes subjective opinions of the researcher and maintains objectivity on the phenomenon experienced by the subjects.

As such, the questions were designed not to lead certain answers the researcher wishes to hear but to have the subjects honestly discuss their reaction or feelings.

**Data analysis process:** The analysis method presented by Van Kaam for phenomenological studies were used as the basis.

The following process was followed.

1. The first stage was to repeatedly listen to the recording of interviews with the subjects for analysis. The statements of the subjects were written out as they were to familiarize oneself with the content and to gain specific feelings of the clinical practice experience.
2. The second stage was to repeatedly read the statements written out to extract meaningful phrases and sentences.
3. The third stage was to repeatedly read the extracted meaningful statements to categorize them by common traits. The content validity of whether the categorization and selection of themes were done correctly was reviewed by three professors of nursing studies.

Focus group interviews took between 100 and 150 minutes per group and supplemented additional information via telephone and e-mail, if necessary. The contents of the interviews were copied within 3 days after the recording by the researcher using a tape recorder.

At this time, the researchers exchanged opinions with the research assistants who were interviewed in the interviews, The purpose of the study is to provide a brief training on the methods, procedures and precautions of the focus group interviews, assist the researchers in the focus group interview, record interviews. The assistant

was also responsible for checking the arrival status of the participants and preparing and collecting the questionnaires before the start of the interview.

Before starting the data collection, explain the purpose of the study and how to collect the data by telephone conversation with the participant.

After confirming the participant's intention to participate in the study, the participant should check the possible time, for example, the afternoon time, Etc. In consideration of the movement of the participants, a place for interviewing was selected as an independent space with a seminar room around the school, and a cafe with a seminar room was also reserved in advance. The focus group interview began by talking about the clinical practice that participant had in common in order to create an atmosphere where all participants participated in evenly. As the interview progressed, the researcher began to take an attitude that some participants should listen to passively and all participants participated in the event.

**Ethical considerations for participants:** The researcher explained the purpose of the research, the process of the interview, the main questions and the interview time before the research proceeded.

After understanding the participants, they voluntarily decided to participate and signed the study participation agreement.

The researcher will ask participants to record the reason for recording the interview and record the recorded file and record. In order to ensure the personal confidentiality of the participant in reporting the results of the research, anonymity of all the proper nouns should be anonymized so that the identity of the participant

The interview was conducted in a place that was close to the participant's school or practice place and was quiet and in a place suitable for communication, and it was announced in advance that it would take about 2 hours. A gift of the present.

Participants were initially shy about sharing their medication experiences in clinical practice, but as time went on, the nature of the focus group interview led to a frank and active dialogue with other participants who shared the same experiences naturally.

The study participants expressed their concerns about negative experiences of clinical practice institutes or nursing colleges as a student, while discussing their experience in clinical practice.

The researcher explained the purpose of this study and reaffirmed the assurance of the anonymity of the participants so that they could be frank and comfortable.

### RESEARCH RESULT AND DISCUSSION

The While reading repeatedly the original data that describes the nursing students' experience of clinical practice, meaningless statements were abandoned. If the subject had consecutively stated the same idea, they were extracted as a single statement.

If meaningful statements were clustered together, they were separated before extraction. The three professors were asked to verify the confidence levels of mutual compatibility.

The result was that of the total of 260 meaningful statements, 32 sub-themes and 5 themes, as well as 2 categories were determined Table 1.

**Table 1: Categorization table**

Category	Theme
The feelings and reactions when experiencing clinical practice	Emotional response Physical response
Meaning given to clinical practice	Positive stimulus factor Challenging aspects

Nursing students were taught basic nursing skills, including medication, through modeling and simulator training before going out to clinical practice. However, it has been found that it is difficult for nursing students to get the opportunity to administer medication directly to the patient in a medical field where the patient is struggling to cope with the patient's treatment.

The nursing students were able to identify the nurses who were interested in the practical guidance and to follow the active nurses to the practical guidance and to help the nurses Knowing in advance or asking questions Nursing students were able to obtain medication opportunities from nurses when they actively asked and participated to get nurse's attention.

Patients and families may show a negative attitude toward nursing students when a nursing student who is immature in the nursing process and is in the process of learning stands in front of the patient to administer the medication<sup>8</sup>. In this study, we found that nursing students were not able to express their disliked expressions

or expressions in a linguistic way, but they showed expressions of rejection by facial expressions and gestures<sup>9</sup>. The nursing student had to endure the patient's gaze and the family's gaze in a nervous state because the nursing student looked at each act of the nursing student with suspicion in the mind that he would commit, so the nursing student positively approached the patient.

It was difficult, and the medication practice was carried out in an unstable situation than expected and it was difficult to concentrate on medication itself<sup>10</sup>.

In clinical settings, there are nurses with diverse job skills ranging from new nurses to career nurses. Nursing students are more skilled in nursing work and more experienced nurses than nurses in the case of new nurses, It is difficult to get guidance on the practice because there are many new nurses in the first semester clinical practice as compared to the second semester in the nursing students.

The nursing student looked at the nurses' preparation process and watched the nursing preparation process, followed the nurse who was heading to the room to medicate the patient, I was denied medication observation. Practical experience I was aware of the behavior of the nurse and understood the position of the nurse. I followed the nurse looking for the medication practice.

The results of this study indicate that nursing students are vaguely aware that they can be administered under the supervision of nurses, and the positions of clinical practitioners and clinical practitioners are not clear. Therefore, It is necessary to clearly define the scope of the work and to state the responsibilities by distinguishing qualified medical personnel from trainees for the work of medication.

In order to be a nurse, it is necessary to establish policies and regulations for the scope of medication practice for nursing students, and to provide nursing care for nursing students.

It is possible to contribute to systematic nursing education, patient safety, and patient satisfaction by presenting clear criteria in terms of the student's side, the nurse's guidance in the clinical setting, and the patient's right to be treated safely. It is significant that the study suggested the necessity of establishing legal institutional standards and procedures for the medication that the nursing students performed in the clinical field.

The purpose of this study was to investigate the meaning of the parenteral medication experienced by the nursing students in the clinical field and to find out

the meaning of the nursing students' And that they will be able to carry out further research on the concepts that constitute them, as well as the guidelines for the scope and responsibilities of nursing students in each practice.

This study suggests the necessity of the research on the actual condition of the applicant 's facilities.

This study suggests the necessity of research to compare and analyze the regulations of medication practice of nursing students included in clinical practice regulations used in nursing education institutions. The results of this study can be summarized as follows: First, it is expected that nursing students will be able to use the experiences of the nursing practitioners and the experiences of patients who have been given medication practice.

### CONCLUSION

This study was conducted to understand the feelings and reactions of nursing students experiencing clinical practice and to analyze them using Van KAnn's phenomenological methods to contribute to the development of training materials for clinical practice programs.

In conclusion, this study explored the meaning of the parenteral medication experienced by the nursing student and found that 'the nursing student' s active attitude is able to practice medication, and in the process of medication, have It is necessary to have an approach to encourage the active attitude of nursing students in practice of clinical nursing practice in the clinical field, and in nursing education institutions and practice institutes, Medication practice It is meaningful to confirm that it is necessary to create conditions for motivation. In addition, this study confirmed the absence of policies and guidelines related to medication of nursing students and suggested the necessity to clarify the range of activities that nursing students can directly perform in medication practice items in future clinical practice.

Based on the supervision of the field leader, we were able to provide basic data for establishing guidelines for defining responsibilities for the results of nursing students.

As such, this study, in identifying from the subjects' perspective the meaning of their feelings and reactions shown during clinical practice training, helped with the understanding of the phenomenological feeling and reaction in nursing clinical practice, and contributed to nursing knowledge by providing a basic set of data for the training of nursing students.

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# The Analysis of Health Promotion Benefits on Public Health Care Posts

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## ABSTRACT

Public Health Care Posts (PHCHs) are the primary medical institutions for the health promotion of residents in medical vulnerable areas. This study proved the effectiveness of health promotion services provided by PHCHs. This study uses benefit analysis to evaluate the economic value of health promotion on PHCPs. The benefits were analyzed by health promotion services and by region. The benefits of reducing outpatient and inpatient medical expenses, saving time, preventing complications, and life extension was included. The health benefits for hypertension were estimated at \$43,921, and the benefits for diabetics were estimated at \$38,909. The benefits from the vaccination of the PHCPs were \$69,759. Benefits from dementia management services were \$443, mental health care service \$997, oral health care \$1,634, and benefits from medication adherence management were \$1,439. Total benefits of health promotion services at PHCPs were estimated at \$157,102 per year. By region, the benefits of rural areas were the greatest. Since the health promotion benefits of PHCPs are estimated to be considerably high, it will be possible to increase the efficiency of PHCPs by expanding health promotion service programs.

**Keywords:** Benefit Analysis, Health Promotion Service, Health Promotion Benefits, Public Health Care Posts, Medical Vulnerable Area

## INTRODUCTION

Over the past decade, rural health policy has been dominated by the need to reduce health inequalities between the metropolitan areas and in rural areas, and these policies have focused on human resources issues<sup>1</sup>. The Public Health Care Posts (PHCPs) are a Korea health care system that has been initiated in accordance with the social need to meet the primary health care needs in medical vulnerable areas. The PHCPs are responsible for primary health care in medical vulnerable areas such as rural areas and fishing villages. PHCPs started in 1977 and about 1,900 institutions were operating in 2014. In Korea, PHCPs are operated by nurses because the PHCPs are established in areas where doctors are insufficient. Primary health services of the PHCPs include the range of medical service, such as diagnosis and treatment to determine the state of the disease, examination, transfer of the patient, emergency treatment of the patient, treatment for preventing the deterioration of the disease, management of the chronic disease patient s,

administration of medicines. Although PHCPs make a lot of contribution to the health promotion of residents, the results are not visible. In other words, the services provided by the PHCPs are effective in accessibility and economic feasibility when using medical services, such as medication, health education, counselling, treatment, and health checkups. However, researches related to PHCPs so far have mainly focused on the perception of the services, the job satisfaction and the survey of the actual situation<sup>2,3</sup>. Until the early 1980s, the health-related sector was excluded from the cost-benefit analysis, but it was positively included in the cost-benefit analysis as the monetary valuation method for non-market goods and services developed from the mid-1980s<sup>4</sup>. The PHCP services presented in the 2013 PHCPs' operational status report are as follows; 14 areas of health promotion management, 5 areas of primary care, 4 areas of cerebrovascular disease prevention management, and 7 areas of dementia management. The addition of the cerebrovascular disease prevention management and dementia management is emphasized as the death and

disease structure changes into chronic diseases, and it is anticipated that the burden of chronic diseases will increase with rapid population aging<sup>5</sup>. PHCPs manage many chronic diseases such as hypertension, diabetes, cerebrovascular disease, and dementia. The health promotion services provided by the PHCPs can prevent such many chronic diseases. Therefore, it is necessary to verify the effectiveness of the health promotion services of PHCPs. In addition, PHCPs are national public policies and need to use limited resources efficiently. The most widely used method for solving the scarcity of resources is economic evaluation. Effective use of resources is of great interest today, as spending on the healthcare service area continues to grow and health care spending is growing in the GNP. So far, the economics evaluation studies have rarely been conducted in PHCPs. Therefore, this study was tried to estimate the effect of the health promotion services of the PHCPs by the monetary value. This study aims at estimating the

performance of health promotion services provided by PHCPs as monetary values and suggesting effective ways of development for PHCPs.

## MATERIALS AND METHOD

**Research design:** This study analyzed the benefit of the health promotion services of the public health care posts (PHCPs). The health promotion benefits were calculated by the benefits of reducing outpatient and inpatient medical expenses, saving time, preventing complications and life extension by the services of the PHCPs in 2014. The health promotion services of PHCPs included chronic disease management (hypertension and diabetes), immunization, dementia, mental health, oral health, and medication management as shown in Table 1. The health promotion benefits of PHCPs were presented by region. The area was classified into rural, fishing, island, and urban and rural integration areas.

**Table 1: Analysis framework of health promotion benefits**

	Health promotion benefits				
	Outpatient medical expenses	Inpatient medical expenses	Time saving	Complication prevention	Life extension
Hypertension	0	0	0	0	0
Diabetes		0	0	0	0
Immunization	0	0			
Dementia	0				
Mental health	0				
Oral health	0				
Medication management	0				

**Analysis formula:** The health promotion benefits include the benefits of reducing outpatient and inpatient medical expenses, saving time, preventing complications, and life extension due to health promotion services of PHCPs.

- The benefits of reduced outpatient medical expenses = No. of patients in PHCPs × the severity or control rate of outpatient visits × decreased average length of stay (LOS) in National Health Insurance (NHI) × outpatient medical expenses in NHI
- The benefits of reduced inpatient medical expenses = No. of patients in PHCPs × disease control rate × average length of stay in NHI × reduce rate of hospitalization × inpatient medical expenses in NHI
- The benefits of saving time = No. of patients in

PHCPs × disease control rate × average length of stay in NHI × labor cost and caregiver cost per day

- The benefits of preventing complications = No. of patients in PHCPs × contribution rate of disease occurrence × complication medical expense
- The benefits of life extension = No. of patients in PHCPs × disease mortality × lost earnings

**Data collection:** The number of hypertension, diabetes, and dementia patients managed by the PHCPs was obtained through the questionnaire survey, and the performances of health promotion service were obtained through the 2014 PHCP operation report data. Additionally, the data of the 2013 National Health Insurance, the 2013 National Health and Nutrition



Survey, and the 2014 National Statistical Office Report was used in this study. The data of medical expenses, length of stay (LOS), disease mortality, and disease control rate were used. The severity and incidence of complications were referred to the results of the previous study<sup>6,7,8</sup>. The mortality rate was used by the National Statistical Office. In order to calculate life extension benefit, the 2014 labor cost data of Ministry of Labor was used. These benefits were obtained for each service and the total health promotion benefit was calculated.

**RESULTS AND DISCUSSION**

**General characteristics of the public health care posts:** There are a total of 1,904 public health care posts (PHCPs) in Korea, of which the data of 696 PHCPs was analyzed.

The general characteristics of the public health care posts are shown in Table 2. The number of PHCPs included in this study is the largest in rural areas as

82.0%. The average population in charge is 973 people. There are 1,724 people in urban rural integration areas, 894 people in rural areas, 805 people in fishing villages, and 469 people in the island by region. The actual percentage of the population using PHCPs was 59.7%. By region, the utilization rate was the highest at 72.7% in the island, followed by fishing villages 67.4%, rural areas 60.9% and urban rural integration areas 52.0%. The island has the highest rate of using PHCPs because it is difficult to access private medical institutions due to inconvenient traffic. The number of users or cases per health promotion service is as follows; the average annual number of hypertensive patients managed per PHCPs is 61 persons, the number of diabetic patients is 18 persons, and the number of patients who are immunized at the PHCP is 161 persons per year. The number of dementia is 4 people. And, the mental health management cases are 95 per year and oral health care cases is provided in 170 cases. The number of medication management at the PHCP is 2,392 cases a year.

**Table 2: General characteristics per a public health care post**

	Average	Rural area (571 PHCPs)	Fishing village (54 PHCPs)	Island (27 PHCPs)	Urban-rural area (44 PHCPs)	
Number of people (person)	973	894	805	469	1,724	
Number of users (person)	581	544	543	341	896	
Utilization (%)	59.7	60.9	67.4	72.7	52.0	
Number of services	Hypertension (person)	61	64	47	27	71
	Diabetes (person)	18	18	14	7	22
	Immunization (person)	161	196	181	108	140
	Dementia (person)	4	5	2	1	2
	Mental health (cases)	95	138	110	40	124
	Oral health (cases)	170	216	226	135	295
	Medication management (cases)	2,392	2,405	2,290	1,805	2,839

**Benefits analysis of the public health care posts**

**The benefits in hypertensive patients:** It is estimated that benefits of reducing outpatient and inpatient medical expense, saving time, preventing complication, and life extension in hypertensive patients. The severity of hypertensive patients using PHCPs was lower than that of NHI. If the PHCPs did not provide hypertension management, and the severity of hypertension would have increased<sup>6</sup>. The benefit of reduced outpatient medical expenses was calculated by multiplying the medical expenses for each severity by the number of patient. As a result, the reduced outpatient medical expense benefit is an average of \$1,848 as shown in Table 3. By region, it was analyzed as \$1,957 in rural area, \$1,008 in fishing village, \$833 in island area and \$2,172 in urban rural integration area.

**Table 3: The reducing outpatient benefit of hypertension in public health care post**

	2014 NHI outpatient medical expense(\$ <sup>1</sup> )	NHI <sup>1</sup>		PHCH <sup>2</sup>		Reducing outpatient medical expenses(\$)
		Person	medical expense(\$)	Person	medical expense(\$)	
Stage 1	407	8	3,259	59	24,037	1,848
Stage 2	440	3	1,321	1	440	
Stage 3	444	50	22,189	1	444	
Total(\$)	-	26,769		24,921		

<sup>1</sup>Exchange rate = 1,050KRW/\$1

The benefit of reducing inpatient care is the expected medical expenses when high blood pressure is not controlled and hospitalization is required. The hypertension control rate of hypertension patients in PHCPs is 7.1%p higher than the control rate proposed in the 2013 National Health and Nutrition Survey. In other words, an average of 4 patients may have been hospitalized if they did not receive hypertension management services from the PHCPs. For a conservative estimate, assuming only a 25% reduction in the hospitalization rate, the reduced inpatient medical expense benefit is calculated as \$3,516.

If hospitalization is reduced due to hypertension management services at the PHCP, the patient can do more work during the reduced days and save on the care-giver cost for that period. During that period, the labor and care-giver cost were calculated as time saving benefits and estimated as \$3,135.

The benefit of preventing complications was calculated as the expenses of treatment for complications that occurred when hypertension was not controlled. Complications of hypertension are reported as ischemic heart disease and cerebrovascular disease. The complication incidence rate was calculated. The length of stay of hospitalization and the medical expenses per day for each complication were based on the National Health Insurance data. The complication prevention benefit calculated by multiplying the prevalence calculated in this study on the medical expenses for each disease was \$19,671.

Life extension benefits are increased lost earning when hypertension is controlled and death from hypertensive diseases is reduced. Estimated life extension benefit of patients with hypertension was \$15,751 on average. By region, it was analyzed as \$16,963 in rural area, \$12,116 in fishing village, \$7,270 in island area and \$19,386 in urban rural integration area. The total benefits of hypertensive patients are shown in Table 4.

**Table 4: The health promotion benefits in hypertensive patients**

		Average	Rural	Fishing	Island	Urban-rural
N of person	N of hypertension(person)	61	64	47	27	71
	a. Control in PHCH(person)	46	48	36	20	54
	b. 2013 NHI control(person)	42	44	32	18	49
	(a-b)	4	5	3	2	5
Reducing outpatient benefit	total (\$)	1,848	1,957	1,008	833	2,172
Reducing inpatient benefit <sup>1</sup>	hypertension in NHI	c. LOS(day)	45			
		d. expenses per day(\$)	78.1			
	(a-b) × c × d × 0.25 (\$)	3,516	4,395	2,637	1,758	4,395
Time saving benefit <sup>1</sup>	e. Labor cost per day <sup>2</sup> (\$)	59.5				
	f. Care-giver cost per day <sup>3</sup> (\$)	10.1				
	(a-b) × c × (e + f) × 0.25 (\$)	3,135	3,919	2,351	1,568	3,919

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Preventing complication benefit	ischemic heart disease	g. LOS(day)	4				
		h. expenses per day(\$)	130.1				
		i. PAR <sup>4</sup>	16.5				
		a × g × h × i (\$)	3,949	4,120	3,090	1,717	4,635
	cerebrovascular disease	j. LOS(day)	11.8				
		k. expenses per day(\$)	126				
		l. PAR <sup>4</sup> (%)	23				
		a × j × k × l (\$)	15,722	16,406	12,304	6,836	4,635
	total (\$)		19,671	20,526	15,395	8,553	9,271
	Life extension benefits	m. death rate		0.0291			
n. N of death(person) (a × m)		1.3	1.4	1	0.6	1.6	
o. Lost earning <sup>5</sup> (\$)		12,116					
a × n × o (\$)		15,751	16,963	12,116	7,270	19,386	
Total		43,921	47,760	33,507	19,981	39,143	
<sup>1</sup> assuming 25% reduction in the hospitalization rate <sup>2</sup> 2014 simple labor wages <sup>3</sup> Comprehensive nursing service co-care fee for 6 persons <sup>4</sup> PAR(%)=□P(R-1)/P)R-1)+1) × 100 (P: prevalence, R: relative risk) <sup>5</sup> Simple labor wage × 2/3 (excluding living expenses) × 12 months Life Nitze Factor							

**The benefits in diabetic patients:** The total benefits of diabetic patients are shown in Table 5. In the case of diabetic patients, inpatient care reduction benefit, time saving benefit, complication prevention benefit, and life extension benefit were estimated. The diabetic control rate in PHCPs is higher than the control rate proposed in the 2013 National Health and Nutrition Survey. Assuming a reduction in hospitalization rate of 25% in the same way as the hypertension, the reduced inpatient medical expense benefit is calculated as \$12,255. According to the National Health Insurance data, the average length of hospital stay for diabetic patients is 26.5 days. If the diabetes is well controlled and the patients are working without hospitalization during this period, the income

will be \$4,299 on a 25% reduction in hospitalization rate. The benefit of reducing the cost of care-giver for the same period is \$732. It can be estimated that a time saving benefit of \$5,031 is finally generated. Diabetic complications can be estimated as kidney complication, retinal complication, neurologic disease, coronary artery disease, and stroke, and the contribution rate of each complication due to diabetes is suggested as 11.4% to 38.0%<sup>7</sup>. The incidence rate of diabetes mellitus in Korea is estimated to be 8% by applying the prevalence of diabetes mellitus and risk of complications. Considering the medical expenses for each complication, the benefit for prevention of complications is calculated as \$13,880. Life extension benefit from diabetes control is average \$7,743.

**Table 5: The health promotion benefits in diabetic patients**

		Average	Rural	Fishing	Island	Urban-rural
N of person	N of DM (person)	18	18	14	7	22
	a. Control in PHCH(person)	15	16	12	6	19
	b. 2013 NHI control(person)	4	5	3	2	6
	(a-b)	11	11	9	4	13

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Reducing inpatient benefit <sup>1</sup>	DM in NHI	c. LOS(day)	26.5				
		d. expenses per day(\$)	169.7				
	$(a-b) \times c \times d \times 0.25$ (\$)		12,255	12,705	9,894	5,060	4,954
Time saving benefit <sup>1</sup>	e. Labor cost per day <sup>2</sup> (\$)		59.5				
	f. Care-giver cost per day <sup>3</sup> (\$)		10.1				
	$(a-b) \times c \times (e + f) \times 0.25$ (\$)		5,031	5,216	4,062	2,077	6,139
Preventing complication benefit	g. Medical expenses per year (\$)	Kidney	7,613				
		Retina	368				
		Neurologic	201				
		Coronary artery	682				
		Stroke	2,403				
	h. PAR <sup>4</sup> (%)		8				
$a \times g \times h$ (\$)		13,880	14,420	11,176	5,768	16,854	
Life extension benefits	i. death rate		0.0415				
	j. N of death(person) ( $a \times i$ )		0.6	0.7	0.5	0.3	0.8
	k. Lost earning <sup>5</sup> (\$)		12,116				
	$a \times j \times k$ (\$)		7,743	8,045	6,235	3,218	9,403
Total		38,909	40,386	31,367	16,123	37,350	
<sup>1</sup> assuming 25% reduction in the hospitalization rate							
<sup>2</sup> 2014 simple labor wages							
<sup>3</sup> Comprehensive nursing service co-care fee for 6 persons							
<sup>4</sup> $PAR(\%) = \frac{P(R-1)}{P(R-1)+1} \times 100$ (P: prevalence, R: relative risk)							
<sup>5</sup> Simple labor wage $\times 2/3$ (excluding living expenses) $\times 12$ months Life Nitze Factor							

**The benefits from immunization services:** In the case of immunization, outpatient and inpatient medical expense reduction benefit are included. PHCPs mainly provide flu vaccination, which prevents the pneumonia. The reduction of medical expenses of outpatient and inpatient due to pneumonia prevention is the benefit of immunization service as shown in Table 6. Assume that immunization reduces outpatient and inpatient care by 25%, it is \$2,458 in outpatient and \$67,301 in inpatient when calculating the benefits of vaccination based on outpatient medical expenses, inpatient medical expenses, and length of stay (outpatient and hospitalization) for pneumonia patients presented by the National Health Insurance data.

**Table 6: The health promotion benefits in immunization**

			Average	Rural	Fishing	Island	Urban-rural
N of immunization person			161	196	181	108	140
Reducing outpatient benefit <sup>1</sup>	Pneumonia in NHI	b. LOS(day)	2.4				
		c. expenses per day(\$)	25.4				
	$a \times b \times c \times 0.25$ (\$)		2,458	2,992	2,763	1,649	2,137
Reducing inpatient benefit <sup>1</sup>	Pneumonia in NHI	d. LOS(day)	9.6				
		e. expenses per day(\$)	174.2				
	$a \times d \times e \times 0.25$ (\$)		67,301	81,931	75,661	45,146	58,522
Total			69,759	84,924	78,424	46,795	60,660
<sup>1</sup> assuming 25% reduction in the hospitalization rate							

**The benefits of dementia, mental health, oral health and medication management:** The health promotion benefits of dementia, mental health, oral health and medication management is the reduction of medical expenses in outpatients. Based on the assumption that outpatient visits are reduced due to the dementia management of the PHCPs, the benefit is estimated by using the medical expenses and the length of stay of dementia in the National Health Insurance. A benefit of 25% reduction in outpatient care due to dementia management is \$443.

When the mental health service provided by the PHCPs decrease mental illness, the benefit of outpatient care is \$997 on a 25% reduction. The mental illness included manic episode, bipolar affective disorder, depressive episode, recurrent depressive disorder, and mood [affective] disorders.

The diseases that can be prevented by oral health are dental caries and diseases of pulp and periapical tissues, and gingivitis and periodontal diseases. The medical expense benefit of 25% reduction in outpatient care is \$1,634.

The medication adherence rate in Korea is 85.5%, among which the drug side effect experience rate is 17.1%<sup>8</sup>. 2,392 cases were managed by the PHCPs. If PHCPs do not provide medication management, the corresponding side effect would have occurred, and it was calculated as the benefit of outpatient care reduction of \$1,439. In this case, the standardized medical expenses were the average outpatient medical expenses in family medicine department clinic. The total benefits of dementia, mental health, oral health and medication management are shown in Table 7.

**Table 7: The health promotion benefits of dementia, mental health, oral health, and drug management**

Reducing outpatient benefit <sup>1</sup>		Average	Rural	Fishing	Island	Urban-rural
Dementia	N of dementia	4	5	2	1	2
	Dementia in NHI	b. LOS(day)	6.4			
		c. expenses per day(\$)	69.3			
a × b × c × 0.25 (\$)		443	554	222	111	222
Mental health	d. N of case in mental health	95	138	110	40	124
	e. Outpatient medical expenses of mental illness in NHI per day(\$)	174.2				
		d × e × 0.25 (\$)	997	1,448	1,154	420
Oral health	f. N of case in oral health	170	216	226	135	295
	g. Outpatient medical expenses of oral disease in NHI per day(\$)	38.4				
		f × g × 0.25 (\$)	1,634	2,076	2,172	1,298
Medication management	h. N of case in drug management	2,392	2,405	2,290	1,805	2,839
	i. Rate of medication adherence	85.5				
	j. Rate of side effect experience	17.1				
	k. Outpatient medical expenses of family medicine department in NHI per day(\$)	16.5				
	h × i × j × k × 0.25 (\$)	1,439	1,447	1,377	1,086	1,708

<sup>1</sup> assuming 25% reduction in the hospitalization rate

As suggested above, the health promotion benefits provided by PHCPs can be analyzed as being very large. In a study analyzing the benefits of PHCPs in 2000, the benefits of PHCPs were suggested to be \$6,392 per

month<sup>9</sup>. Due to the increase in medical needs, such as the development of medical technology and the aging of the population, the expenditure of the healthcare sector has increased rapidly, and the interest in the cost

has also increased greatly. Costs are also an important consideration in health care policy decisions<sup>10</sup>. Direct comparisons are difficult, but PHCPs are surely a primary health care system that is very cost effective. In other words, the PHCP is an economically-efficient system and positively plays a role in the health promotion of local resident and in the cost of national healthcare.

## CONCLUSION

This study analyzed the health promotion benefits of public health care posts (PHCPs). The health promotion benefits included the benefits of reducing outpatient and inpatient medical expenses, saving time, preventing complications, and life extension. For conservative estimates, the benefits of reducing medical expenses and saving time were calculated based on the 25% reduction in admission rate. And the benefits of preventing complications did not reflect sensitivity. The

health promotion benefits of this study are estimated to be \$157,102 per year as shown in Table 8. By region, the benefits of rural areas, fishing villages, islands, and urban rural integration area were analyzed as \$178,595, \$148,223, \$85,814, and \$143,220, respectively. The benefits of rural areas were greatest. Most of the studies on PHCPs were about the services carried out and their effects presented as satisfaction and the measured values like disease control rate not monetary value. This study has significant implications for providing cost-effective services among PHCPs programs and providing basic data to expand the role of PHCPs centered on economically viable projects. As the health promotion services of PHCPs increases, the PHCPs will be able to contribute to the public health care more effectively. In addition, it can be used as a basic data for evaluating the efficiency of the current PHCPs' programs to activate the high-performance services and to suggest the operation direction of PHCPs.

**Table 8: Total health promotion benefits of public health care post**

Category	Average	Rural	Fishing	Island	Urban-rural
Hypertension	43,921	47,760	33,507	19,981	39,143
Diabetes	38,909	40,386	31,367	16,123	37,350
Immunization	69,759	84,924	78,424	46,795	60,660
Dementia	443	554	222	111	222
Mental health	997	1,448	1,154	420	1,301
Oral health	1,634	2,076	2,172	1,298	2,836
Medication management	1,439	1,447	1,377	1,086	1,708
Total	157,102	178,595	148,223	85,814	143,220

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# Strategies for Reestablishing the Role of Public Health Care Posts in Korea

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## ABSTRACT

This study aims to identify the current public health care posts status, analyze the surrounding environment, and suggest the future role of public health care posts. To redefine the function of the public health care posts, the public health care posts were classified into four types. The classification was based on the existence of a medical facility in the region, the arrival time to medical institutions in case of emergency, and the frequency of emergencies. As the result of this study, 3.1% of the total public health care posts were required to strengthen the function of the clinic medical care and 9.5% of the public health care posts should maintain the current medical care function. 54.9% of the public health care posts should strengthen the health promotion function and 32.5% of the public health care posts should be transferred to health promotion role. Most public health care posts need to expand their role from medical care to health promotion, so institutional support should be provided.

**Keywords:** *Community Health Nurse, Public Health Nurse, Public Health Care Post, Primary Health Care, Health Promotion*

## INTRODUCTION

Nurses are health care providers who play a key role in providing efficient and cost-effective services to health care throughout the community, including health promotion, health monitoring, and screening<sup>1</sup>. The Korean government also began to encourage nurses to deal with health problems in the medical vulnerable areas, believing in their strengths and potential. That is the Public Health Care Posts (PHCPs) system. Almost all countries in the world are experiencing transportation difficulties in delivering health care systems, and facing the lack of doctors and other health professionals in rural and remote areas<sup>2</sup>. In Korea, the public health care posts were established in 1981 to perform primary health care services in the medical vulnerable areas without doctor. Public health care posts are set up in the medical vulnerable areas with a population of 500 or more (over 300 in island) and less than 5,000, and are operated by a single nurse. As of 2016, there are 1,905 public health care posts in Korea. In Canada, 30% of the population lives in rural and remote areas, where nurses play a major role. As in Korea, the proportion of

nurses solely operating the public health care posts was 11.5 % in Canada<sup>3</sup>. In the United States, non-physician workforce is being used to address the shortage of patient care physicians in rural areas. In rural areas, there is a shortage of doctors due to low income. 75.4% of the rural areas reported lack of doctors, and the most commonly needed health professionals were nurses<sup>4</sup>. The federal government has made the Nurse Practitioner become the head of the rural clinic, suggesting that less trained personnel than doctors can satisfy a significant portion of the needs of the population. Approximately 4,000 Rural Health Clinics are in operation. In the early days, medical activities such as basic medical treatment and emergency medical care were the main tasks of the public health care posts. Over the past 30 years, there has been a growing need for a new role of the public health care posts due to the changes in the healthcare environment, the development of transportation and communication, the aging of the population, and the decline of the rural population. The results of the previous studies show that the public health care post have a positive effect on increasing the utilization rate and satisfaction of the healthcare services of the local



resident and maintaining and promoting health state<sup>5</sup>. However, the research presented so far is limited in some areas and difficult to generalize. Changes in the healthcare environment are leading to the need to shift the role of public health care posts. In this study, the role of public health care posts will be redefined and measures will be taken to strengthen health promotion in order to ensure effective operation of primary health care policy by identifying the main tasks of the public health care post and the characteristics of the jurisdiction.

## MATERIALS AND METHOD

**Research design:** This study is a descriptive research to develop classification indicators of public health care posts and to diversify functions of public health care posts. In order to carry out the research, domestic and foreign literature and up-to-date report on primary health care in medical vulnerable areas were analyzed. After that, the public health care posts' operation status report was analyzed and two types of surveys were conducted to classify the characteristics of the public health care posts

**Research subjects:** A nationwide survey was conducted of total 1,905 public health care posts and 166 public health centers. The public health center is one of the local public health care organizations in Korea and is responsible for overseeing the public health care posts. There are 254 public health centers nationwide, of which 166 have public health care posts. Of the 166 public health centers, 111 were included in this study. The response rate of the public health center was 66.9%. Among 1,905 public health care posts, 1,205 posts responded to the questionnaire. Except for missing values, the final number of public health care posts included in the analysis was 1,192, which was 62.6% of total public health care posts.

**Data collection and analysis:** Data collection was conducted from August to September in 2016 with IRB approval. The structured questionnaire was completed through consultation with experts and then supplemented by a pilot survey. After explaining the purpose of the questionnaire, the survey was conducted only when the respondent agreed, and the respondents were informed that they could stop at any time if they did not want to. The survey used online survey and postal survey method. General characteristics were analyzed through descriptive statistics. After selecting the classification indicators of medical vulnerable areas through literature

review and Delphi survey, the public health care posts were typified by merging the general characteristics data of the public health care posts surveyed through questionnaires. Delphi is a method to make final decision through opinion and consensus of experts based on objective and accurate information when decision making is difficult. The role of each type was developed through expert panel. The panel of this study consisted of 15 experts with 3 physicians, 5 nurses, 3 professors, 2 social welfare workers, and 2 health and welfare officers.

## RESULTS AND DISCUSSION

**General characteristics of public health care posts:** 1,905 public health care posts are responsible for dealing with a total of 1,551,618 people. It is about 3% of total population in Korea. Among them, the population aged 65 and over is 633,207, which is 40.8%, which is three times higher than that of Korea's elderly population of 13.2%. This means that the population in charge of public health care posts is aging. The average number of people in charge of one health clinic was 814, ranging from 22 to 5,628.

**Public health center survey results:** As the result of examining the traffic development level and the accessibility of the private medical clinic, 53.3% of the respondents answered that the traffic in the area with the public health care posts is developed. Only 23.4% of the respondents answered that the access to the private medical clinic for the local resident was good, and 35.7% answered that accessibility was low. It was surveyed that more than 90% should maintain or reduce the current level of medical care services, which was the initial main task of the public health care posts. 52.6% of the respondents believed that the future role of public health care posts should be centered on health promotion program, and only 14.8% agreed with the role of medical care provider.

**Public health care posts survey results:** The general characteristics of public health care posts are shown in Table 1. The public health care posts were the most dominant in rural areas (70.8%) followed by fishing villages (12.0%), island areas (6.8%) and urban-rural areas (5.7%). Of the 81 posts installed in the island area, 17.3% were connected to the land by bridges, and 82.7% were not connected to the land, so they had to use boat to get to the land. The average number of households in the area covered by one public health care post is 382.8,

the average number of single elderly households is 83.3, and that of multicultural is 6.1. The average age of public health care specialists is 40.1 years old, and over 60% is over 50 years old. 67.6% of the respondents answered that the traffic envelopment level in their jurisdictions was insufficient, and 76.8% of the respondents said that they did not have enough convenient transportation infrastructure to use healthcare facilities. There are still areas where public transportation operates less than once a day. 10.7% of the respondents answered that there were other medical institutions within the jurisdiction except the public health care post. Where medical institutions exist, the average number of clinics is 2.3 and the number of pharmacies is 1.9. In case of using the most popular transportation methods, the average travel time for the local resident is 29.7 minutes to private clinics, 58.2 minutes for hospitals, and 111.8 minutes to general hospitals. Even in emergencies, it takes 17.6 minutes to private clinic, 25.2 minutes to hospital, and 44.2 minutes to general hospital. The average time to 911 arrival is 12.1 minutes and some areas take up to more than 90 minutes. More than 80% of public health care posts responded that the frequency of emergencies was less than one or two times per quarter. 75.5% of the respondents said that the current role of public health care posts is primary medical care, but in the future, 47.8% of respondents said that they should go to the center of health promotion rather than primary medical care.

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**Table 1: General characteristics of public health care posts**

Categories		n(%) / Mean
Location	Rural	844(70.8)
	Fishing	143(12.0)
	Island	81(6.8)
	Urban-rural	68(5.7)
	Mountainous-border	56(4.7)
Mean households in charge	Total	382.8
	Single elderly	83.3
	Multicultural	6.1
Age(year)	Mean	40.1
	20-29	60(5.0)
	30-39	166(14.0)
	40-49	204(16.9)
	50-59	674(56.7)
	60-69	87(7.3)
	More than 70	1(0.1)

Traffic envelopment	Very develop	42(3.5)
	Develop	344(28.9)
	Underdeveloped	621(52.1)
Transportation infrastructure	Very underdeveloped	185(15.5)
	Sufficient	277(23.2)
Number of public transportation per day	Insufficient	915(76.8)
	Less than 1	29(2.4)
	2-4	409(34.3)
	5-9	534(44.8)
Medical Institutions	More than 10	221(18.5)
	Yes	128(10.7)
Time to arrival (minutes)	No	1,064(89.3)
	Normal	□
	private clinic	29.7
	hospital	58.2
	general hospital	111.8
	Emergency	□
	private clinic	17.6
hospital	25.2	
Time to 911 arrival	general hospital	44.2
	Mean(minutes)	12.1
	Less than 5 minutes	91(7.6)
	6-10 minutes	375(31.5)
	10-15 minutes	241(20.2)
	16-20 minutes	279(23.4)
	21-30 minutes	155(13.0)
	31-60 minutes	39(3.3)
Emergency frequency	61-90 minutes	7(0.6)
	More than 90 minutes	5(0.4)
	More than 2 ~ 3 times a week	41(3.4)
	1-2 times a month	160(13.4)
Role	1-2 times a quarter	361(30.4)
	1-2 times a year	631(52.9)
	Now	
	Primary care centered	900(75.5)
	Health promotion centered	180(15.1)
	Health and welfare integration	97(8.1)
	Etc.	15(1.3)
	Future	
	Primary care centered	266(22.3)
	Health promotion centered	570(47.8)
Health and welfare integration	325(27.3)	
Etc.	31(2.6)	

**The classification of public health care posts**

**The classification indicators of medical vulnerable areas:** According to existing research and policy, medical vulnerable area is defined as a region with limited health care demand, difficult access to health care resources, poor quality health care coverage, and poor health level and health outcomes<sup>6</sup>. Accessibility and medical utilization rates are used as indicators of vulnerable health. Accessibility can assess through the proportion of population that is inaccessible or not included within the service area of primary care. The use of healthcare can be analyzed through the percentage of healthcare use within the residence area and the percentage of healthcare use within the reference hour. Accessibility and utilization vary depending on the location and mobility of the subject, and it should be taken into account that such changes tend to be masked by overall data<sup>7</sup>. In this study, we considered the existence of medical institutions in the jurisdiction, the time to arrive to the primary medical institution in emergencies, and the frequency of emergencies to classify the public health care posts and develop the different functions according to characteristics of areas. The presence of medical institutions in the jurisdictions was investigated from the questionnaire survey of the public health care posts. The time required for arrival to the primary medical institution in the emergency was classified as less than 10 minutes, 11-29 minutes, and more than 30 minutes. More than 30 minutes are classified as high vulnerabilities according the study of monitoring medical vulnerable area, which was defined more than 30 minutes as those with a high vulnerability. The frequency of emergencies was determined by reflecting the results of surveys, which suggested the frequency of emergencies such as unconsciousness, dyspnea, fracture, bleeding, trauma, shock, hypoglycemia, etc. is occurred more than once

a day, 1-2 times a week, 2-3 times a week, 1-2 times a month, 1-2 times a quarter, and 1-2 times a year.

**The classification of public health care posts:** The public health care posts were classified into clinic centered posts, clinic maintenance posts, health promotion based posts, and health promotion centered posts as shown in Table 2. 3.1% of the total public health care posts should be strengthened in medical services because there is no medical institution in the jurisdiction, the arrival time to the clinic is more than 10 minutes, and the frequency of emergency is more than once a week. 9.5% of all public health care posts should maintain the same tasks as present; when there is no medical institution in the jurisdiction, the frequency of emergencies is small or the time of arrival in the emergency case is less than 10 minutes. Or if there is a medical institution in the jurisdiction, it is posts where an emergency occurs more than once a week or arrival time to medical institution in an emergency is more 30 minutes. The health promotion based posts means reducing medical treatment work and increasing health promotion work. This type corresponds to 54.9% of the total public health care posts, regardless of whether there is a medical institution in the jurisdiction or not, where the emergency occurs more than once a month, or in the case of emergency, the arrival time to the medical institution is more than 10 minutes. Finally, 32.5% of public health care posts that should be converted into health promotion functions are currently performing both medical care and health promotion services, but in the future, it will be necessary to convert functions into health promotion services rather than medical services. Regardless of the presence or absence of a medical institution in the jurisdiction, this includes areas where the arrival to the medical institution in an emergency is possible within 10 minutes or areas where there are medical institutions and incidence of emergencies is low.

**Table 2: The classification of public health care posts**

Model	Medical facilities	Time to medical institutions	Emergency Frequency	Public health care posts	
Clinic centered	No	≥30min	1-4/week	20	37 (3.1%)
		11-29min		17	
Clinic maintain	No	≥30min	1-2/ quarter	93	113 (9.5%)
		≤10min	1-4/week	11	
	Yes	≥30min	1-2/month	1	
		11-29min	1-4/week	5	
		≤10min		3	

Conted...

Health promotion based	No	11-29min	1-2/month	87	655 (54.9%)
			1-2/ quarter	519	
		≤10min	1-2/month	24	
	Yes	≥30	1-2/ quarter	4	
		11-29min	1-2/month	13	
		≤10min		8	
Health promotion centered	No	≤10min	1-2/ quarter	295	387 (32.5%)
	Yes	11-29min	1-2/ quarter	41	
		≤10min		51	

The characteristics of the area according to the classification of the public health care posts, the rate of island areas is high in clinic centered and maintain posts requiring medical service, and in the case of health promotion based and centered posts, the proportion of urban-rural areas is relatively high as shown in Table 3.

**Table 3: The characteristics of the area according to the classification**

Model	Rural		Fishing		Island		Urban-rural		Mountainous-border		Total
	n	%	n	%	n	%	n	%	n	%	N
Clinic centered	17	2.0	5	3.5	12	14.8	1	1.5	2	3.6	37
Clinic maintenance	60	7.1	11	7.7	34	42.0	1	1.5	7	12.5	113
Health promotion based	474	56.2	81	56.6	26	32.1	38	55.9	36	64.3	655
Health promotion centered	293	34.7	46	32.2	9	11.1	28	41.2	11	19.6	387
total	844	100.0	143.0	100.0	81.0	100.0	68.0	100.0	56.0	100.0	1,192

The average population of public health care posts in the jurisdiction is 845 in the clinic centered posts, 700 in the clinic maintain posts, 784 in the health promotion based posts, and 846 in the health promotion centered posts. The proportion of the elderly population was 41.3% in the health promotion based area, 41.0% in the health promotion based areas, 40.9% in the clinic centered area, and 38.5% in the clinic maintain area. The rate of the number of single elderly households was the highest at clinic maintain area as 25.8%, while the number of multicultural households was the highest at health promotion centered area as 2.0% like Table 4. There was a statistically significant difference in the number of population and household according to classification.

**Table 4: The average population and household**

Model	The number of population			The number of household				
	Total	More than 65 years		Total	Single elderly		Multicultural	
		n	%		n	%	n	%
Clinic centered	845	346	40.9	427	77	18.0	6	1.4
Clinic maintain	700	270	38.5	279	72	25.8	4	1.4
Health promotion based	784	324	41.3	353	78	22.1	5	1.4
Health promotion centered	846	347	41.0	459	97	21.1	9	2.0
F(p)	2.822(.038)	4.980(.002)		2.999(.030)	3.195(.023)		1.446(.228)	

**Reestablishing the Role of public health care posts:** Various management plans should be prepared considering the size of the population and the accessibility of medical institutions. If the population is less than 300 or more than 5,000 people, it is necessary to improve the efficiency of the public health care posts by integrating the posts considering the accessibility of the medical institutions. As the working form of the public health care post is a one-person work system, the scope of the work that can be operated is limited, and it is necessary for several people to work together with the public health care specialists to provide services that match the characteristics of the area. The roles of the public health care posts are shown in Table 5. In the clinic centered model, it is necessary to maintain

the role of primary care, but in clinic maintain model, it is necessary to change the work system to work 1-2 persons together, limit the number of days to provide medical care, and to expand the health promotion work. In the health promotion based model, two or three public health care posts should be integrated into one team with one person in charge of visiting care, one person in health promotion project, and one person for other work. Finally, in the health promotion center model, if the population is low, two or three clinics and residents' welfare centers should be integrated to provide services that link health and welfare. If there are many people in the jurisdiction, additional personnel should be hired to provide a wide range of health promotion programs.

**Table 5: The roles of the public health care posts by classification model**

Model	Scale	Area	Organization and role
Clinic centered	Maintain current scale	<ul style="list-style-type: none"> <li>● Traffic development is low.</li> <li>● difficulty in accessing a clinic</li> </ul>	<ul style="list-style-type: none"> <li>● One person system</li> <li>● Current medical care oriented business</li> </ul>
Clinic maintain	Maintain current scale	<ul style="list-style-type: none"> <li>● Traffic development level is rather low.</li> <li>● Not many emergency patients.</li> <li>● High demand for health promotion work</li> </ul>	<ul style="list-style-type: none"> <li>● One or two persons system</li> <li>● Limited number of medical care days (2~3 days)</li> <li>● Expansion of health promotion business</li> <li>● Visiting and homecare services</li> </ul>
Health promotion based	Integration of 2-3 posts	<ul style="list-style-type: none"> <li>● Good traffic development level</li> <li>● Small population</li> <li>● High demand for home-care services</li> </ul>	<ul style="list-style-type: none"> <li>● Integrated 2~3 of public health care posts into one team</li> </ul>
Health promotion centered	Integration of 2-3 posts and residents' welfare centers	<ul style="list-style-type: none"> <li>● Good traffic development level</li> <li>● Small population</li> <li>● Inadequate welfare facilities in the area</li> </ul>	<ul style="list-style-type: none"> <li>● Organization by integrating with 2~3 posts and resident welfare center</li> <li>● Provide health and welfare linkage service</li> </ul>
	Hire more people under current scale	<ul style="list-style-type: none"> <li>● Good traffic development level</li> <li>● More than a certain size of the population</li> <li>● The existence of welfare facilities in the area</li> <li>● A lot of medical blind people</li> </ul>	<ul style="list-style-type: none"> <li>● One post performs health promotion business</li> <li>● The public health care post specialist is the head of the center, and the health promotion project is carried out by the team including the social worker and the exercise prescription team.</li> </ul>

The proportion of elderly medical expenses among total medical expenses is increasing every year due to the trend of low fertility and aging. It increased to 3.16% in 2010, 33.3% in 2012, 35.5% in 2014, and 38.3% in

2015. In Korea, the proportion of elderly people aged sixty-five and over is 13.1% of the total population, while the proportion of elderly population in public health care posts is about 40%. In addition, 68.7% of fifty-year-old

have at least one chronic illness, 83.7% of those in their sixties, and 91.3% of those in their seventies or older have chronic diseases<sup>8</sup>. Therefore, comprehensive health care through health promotion programs is important. In order to prolong healthy life, continuous and comprehensive management for preventing and early detecting of high-risk factors, minimizing transition to chronic disease, and preventing multiple complications are important. It is effective to manage the high potential of chronic diseases from the middle age to be able to fully exercise the health potential.

In Korea, a dementia rate of the elderly who are over sixty-five is about 9.2%. This is much higher than the 4.19-7.63% prevalence of dementia in Southeast Asia and China. This shows that Korea is relatively more aging than Southeast Asia and China and has been showing a high rate of progress. Japan has entered the super-aged society, and the prevalence of dementia in the elderly population over 65 is 15%<sup>9</sup>. The prevalence of Alzheimer's disease was 5.7% in dementia, and vascular dementia was 2.1%. The cause of vascular dementia is associated with chronic diseases such as hypertension, arteriosclerosis and diabetes, so careful management of this disease can partially prevent vascular dementia. Excessive drinking and smoking are the factors that cause dementia. Currently, the elderly health services are mostly provided in the public health care posts, but it is required to activate the programs for the early detection, treatment and prevention of dementia, early screening project, registration, and support of dementia. The need for persistence and comprehensiveness of health care is high for the elderly in the 50-64 age groups<sup>10</sup>. However, there is a lack of health care programs for people aged 20-64 because the public health care post programs are focused on the elderly health care and medical services. Therefore, it is necessary to operate the public health care post hours in a flexible manner or to visit the business sites to provide services. Lastly, access to services through home and institution visits should be improved, and regular and comprehensive health care will be required through periodic visits.

## CONCLUSION

This study suggested the types and roles of public health care after analyzing the characteristics of public health care posts by their location, demographic and socioeconomic characteristics. The subjects of this

study were 1,904 public health care posts nationwide in 2016, and finally analyzed the data of 1,192 posts. The public health care posts were classified based on the classification indicator of medical vulnerable area. The existence of medical institutions in the jurisdiction, the time to arrive to the medical institution in case of emergency, and the frequency of emergencies were used as indicators of medical vulnerable area. Finally, the public health care posts were classified into clinic centered posts, clinic maintenance posts, health promotion based posts, and health promotion centered posts. Among 1,192 posts, clinic centered model were 37 posts (3.1%), clinic maintain model were 113 posts (9.5%), health promotion based model were 655 posts (54.9%), and health promotion centered model were 387 posts (32.5%). In other words, it was analyzed that more than 80% of the total public health care posts should expand the health promotion services rather than the medical clinic services. To redefine the role of public health care posts, the size of the population and the accessibility of medical institutions were considered. Even in the same rural areas, there is a clear difference between the distance from the cities, the accessibility of the medical institutions in the region, and the social and cultural characteristics. Therefore, the healthcare and health promotion policies should be established and promoted by subdividing functions. Where medical clinic services are needed, they should maintain the function of medical care as in the present role. However, where health promotion work is required, the system should be changed to provide services that match the characteristics of local conditions. One alternative would be to have multiple staff members working together to provide diverse services. In addition, it is also necessary to strengthen the education and support system that can strengthen the professionalism of the public health care post specialists to carry out various roles.

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# The Effects of Dietary Habits and Food Stability Awareness on Diabetes in South Korea

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## ABSTRACT

This study aimed to analyze the effects of dietary habits and food stability awareness on diabetes in South Korea. This study used the data from the Korea Health Statistics 2014: Korea National Health and Nutrition Examination Survey (KNHANES) VI-2, which were disclosed in 2015. The data from 4,374 persons were analyzed, with the exception of those who were in the group aged  $\leq 20$  years, who made no response, and who had missing values. The analysis was performed using an SPSS for Windows program 12.0 Version. As for the dietary conditions, the group lacking food intake sometimes had diabetes diagnosis status affected ( $p < .05$ ). As for the dietary habits, the negative answers to dietary conditions, experience of being concerned about food intake, experience of poor dietary balance, and experience of skipping a meal were associated with lower levels of food stability ( $p < .001$ ). As for the associations between diabetes treatment and food stability, diabetes treatment status ( $\beta = -.221$ ,  $t = -2.299$ ,  $p < .05$ ), insulin injection ( $\beta = .044$ ,  $t = 2.366$ ,  $p < .05$ ), and antidiabetic medication ( $\beta = .263$ ,  $t = 2.831$ ,  $p < .01$ ) affected food stability ( $p < .05$ ) ( $p < .01$ ). Dietary habits affected poor dietary balance, experience of skipping a meal, food stability, diabetes diagnosis, and diabetes treatment. On the basis of these results, it is necessary to improve health programs with the objective of maintaining a healthy life by treating diabetes and by improving food stability.

**Keywords:** *Dietary habit, food stability, diabetes, diabetes treatment, food stability status*

## INTRODUCTION

Yoon and Kim<sup>1</sup> suggested the need to see if food science and technology applied to food production, processing, and distribution was appropriate in determining the level of food safety. They also noted that safety or risk determination covered the psychological aspect: consumers' subjective judgment and awareness. Lee and Yoo<sup>2</sup> found that the food instability group was 3.49 times more likely to have depression and 3.7 times more likely to feel depressed than the food stability group. They also found that the group at the early stage of food instability was 1.69 times more likely to feel depressed in the final model.

Park<sup>3</sup> suggested that the changes of the dietary habits could lead to changes in diabetes. Jeon and Kim<sup>4</sup> noted that the risk of the onset of diabetes depended on the frequency of food intake. Park<sup>3</sup> noted that maturity-onset diabetes was common and formed 80-90% of all types of diabetes. Montonen et al.<sup>5</sup> found that a food pattern was associated with the onset of Type 2 diabetes.

Jeong et al.<sup>6</sup> who analyzed diseases by the degree of obesity, found that the overweight and obese groups showed higher prevalence rates of hypercholesterolemia than the underweight group. They also found that the overweight and obese groups showed higher prevalence rates of impaired fasting glucose and diabetes. Yeo et al.<sup>7</sup> suggested that diabetes treatment involve medication and insulin injection, regardless of gender. Hong and Kim<sup>8</sup> suggested that diabetes management involve medication, exercise, and a diet. They indicated that its complications and progression could be delayed by using these three basic methods.

This study used the data from the sample survey representative of national health of South Korea—KNHANES VI-2—which were disclosed by the Ministry of Health and Welfare (MOHW) and the Korea Centers for Disease Control and Prevention (KCDC) in 2015. This study aimed to determine the effects of dietary habits and food stability awareness on diabetes by using the raw data concerning diabetes and food stability.



Since diabetes is very likely to be caused by bad dietary habits, it is necessary to make efficient food stability management and develop diabetes prevention programs. This study aimed to see how food stability affected diabetes and help keep a healthy life against the onset of diabetes. On this basis, it intended to provide basic data that could help develop food stability and diabetes programs.

### MATERIALS AND METHOD

**Tool of study:** This study used the raw data from Korea Health Statistics 2014: KNHANES VI-2, which were disclosed by MOHW and KCDC<sup>9</sup> in 2015.

The raw data are coded in numbers and one can choose items related to the theme of the study. This study used the raw data concerning diabetes and food stability from Korea Health Statistics 2014: KNHANES VI-2.

The raw data from those who made no response, who had missing values, and who were aged ≤20 were excluded. Of 7,550 respondents, a total of 4,374 respondents were analyzed, with the exception of 3,176 who made no response, who had missing values, and who were aged ≤20.

The variables drawn from the raw data included the general characteristics, the diabetic characteristics, food stability, and dietary habits. Specifically, the diabetic characteristics included diabetes diagnosis status, diabetes treatment status, insulin injection, antidiabetic medication, and non-pharmaceutical therapy. The variables of dietary habits related to food stability included household dietary management, dietary conditions, experience of being concerned about food intake, experience of poor dietary balance, experience of skipping a meal, and differentiated food stability status.

In scoring for “food stability status” among the variables of dietary habits related to food stability, the

scores for 18 items, which covered children as well, were added up to determine household food stability. In adding up the scores for the 18 items, never scored 0 and frequently and sometimes scored 1. The added-up scores for the 18 items were rescored for differentiated food stability status. For rescoring, 0-2 items scored 1, 3-7 items scored 2, 8-12 items scored 3, and 13-18 items scored 4. This is called “food stability status.”

A four-point likert scale was used to rate food stability status. The scores ranged from 1 to 4. Specifically, food stability security scored 1, the early stage of food instability 2, the intermediate stage of food instability 3, and the intensive stage of food instability 4. The higher score, the lower level of food stability.

**Data utilization:** Approval was obtained from the Institutional Review Board (IRB) of C University before using the raw data. The results of approval review were exempted from review (Human-002-20170415-1st). The raw data were drawn from KNHANES-2.

**Statistical analysis:** The analysis was performed using an SPSS for Windows program 12.0 Version. The empirical analysis was performed by using frequency and percentage,  $\chi^2$ , the mean and standard deviation, t-test, ANOVA, multiple regression analysis, and dichotomous logistic regression. The significance level was set at  $p < .05$ .

### RESULTS AND DISCUSSION

**Differences in household dietary management status by general characteristics:** The differences in household dietary management status by the general characteristics are as presented in Table 1. Males (38.7%) were better at household dietary management than females (61.3%) ( $p < .001$ ); the older, the better at household dietary management ( $p < .001$ ). No statistically significant difference was found in the other items.

**Table 1: Differences in household dietary management status by general characteristics**

Category Yes4156(95.0)		Household dietary life management status (4374)		$\chi^2$	p
		No218(5.0)			
Gender	Male	1610(38.7)	137(62.8)	50.173	.000***
	Female	2546(61.3)	81(37.2)		

Conted...

Age	20-29	389(9.4)	35(16.1)	19.327	.001***
	30-39	740(17.8)	22(10.1)		
	40-49	711(17.1)	29(13.3)		
	50-59	791(19.0)	44(20.2)		
	60≤	1525(36.7)	88(40.4)		
Household income	Low	811(19.5)	39(17.9)	.824	.844
	Mid low	1036(24.9)	59(27.1)		
	Mid high	1188(28.6)	64(29.4)		
	High	1120(27.0)	56(25.7)		
Education level	Elementary school graduates	1063(25.6)	49(22.5)	1.569	.666
	Junior high school graduates	463(11.1)	27(12.4)		
	High school graduates	1301(31.3)	74(33.9)		
	University graduates≤	1329(32.0)	68(31.2)		
Occupation	Manager & professional	521(12.5)	28(12.8)	3.254	.776
	Office worker	371(8.9)	17(7.8)		
	Service provider	487(11.7)	29(13.3)		
	Agriculture, forestry, & fishery worker	245(5.9)	11(5.0)		
	Technical service provider	373(9.0)	21(9.6)		
	Manual laborer	366(8.8)	25(11.5)		
	Unemployed (housewife/ student)	1793(43.1)	87(39.9)		
***p<.001					

**Effects of general characteristics on household dietary management status:** The effects of the general characteristics on household dietary management status are as presented in Table 2. Dichotomous logistic regression was carried out to determine the effects on household dietary management status. Females were (approx. 2.7 times;  $p<.001$ ) better at household dietary management than males. The younger, the more concerned about household dietary management status ( $p<.001$ ). No statistically significant difference was found in the other items.

**Table 2: Effects of general characteristics on household dietary management status**

Category	B	p	Odds Ratio lower	95% Confidence interval	
				upper	
Gender#	Male		1.00		
	Female	1.028	.000***	2.795	2.065 3.785

Conted...

Age#	20-29			1.00		
	30-39	-1.080	.000***	.340	.193	.597
	40-49	-.753	.005**	.471	.279	.794
	50-59	-.404	.107	.667	.408	1.091
	60≤	-.355	.146	.701	.434	1.132
Household income#	Low			1.00		
	Mid low	.171	.448	1.186	.763	1.844
	Mid high	.175	.457	1.191	.751	1.889
	High	.049	.844	1.051	.643	1.717
Education level#	Elementary school graduates			1.00		
	Junior high school graduates	.084	.744	1.088	.655	1.806
	High school graduates	.107	.645	1.113	.707	1.752
	University graduates≤	.147	.575	1.158	.693	1.934
Occupation#	Manager & professional			1.00		
	Office worker	-.205	.521	.815	.436	1.523
	Service provider	.185	.528	1.203	.678	2.134
	Agriculture, forestry, & fishery worker	-.387	.331	.679	.312	1.480
	Technical service provider	-.295	.360	.745	.397	1.399
	Manual laborer	.226	.474	1.254	.675	2.331
	Unemployed (housewife/student)	-.033	.898	.968	.586	1.597
**p<.01, ***p<.001 # Analysis after changing independent variable into dummy variable						

**Differences in diabetes diagnosis status by dietary habits:** The differences in diabetes diagnosis status by the dietary habits are as presented in Table 3. As for the dietary conditions, the group having a sufficient amount of diverse foods was more concerned about diabetes diagnosis status (p<.05). The group skipping no meal (97.0%) was more concerned about diabetes diagnosis status (p<.05).

Park <sup>3</sup> found that both males and females shifted into mild food after the onset of diabetes. This finding implies that diabetes can be treated by dietary habits. Hong et al <sup>8</sup> suggested that the patients themselves should manage diabetes on a steady basis.

**Table 3: Differences in diabetes diagnosis status by dietary habits**

Category Yes395(9.0)		Diabetes diagnosis status (4374)		$\chi^2$	p
		No3979(91.0)			
Dietary management	Yes	374(94.7)	3782(95.0)	.101	.750
	No	21(5.3)	197(5.0)		

Conted...

Dietary conditions	Sufficient amount of diverse foods	192(48.6)	2019(50.7)	8.617	.035*
	Sufficient amount of foods without diversity	173(43.8)	1786(44.9)		
	Lacking food intake sometimes	24(6.1)	134(3.4)		
	Lacking food intake frequently	6(1.5)	40(1.0)		
Experience of skipping a meal	Yes	12(3.0)	66(1.7)	3.903	.048*
	No	383(97.0)	3913(98.3)		
*p<.05					

**Effects of dietary habits on diabetes diagnosis status:** The effects of dietary habits on diabetes diagnosis status are as presented in Table 4. Dichotomous logistic regression was carried out to determine diabetes diagnosis status. The dependent variable was “diabetes diagnosis status” and the independent variables were “dietary life management,” “dietary conditions,” and “experience of skipping a meal.”

As for the dietary conditions, the “group lacking food intake sometimes” had diabetes diagnosis status affected ( $p<.05$ ).

Whiting et al <sup>10</sup> noted that diabetes was on the increase. Park <sup>3</sup> found that before the onset of diabetes, males were likely to have spicy food and meat and females were also likely to have meat. This finding implies that dietary habits can affect diabetes.

**Table 4: Effects of dietary habits on diabetes diagnosis status**

Category		B	p	Odds Ratio	95% Confidence interval	
					lower	upper
Dietary management #	Yes			1.00		
	No	.092	.698	1.096	.690	1.741
Dietary conditions#	Sufficient amount of diverse foods			1.00		
	Sufficient amount of foods without diversity	-.014	.899	.986	.795	1.223
	Lacking food intake sometimes	-.571	.019*	.565	.350	.912
	Lacking food intake frequently	-.274	.570	.761	.296	1.957
Experience of skipping a meal#	Yes			1.00		
	No	-.372	.297	.689	.342	1.388
*p<.05						
# Analysis after changing independent variable into dummy variable						

**Differentiated food stability status by dietary habits:**

Differentiated food stability status by the dietary habits are as presented in Table 5. The scores for differentiated food stability status ranged from 1 to 4. Specifically, food stability security scored 1, the early stage of food instability 2, the intermediate stage of food instability 3, and the intensive stage of food instability 4. The higher score, the lower level of food stability.

As for the dietary conditions, the “group lacking food intake frequently” (2.37) was negative about food stability ( $p<.001$ ). The “group concerned about food intake frequently” (2.19) was more concerned about food

intake ( $p<.001$ ). The “group frequently experiencing poor dietary balance” (1.81) was more aware of poor dietary balance ( $p<.001$ ). The “group skipping a meal” (2.65) was more likely to have experience of skipping a meal ( $p<.001$ ). The higher score, the lower level of differentiated food stability.

Knight <sup>11</sup> found that food safety was affected by the determinants of the risk of food safety. This finding is consistent with the result of this study that the group lacking food intake showed a lower level of differentiated food stability.

**Table 5: Differentiated food stability status by dietary habits**

Category		Differentiated food stability status	t/F	p
		Mean ± SD		
Dietary conditions	Sufficient amount of diverse foods	1.02 ± .140	630.900	.000***
	Sufficient amount of foods without diversity	1.09 ± .312		
	Lacking food intake sometimes	1.72 ± .704		
	Lacking food intake frequently	2.37 ± .878		
Experience of being concerned about food intake	Frequently	2.19 ± .799	2203.873	.000***
	Sometimes	1.53 ± .584		
	Never	1.00 ± .074		
Experience of poor dietary balance	Frequently	1.81 ± .799	1388.737	.000***
	Sometimes	1.50 ± .599		
	Never	1.01 ± .083		
Experience of skipping a meal	Yes	2.65 ± .641	52.996	.000***
	No	1.06 ± .251		

**Differentiated food stability status by diabetes treatment:** The differentiated food stability status by diabetes treatment is as presented in Table 6. The higher score, the lower level of differentiated food stability. The group getting treatment for diabetes was statistically insignificantly more negative about differentiated food stability.

**Table 6: Differentiated food stability status by diabetes treatment**

Category		Differentiated food stability status	t/F	p
		Mean ± SD		
Diabetes treatment status <sup>#</sup>	Yes	1.16 ± .437	.559	.576
	No	1.12 ± .327		
Insulin injection <sup>#</sup>	Yes	1.23 ± .598	.968	.334
	No	1.15 ± .416		
Antidiabetic medication <sup>#</sup>	Yes	1.17 ± .443	1.297	.195
	No	1.00 ± .000		
Non-pharmaceutical therapy <sup>#</sup>	Yes	1.21 ± .544	1.204	.229
	No	1.15 ± .401		

**Effects of diabetes treatment on food stability:** The effects of diabetes treatment on food stability are as presented in Table 7. Multiple regression analysis was performed to determine the effects of diabetes treatment on food stability. Such factors as diabetes treatment status ( $\beta=-.221$ ,  $t=-2.299$ ,  $p<.05$ ), insulin injection ( $\beta=.044$ ,  $t=2.366$ ,  $p<.05$ ), and antidiabetic medication ( $\beta=.263$ ,  $t=2.831$ ,  $p<.01$ ) affected food stability.

Hong et al.<sup>8</sup> suggested that diabetes management involve a diet, exercise, and medication. Van Dam et al.<sup>12</sup> found that the Western dietary pattern increased the

risk of Type 2 diabetes for males. Bains and Egede<sup>13</sup> noted that knowledge about diabetes and health status was associated with blood glucose control. Aljaseem et al.<sup>14</sup> suggested that self-awareness ability should be integrated into a health belief model.

The literature review suggests that a health belief model integrated with exercise, medication, diets, and self-management to treat diabetes can help maintain a healthy life. It is necessary to perform health care with the objective of keeping a healthy life against diabetes.

**Table 7: Effects of diabetes treatment on food stability**

	<b>B</b>	<b>S.E</b>	<b>β</b>	<b>t</b>	<b>p</b>
Diabetes treatment status <sup>#</sup>	-.270	.118	-.221	-2.299	.022*
Insulin injection <sup>#</sup>	.165	.070	.044	2.366	.018*
Antidiabetic medication <sup>#</sup>	.326	.115	.263	2.831	.005**
Non-pharmaceutical therapy <sup>#</sup>	.070	.043	.028	1.633	.103
*p<.05, **p<.01 R=.081, R <sup>2</sup> =.007, F=7.249, P=.000 # Analysis after changing independent variable into dummy variable					

## CONCLUSION

This study aimed to analyze the effects of dietary habits and food stability awareness on diabetes in South Korea. Dietary habits affected poor dietary balance, experience of skipping a meal, food stability, diabetes diagnosis, and diabetes treatment.

For food stability and diabetes prevention, the following suggestions can be made: first, it is necessary to reinforce institutional devices with the aim of improving food stability; second, it is necessary to reinforce treatment programs for diabetes prevention.

This study has the following limitations: first, since it used the data from KNHANES, those aged  $\leq 20$  years were not covered; second, those aged  $\geq 20$  years who made no response and who had missing values were excluded. Care should be taken in comparison with the results of other studies on food stability and diabetes.

On the basis of these results, it is necessary to reinforce health programs aimed at maintaining a healthy life through diabetes treatment and improvement in food stability.

**Ethical Clearance:** Taken from Chungcheong University

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# The Effects of Adults' Dietary Habit Awareness on Obesity and Weight Control

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## ABSTRACT

This study aimed to analyze the effects of adults' dietary habit awareness on obesity and weight control. This study used the data from the Korea Health Statistics 2015: Korea National Health and Nutrition Examination Survey (KNHANES) VI-3, which were disclosed in 2016. Of 7,380 respondents, a total of 4,385 respondents were analyzed, with the exception of 2,995 who were aged  $\leq 20$ , who had missing values, and who made no response. The analysis was performed using an SPSS for Windows program 12.0 Version. Dietary supplement intake and nutrition labeling recognition affected weight control ( $p < .01$ ). As for the association between obesity and weight control and subjective body image, the "weight gain group" (3.79) showed a higher level of subjective body image than the "weight loss group" (3.02) ( $p < .001$ ). Dietary habit awareness affected obesity and weight control. On the basis of these results, it is necessary to improve programs and policies that can maintain a healthy life through improvement of dietary habits and obesity management and weight control.

**Keywords:** Dietary habit awareness, obesity, weight control, dietary habit, weight variation

## INTRODUCTION

Makino et al.<sup>1</sup> indicated that abnormal dietary attitude was associated with insufficient sleep time and irregular dietary habits. Lowry et al.<sup>2</sup> suggested a good diet and physical activity in pursuit of healthy weight control. Lee et al.<sup>3</sup> noted that the changes in consumption consciousness led to the changes in the environment of dietary culture. Choi et al.<sup>4</sup> mentioned such dietary problems as going without a meal, overeating, habit of having an unbalanced diet, unbalanced nutrient intake, and lack of exercise. They suggested that undesirable dietary habits and lack of exercise could lead to obesity and adversely affect health.

Razay et al.<sup>5</sup> noted that obesity was associated with Alzheimer's disease. Avogaro and Kreutzenberg<sup>6</sup> noted that obesity could lead to endothelial dysfunction. They also indicated that obesity was a chronic condition that could adversely affect infants and adolescents as well as adults.

Health care may involve obesity and weight control; Lee<sup>7</sup> found that females were more concerned about weight and were more likely to try to control weight than males. Bae et al.<sup>8</sup> found that applying an aerobic and

combined exercise program could reduce the body mass index and body fat percentage. Yoon et al.<sup>9</sup> suggested the need to increase the educational opportunities to improve nutritional knowledge.

In case of obesity, failure to control weight is expected to have an adverse effect on health. Al Snih et al.<sup>10</sup> indicated that obesity could disturb activities of daily living (ADL). They also noted that it was associated with Alzheimer's disease<sup>5</sup> and caused endothelial dysfunction<sup>6</sup>.

This study used the data from KNHANES -3. The data concerning dietary habits and food stability were drawn to determine the effects of dietary habits and food stability awareness on diabetes.

Since obesity and weight control are more likely to be caused by bad dietary habits, it is necessary to develop efficient weight control and obesity prevention programs. This study aimed to see how usual dietary habits affected weight control and obesity and help improve dietary culture, manage obesity, and control weight. On this basis, it intended to provide basic data that could help develop weight control and obesity management programs.



**MATERIALS AND METHOD**

**Research tools:** This study used the raw data from Korea Health Statistics 2015: KNHANES -3 by the Ministry of Health and Welfare (MOHW) and the Korea Centers for Disease Control and Prevention (KCDC)<sup>11</sup>.

The guidelines for using the raw data from KNHANES<sup>11</sup> largely had three categories: a survey on health, a survey on check-up, and a survey on nutrition. They were subdivided into a survey on household, a survey on medical check-up and vaccination, activity restrictions and quality of life, injuries and accidents/intoxication, healthcare utilization, and education and economic activity, a survey on health behavior, a survey on dietary life, a survey on frequency of food intake, and a survey on food intake. This study used the surveys on health behavior and on dietary life among those on health and nutrition to determine the association between dietary habits and obesity and weight control.

To determine the association between dietary habit awareness and obesity and weight control, only the raw data from those aged ≥20 years were used. To investigate adults’ dietary habit awareness and obesity, the group aged ≤20 years was excluded. In terms of the socio-demographic characteristics, those who had missing values and who made no response were also excluded. Of 7,380 respondents, a total of 4,385 respondents were analyzed, with the exception of 2,995 who were aged ≤20, who had missing values, and who made no response.

The variables in the surveys on health behavior and on dietary habits included the socio-demographic characteristics, obesity and weight control, and dietary habit awareness. Of the obesity-related variables, subjective body image was rated in a five-point likert scale: very thin 1, slightly thin 2, average 3, slightly obese 4, and very obese 5, with a higher score meaning more obese. The variable composition is as presented in Table 1.

**Ethics Approval for Research:** Approval was obtained from the Institutional Review Board (IRB) of C University before starting this study. The raw data were drawn from KNHANES. The results of approval review were exempted from review (Human-001-20170415-1st).

**Analysis method:** The data analysis was performed using an SPSS for Windows program 12.0 Version. Specifically, frequency and percentage, the mean and

standard deviation, t-test, ANOVA, multiple regression analysis, and dichotomous logistic regression were used. The significance level was set at p<.05.

**RESULTS**

**Differences in nutrition labeling recognition status by socio-demographic characteristics:** The differences in nutrition labeling recognition status by the socio-demographic characteristics are as presented in Table 2. Females (62.1%) were more likely to recognize nutrition labeling than males (37.9%) (p<.001). The respondents aged 50-59 (22.6%) were more likely to recognize nutrition labeling than those aged 40-49 (22.2%) (p<.001). As for household income, the high-income bracket (34.5%) were more likely to recognize nutrition labeling (p<.001); college graduates (41.5%) were more likely to recognize nutrition labeling (p<.001). Unemployed housewives (36.9%) were more likely to recognize nutrition labeling than the other vocational groups (p<.001)

**Table 1: Variable composition**

Variable category	Variable details
<b>Dependent variables</b>	
Nutrition labeling recognition status	Yes, No
Weight control status	Yes, No
Subjective body image	Very thin, slightly thin, average, slightly obese, very obese
<b>Independent variables</b>	
<b>Socio-demographic characteristics</b>	
Gender	Male, Female
Age	20’s, 30’s, 40’s, 50’s, 60’s≤
Household income	Low, Mid low, Mid high, High
Education level	Elementary school graduates, Junior high school graduates, High school graduates, University graduates≤
Occupation	Manager & professional. Office worker Service provider Agriculture, forestry, & fishery worker Technical service provider Manual laborer Unemployed (housewife/student)

Conted...

Dietary habit	
Dietary supplement intake status	Yes, No
Nutrition education status	Yes, No
Nutrition labeling recognition status	Yes, No
Dietary life support program benefit	Yes, No

Conted...

Obesity and weight control	
Weight variation status for a year	No variation, weight loss, weight gain
Weight loss for a year	3-6kg, 7-10kg, 10kg≤
Weight gain for a year	3-6kg, 7-10kg, 10kg≤
Weight control status	Yes, No

**Table 2: Differences in nutrition labeling recognition status by socio-demographic characteristics**

Category		Nutrition labeling recognition(4385)		p
		Yes 3130(71.4)	No 1255(28.6)	
Gender	Male	1186(37.9)	628(50.0)	.000***
	Female	1944(62.1)	627(50.0)	
Age	20-29	459(14.7)	25(2.0)	.000***
	30-39	585(18.7)	24(1.9)	
	40-49	694(22.2)	71(5.7)	
	50-59	706(22.6)	215(17.1)	
	60≤	686(21.9)	920(73.3)	
Household income	Low	355(11.4)	498(39.7)	.000***
	Mid low	756(24.2)	329(26.2)	
	Mid high	936(29.9)	241(19.2)	
	High	1080(34.5)	187(14.9)	
Education level	Elementary school graduates	345(31.0)	717(57.1)	.000***
	Junior high school graduates	303(9.7)	177(14.1)	
	High school graduates	1182(37.8)	240(19.1)	
	University graduates≤	1300(41.5)	121(9.6)	
Occupation	Manager & professional	525(16.8)	48(3.8)	.000***
	Office worker	368(11.8)	32(2.5)	
	Service provider	450(14.4)	90(7.2)	
	Agriculture, forestry, & fishery worker	112(3.6)	136(10.8)	
	Technical service provider	270(8.6)	124(9.9)	
	Manual laborer	250(8.0)	161(12.8)	
	Unemployed (housewife/student)	1155(36.9)	664(52.9)	
***p<.001				

**Effects of socio-demographic characteristics on nutrition labeling recognition status:** The effects of the socio-demographic characteristics on nutrition labeling recognition status are as presented in Table 3. Dichotomous logistic regression was carried out to determine the effects on nutrition labeling recognition status.

Females were (approx. 2.8 times;  $p<.001$ ) more likely to recognize nutrition labeling; the older, the more likely to recognize nutrition labeling: about 2.0 times for the respondents aged 40-49 ( $p<.01$ ), about 3.7 times for those aged 50-59 ( $p<.001$ ), and about 8.6 times for those aged  $\geq 60$  ( $p<.001$ ). Household income and education level affected nutrition labeling recognition ( $p<.001$ ).

Yoon et al<sup>9</sup> suggested the need to make efforts to improve nutritional knowledge in terms of dietary habits. They imply that people can make their own efforts to improve dietary habits.

**Table 3: Effects of socio-demographic characteristics on nutrition labeling recognition status**

	Category	B	p	Odds Ratio	95% Confidence interval	
					lower	upper
Gender#	Male			1.00		
	Female	1.011	.000***	2.750	2.272	3.327
Age#	20-29			1.00		
	30-39	.050	.868	1.052	.582	1.900
	40-49	.711	.004**	2.035	1.251	3.312
	50-59	1.303	.000***	3.679	2.337	5.791
	60≤	2.146	.000***	8.550	5.506	13.278
Household income#	Low			1.00		
	Mid low	-.532	.000***	.588	.468	.738
	Mid high	-.456	.000***	.634	.495	.811
	High	-.540	.000***	.583	.446	.762
Education level#	Elementary school graduates			1.00		
	Junior high school graduates	-1.051	.000***	.349	.272	.449
	High school graduates	-1.607	.000***	.200	.158	.254
	University graduates≤	-2.065	.000***	.127	.093	.173
Occupation#	Manager & professional			1.00		
	Office worker	-.030	.906	.970	.589	1.598
	Service provider	-.160	.472	.852	.552	1.317
	Agriculture, forestry, & fishery worker	.252	.288	1.287	.808	2.048
	Technical service provider	.331	.134	1.393	.903	2.150
	Manual laborer	.279	.204	1.321	.859	2.032
	Unemployed (housewife/student)	.322	.096	1.379	.944	2.014
**p<.01, ***p<.001 # Dummy variable						

**Differences in weight control status by dietary habits:**

The differences in weight control status by the dietary habits are as presented in Table 4. Of the 4,385 respondents, 66.9% had controlled weight and 33.1% had never controlled weight. 52.9% had take no nutritional supplement (p<.001) and 76.6% were concerned about weight control in terms of nutrition labeling recognition (p<.001).

Lee<sup>7</sup> found that weight control varied by one’s own belief. Bae et al<sup>8</sup> found that an aerobic and combined exercise program led to weight variation and reduced body fat percentage. This finding implies that obesity can be managed effectively by exercise.

**Table 4: Differences in weight control status by dietary habits**

Category		Weight control status (4385)		P
		Yes2934(66.9)	No1451(33.1)	
Dietary supplement intake status	Yes	1383(47.1)	597(41.1)	.000***
	No	1551(52.9)	854(58.9)	

Conted...

Nutrition education status	Yes	135(4.6)	54(3.7)	.177
	No	2799(95.4)	1397(96.3)	
Nutrition labeling recognition status	Yes	2246(76.6)	884(60.9)	.000***
	No	688(23.4)	567(39.1)	
Dietary life support program benefit	Yes	84(2.9)	52(3.6)	.895
	No	2850(97.1)	1399(96.4)	
***p<.001				

**Table 5: Effects of dietary habits on weight control status**

Category	B	p	Odds Ratio	95% Confidence interval	
				lower	upper
Dietary supplement intake status #	Yes		1.00		
	No	-.189	.004**	.828	.942
Nutrition education status#	Yes		1.00		
	No	-.192	.250	.595	1.144
Nutrition labeling recognition status#	Yes		1.00		
	No	-.721	.000***	.424	.558
Dietary life support program benefit#	Yes		1.00		
	No	.016	.933	1.016	1.458
**p<.01, ***p<.001 # Dummy variable					

**Effects of dietary habits on weight control status:** The effects of dietary habits on weight control status are as presented in Table 5. Dichotomous logistic regression was carried out to determine the effects on weight control status.

The “dietary supplement intake group” had weight control affected ( $p<.01$ ). The “group recognizing nutrition labeling” had weight control affected ( $p<.001$ ).

Lee <sup>7</sup> found that as for subjective body image, the respondents considered themselves to be rather fat, with females being more likely to consider themselves to be fat than males. Kim et al<sup>12</sup> attached importance to nutrition intake through good dietary habits

**Table 6: Differences in subjective body image by obesity and weight control**

Category		Mean	S.D	t/F	p
Weight variation status for a year	No variation	3.18	0.879	211.666	.000***
	Weight loss,	3.02	1.067		
	Weight gain	3.79	0.843		
Weight loss for a year	3-6kg	2.95	1.021	18.392	.000***
	7-10kg	3.29	1.183		
	10kg≤	3.06	1.137		
Weight gain for a year	3-6kg	3.71	0.832	11.555	.000***
	7-10kg	3.94	0.807		
	10kg≤	4.22	0.860		
Weight control status	Yes	3.42	.928	11.555	.000***
	No	3.08	.922		
*p<.05, ***p<.001					

**Differences in subjective body image by obesity and weight control:** The differences in subjective body image by obesity and weight control are as presented in Table 6. As for weight variation for a year, the “weight gain group” scored 3.79, the “no weight variation group” scored 3.18, and the “weight loss group” scored 3.02 for subjective body image ( $p<.001$ ).

As for weight loss for a year, the “group weighing 7-10 kg” scored high (3.29) for subjective body image ( $p<.05$ ). As for weight gain for a year, the “group gaining weight by  $\geq 10$  kg” scored high (4.22) for subjective body image ( $p<.001$ ). The “weight control group” scored high (3.42) for subjective body image ( $p<.001$ ).

Kim et al <sup>12</sup> indicated that improvement of dietary habits could prevent diseases and promote health. Im et al<sup>13</sup> noted that obesity was also associated with going without a meal. Avogaro and Kreutzenberg <sup>6</sup> noted that obesity could increase metabolic abnormalities and cardiovascular diseases. They also noted that adipose tissues could adversely affect metabolism and cause atherosclerosis.

Vander Wal and Thelen <sup>14</sup> noted that obesity was affected by diets and dietary habits. Zwaan <sup>15</sup> found that obesity was also associated with binge eating disorder. This finding emphasizes the importance of dietary habits.

### CONCLUSION

This study aimed to analyze the effects of adults’ dietary habit awareness on obesity and weight control. Dietary supplement intake and nutrition labeling affected weight control. In terms of obesity and weight control, the subjective body image of “weight gain” was at a higher level.

In pursuit of a healthy life based on obesity management and weight control, the following suggestions can be made: First, it is necessary to reinforce education programs that can change dietary habits. There is time to overeat due to social stress and phenomena. The efforts to prevent excessive eating through promotional materials, videos, and onsite education in each institution are expected to help manage obesity and control weight. Second, it is necessary to improve obesity treatment and management programs. This is because it is a way of making long-term recovery from the adverse effects on obesity management and weight

control. The efforts to improve education and treatment and management programs are expected to help develop obesity management and weight control programs.

Despite the significance of this study, it has some limitations: first, since it aimed to investigate adults’ obesity and weight control, those aged  $\leq 20$  years were not covered; second, those aged  $\geq 20$  years who made no response and who had missing values were excluded. Care should be taken in generalizing these results in comparison with those of other studies.

On the basis of these results, it is necessary to improve programs and policies that can maintain a healthy life through improvement of dietary habits and obesity management and weight control.

**Ethical Clearance:** Taken from Chungcheong University

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# A Comparison of the Quality of Chest Compression between Right and Left Palm Compression for Cardiopulmonary Resuscitation By a Rescuer

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## ABSTRACT

This study aimed to analyze the differences in the quality of chest compression between right and left palm compression using a manikin. This study was conducted in those who understood its purpose and consented to participate in it. The participants were divided into the left palm chest compression group (LPCG; N=42) and the right palm chest compression group (RPCG; N=40). The measurement was performed from May 15 to June 2, 2017. The analysis was performed using an SPSS for Windows program 12.0 Version. Both LPCG and RPCG showed good compression velocity (times/min) ( $p < .05$ ). The number of times for chest compression was larger in LPCG (127.40) than in RPCG (98.22) ( $p < .01$ ). Chest compression accuracy (%) was at a higher level in LPCG (81.57%) than in RPCG (65.92%) ( $p < .05$ ). LPCG showed higher quality of chest compression than RPCG. However, it seemed that the quality was affected by attention and the shape of hands in measuring chest compression. It is necessary to apply left palm chest compression on the basis of the shape of hands, as suggested in the guidelines.

**Keywords:** *Cardiopulmonary resuscitation, left, right, palm, chest compression*

## INTRODUCTION

AHA<sup>1</sup> suggested that chest compression for cardiopulmonary resuscitation (CPR) be applied on the lower half of the breastbone by using both hands. Kwon et al<sup>2</sup> suggested that cardiac arrest patients be resuscitated by CPR according to the guidelines based on the scientific ground. They emphasized that chest compression at the correct site could make it more likely to revive the patients.

Holmberg et al<sup>3</sup> noted that rapid CPR by a bystander could make it more likely to revive a patient. However, improper chest compression can lead to sternal or rib fracture<sup>4</sup>. Hong et al.<sup>5</sup> warned that inappropriate CPR by a bystander could lead to gastric rupture. Meron et al<sup>6</sup> warned that improper chest compression could damage the liver. AHA<sup>1</sup> and KACPR<sup>7</sup> indicated that this was due to an incorrect compression site and strong chest compression, contrary to the guidelines, and Seong et al<sup>8</sup> noted that a chest compression site could depend on the body type and length of a hand. Kwon et al<sup>2</sup> suggested the need to give continuous feedbacks according to the CPR

guidelines with the aim of reducing such undesirable results. That is, even if CPR is given quickly, it can have adverse effects unless it is correctly performed.

To make chest compression more efficient, this study made a comparison between right and left palm chest compression. According to the guidelines presented by AHA<sup>1</sup> and KACPR<sup>7</sup>, put one hand upon the other. Then, stretch the arms and use the weight of the upper body to give chest compression. The guidelines for the compression site have been revised constantly.

However, AHA<sup>1</sup> and KACPR<sup>7</sup> suggest that a “rescuer should use both hands to give compression, with one hand put completely upon the other at the compression site.” That is, they made no recommendation regarding which palm one needed to put first at the compression site in giving chest compression. A rescuer may put a comfortable hand underneath in giving chest compression.

This study aimed to analyze the differences in the quality of chest compression between right and left palm compression for CPR by a rescuer. Now there is

no recommendation regarding which palm one needs to put first at the compression site. In this context, this study intended to use a manikin to analyze the quality of right and left palm chest compression for a cardiac arrest patient. This analysis aimed to reduce the errors in chest compression skills in emergency situations. On this basis, this study intended to provide basic data that could help improve chest compression skills for CPR and develop CPR skill programs.

## MATERIALS AND METHOD

**Participants:** This study aimed to analyze the differences in the quality of chest compression between right and left palm compression for CPR by a rescuer. This study was conducted only in those who understood its purpose and consented to participate in it.

**The participants were divided into two groups:** The left palm chest compression group (LPCG) put their left palm first at the compression site in giving chest compression. The right palm chest compression group (RPCG) put their right palm first at the compression site in giving chest compression. The shape of hands for both groups was based on the CPR guidelines.

**85 persons consented to participate in this study:** 43 in LPCG and 42 in RPCG. Among the persons consenting to participate in this study, those who had musculoskeletal or neurological disorders in the wrist or who failed to recover from the existing disease were excluded. Those who complained of knee pain and who were likely to be absent from the final experiment were also excluded.

With the exception of 3 absentees, a total of 82 participated in this study: 42 in LPCG and 40 in RPCG.

The measurement was performed from May 15 to June 2, 2017. The characteristics of the participants are as presented in Table 1.

**Measurement:** The participants were divided into two groups: the left palm chest compression group (LPCG) put their left palm first at the compression site and the right palm chest compression group (RPCG) put their right palm first at the compression site.

The participants in both groups were given a 10-minute explanation about the procedure of the study to make it less contaminated. The participants in each

group were given an explanation about the procedure of the study. They were cautioned against information exchange to reduce the resultant contamination.

The experiment was performed in lecture rooms so that both groups could take measurement in the same conditions. Because even healthy participants without knee pain could possibly complain of knee pain, a mattress (180 cm in length, 65 cm in width, and 10 mm in thickness) was laid on the floor. The participants were asked to refrain from excessive physical activity and alcohol intake, which could affect the measurement, the day before the final measurement. They took measurement in numerical order.

Two preliminary tests were performed to reduce prejudices and preconception about the differences in accuracy between LPCG and RPCG: one preliminary test was performed using a manikin for practice—Little Anne TM (Laerdal, Norway)—seven days before the final measurement and the other was performed two days before the final measurement.

Both groups used a manikin to take preliminary tests and the final measurement. Little Anne TM (Laerdal Medical, Norway) was used for preliminary tests. Resusci Anne SkillreporterTM (Laerdal Medical, Norway) was used for the final evaluation.

The only item in the final evaluation was chest compression in both groups. Artificial breathing was excluded on the basis of the importance AHA<sup>1</sup> and KACPR<sup>7</sup> put on chest compression. The final evaluation of chest compression covered compression depth (mm), average compression velocity (times), chest compression accuracy (times), and chest compression accuracy (%).

The shape of hands and the frequency of chest compression were based on the CPR guidelines suggested by AHA<sup>1</sup> and KACPR<sup>7</sup>. The guidelines suggest that a rescuer should use both hands to give compression, with one hand put completely upon the other at the compression site. That is, put one hand right upon the other. Then, stretch the arms and use the weight of the upper body to give chest compression. The shape of hands is as shown in Figure 1.

For ethical consideration, approval was obtained from the Institutional Review Board (IRB) of C University (Human-003-20170415-1st). The participants



were given an explanation about the purpose of the study and those consenting to participate in the study were asked to give a written consent. Their information and

data were kept secret. They were informed that they could withdraw from the experiment any time when they intended to give up their participation.

**Table 1: Characteristics of participants**

		LPCG(n: 42)	RPCG(n: 40)	$\chi^2$	p
Gender	Male	19(45.2)	21(52.5)	.432	.511
	Female	23(54.8)	19(47.5)		



**Left palm chest compression**



**Right palm chest compression**

**Figure 1: Chest compression in each group**

**Analysis:** The analysis was performed using an SPSS for Windows program 12.0 Version. Specifically, frequency and percentage were estimated. The mean and standard deviation were estimated to compare the quality of chest compression between the two groups and non-parametric tests—2 paired samples t-test (Wilcoxon signed rank test) and 2 independent samples t-test (Mann-Whitney U test)—were performed. The statistical significance level was set at  $p < 0.05$ .

**RESULTS AND DISCUSSION**

**Comparison of quality of chest compression between LPCG and RPCG:** The comparison of the quality of chest compression between LPCG and RPCG is as shown in Table 2.

Average compression velocity (times/min) in both LPCG and RPCG was within the normal range of  $\geq 100$  ( $p < .05$ ). The number of times for chest compression (times) was statistically significantly larger in LPCG (127.40) than in RPCG (98.22) ( $p < .01$ ). Chest compression accuracy (%) was at a statistically significantly higher level in LPCG (81.57%) than in RPCG (65.92%) ( $p < .05$ ).

Baek and Park<sup>9</sup> noted that a rescuer’s simplified verbal-order method improved the quality of chest compression. Park<sup>10</sup> found that the use of a smartphone was not more effective in improving the quality of skill application than the conventional method. Miller et al<sup>11</sup> warned that improper chest compression could lead to gastric rupture and make it difficult to secure an airway. Smekal et al<sup>12</sup> found that mechanical compression could lead to rib fracture and leave a mark on the skin.

These researchers indicated that a rescuer’s different methods of applying CPR could have positive or negative effects. Putting very strong compression on the chest can damage the ribs and the sternum. An inappropriate shape of hands can make compression unstable, consequently lowering the quality of the compression.

LPCG showed a higher level of chest compression accuracy than RPCG. However, it seemed that the level was affected by attention and the shape of hands in measuring CPR skills. LPCG was also more effective because of convenience sampling in which the shape of palms mainly used by the participants was excluded.

**Table 2: Comparison of quality of chest compression between LPCG and RPCG**

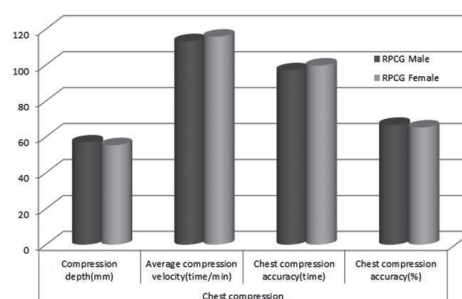
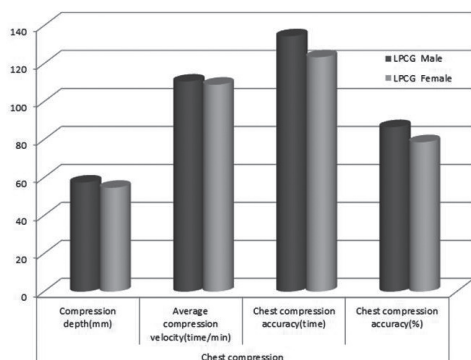
		LPCG	RPCG	t	p
		Mean±SD	Mean±SD		
Chest compression	Compression depth(mm)	55.82±3.71	56.10±3.61	-0.299	.767
	Average compression velocity(time/min)	108.90±9.18	114.35±10.01	-2.607	.013*
	Chest compression(time)	127.40±37.98	98.22±57.34	2.739	.009**
	Chest compression(%)	81.57±24.18	65.92±39.39	2.159	.037*

**Comparison of quality of chest compression by gender between LPCG and RPCG:** The comparison of the quality of chest compression by gender between LPCG and RPCG is as shown in Figure 3. Both males (57.42 mm) and females (54.65 mm) in LPCG were at statistically significant levels of compression depth (mm) that met the standards in the guidelines ( $p < .05$ ). Compression depth, average compression velocity (times/min), chest compression accuracy (times), and chest compression accuracy (%) were statistically insignificant.

Seong et al.<sup>8</sup> found that the chest compression site depended on the length of the sternum. Baek and Park<sup>13</sup> found that a rescuer's position could affect the quality of chest compression. Handley and Handley<sup>14</sup> obtained the same finding. Aufderheide et al.<sup>15</sup> and Park and An<sup>16</sup> found that the standard methods in the guidelines and the modified compression methods affected the quality of chest compression.

As mentioned above, Seong et al.<sup>8</sup> found that the chest compression site depended on the length of the sternum. Males with about average height should give chest compression, with the starting point of the heel of their hand put on the pit of the stomach. Females should give chest compression in the same way as males or by putting the heel of their hand about width of a finger over the pit of the stomach.

This study concluded that left palm chest compression was better than right palm chest compression. However, Seong et al.<sup>8</sup> found that a compression site depended on the body type. They also found that a compression site depended on the length of the heel of a hand as well as on that of the sternum. They recommend that the compression site should vary by the patient's body type.

**Figure 2: Comparison of quality of chest compression by gender between LPCG and RPCG**

## CONCLUSION

On the basis of these results, the researcher continued to doubt the effects on the quality of chest compression: was the quality affected by a dominant hand? In other words, did giving compression with the right hand laid completely upon the left one improve the quality because the dominant hand of rescuers was mainly the right one? In-depth research should be conducted on this issue.

Although the results of this study are significant, it has several limitations: first, the participants were not recommended to use their dominant hand but took measurement in numerical order; second, a manikin for evaluation was used; third, the experiment was performed in a small population; fourth, only a manikin for evaluation was used to measure the quality; fifth, the measurement was not continuous but short-term. Care should be taken in comparison with the results of other studies.

On the basis of the results, it cannot be concluded that left palm chest compression is perfect and excellent. It is however necessary to apply these results to CPR skills.

Left palm chest compression led to higher quality of chest compression. However, it seemed that the quality was affected by attention and the shape of hands in measuring chest compression. On the basis of the results, it cannot be concluded that left palm chest compression is perfect and excellent. It is however necessary to apply

these results to CPR skills on the basis of the shape of hands suggested in the guidelines.

**Ethical Clearance:** Taken from University of Seoul

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Effects of Individual Somatosensory Approach on Attention and Postural Body Schema with Hemiplegic Patients after Stroke

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## ABSTRACT

This study investigated effect of attention and postural body schema on somatosensory individual approach after the stroke. We have 10 subjects who has problem with hemiplegia after stroke patients, we divided into two group: the individual somatosensory training group (ISTG), and conservative group (CVG). To compare the groups, we used several assessment tools; Mini mental status examination Korean version (MMSE-K), star cancellation test (SCT), body visualization and space concepts (BVSC). In ISTG, there was significantly improved MMSE-K, SCT ( $p < .05$ ). Also, there was significantly differences in AT and SCT between groups ( $p < .05$ ). The individual somatosensory approach is influenced for improving of the attention and spatial orientation relative with postural body schema

**Keywords:** Stroke, Individual somatosensory approach, Postural body schema, Attention, Spatial orientation

## INTRODUCTION

Stroke is a disease caused by cerebrovascular accidents, and the patient is accompanied by various physical impairments such as sensory loss, neural weakness, cognition, and perceptual impairment<sup>1</sup>. In addition, the sensory and perceptual impairment causes the body orientation in the space, the lack of recognition on body segment each other<sup>2</sup>. In order to carry out one or more functional tasks in the way, we define that postural body schema act as an important factor in orientation and controlling the body postures in space. So postural body schema plays an important role in regulating body posture in space to perform one or more tasks<sup>3</sup>. Postural body schema is conceptually defined as the ability to determine its position in space and to interact in a new environment. In clinical practice, this is the same concept as internal representation by the clinician. Particularly, the postural body schema is formed by factors such as body geometry, kinetic and orientation with respect to gravity. If a problem a postural body schema, it is difficult to recognize the relationship between the position of the body and each body segment, and it has functionally problem to upright or moving the body<sup>4</sup>. Loss of the postural body schema is difficult for the patient to

move his body in the desired direction or to maintain an upright posture and to observe on space and the left and right discrimination. It also affects activities of daily living (ADL) such as dressing and self-care activities<sup>5</sup>. This postural body schema is completed through various sensory input and integration and it can be described as an essential element in perceiving the body appropriately in space to perform the desired activities. Recently many studies have examined the relationship between visual perception, postural control, and proprioception and posture control in stroke. Therefore, based on the recent research, this study is to investigate the effect of individual somatosensory training on impaired postural body schema in hemiplegic patients after stroke.

## MATERIALS AND METHOD

**Research design:** This study was conducted on stroke patients admitted to a rehabilitation hospital in Korea area. First, we selected patients with cognitive tests such as MMSE-K and four sensory tests such as light touch, position sense, proprioception and streognosis. Patients were excluded from the study if they were older than 24 months after the onset of stroke. Ten patients were included in the study. Six patients were treated with

individual somatosensory training (IST) and four patients were treated conservatively. Individual somatosensory training group (ISTG) was differentiated by conservative treatments group (CTG). It include physical therapy and occupational therapy, and to focus somatosensory input. The conservative training group (CTG) received only physical therapy and occupational therapy. First, we compared the before and after comparison result with Mini Mental Status Examination–Korea (MMSE-K), Star Cancellation Test (SCT) and Body Visualization and Space Concepts (BVSC) in two group. And we observed differences in MMSE-K, SCT and BVSC between groups. Measurement tools used Mini Mental Status Examination - Korea (MMSE - K), Star Cancellation Test (SCT) and Body Visualization and Space Concepts (BVSC).

**Research tools and procedure:** The selected patients were performed to physical therapy and occupational therapy. once a day, and the subjects were individually performed to individual somatosensory training (IST) 20 times a day for 30 minutes, 5 times a week and 4 weeks. The evaluation process was carried out with pre-evaluation before intervention and post-evaluation after 4 weeks. IST was carried out according to the severity of the patient in connection with damage to postural body schema such as body neglects, left and right discrimination and agnosia. IST process is as follows. IST divided into upper limbs and hands. In hand stage 1, Extrinsic muscle length of the finger was normalized and extrinsic and intrinsic muscles length was appropriately adjusted to stimulate the proprioception of the two muscle groups. In hand step 2, we tried tactile stimulation of the fingertips and palms with tools use of different material properties and object recognition use sensory integration training set, manipulation of objects and application of sensory stimulation training such as object recognition, reaching and grasping. Next in upper limb stage 1, we increased stability for gradually moving the shoulder and upper arm from each other to promote movement of the shoulder complex. In upper limb stage 2, we increase proprioceptive sensation of the muscles around the shoulder such as rotator cuff, deltoid, biceps and triceps. And using the grasping function of the hand, it is connected with the functional activities such as reaching and holding in space.

**Statistical analysis:** This study used SPSS 12.0 program for Windows. The descriptive statistics were used to investigate general characteristics of the subjects. After

confirming the normal distribution of the two groups, an independent t-test was used for the comparison between the two groups, and a paired t-test was conducted to determine the difference between the two groups after treatment . All statistical analyzes were performed at  $\alpha = 0.05$  significance level.

## RESULTS AND DISCUSSION

**General characteristics of subjects:** As shown in Table 1, the 10 males who participated in this study were 2 for 40 ~ 49, 3 for 50 ~ 59, 3 for 60 ~ 69, and 2 for 70 ~ 79. The mean age was 58.3 years. The mean age of ISTG was 59.33 years and the mean age of the conservative treatment group was 56.75 years. The causes of the paralysis and the location of the lesion were 4 cerebral infarction (66.7%), cerebral hemorrhage (33.3%), right middle cerebral artery infarction (2) 1 case, other site infarction 1, and basal ganglionic hemorrhage 2 cases. In the conservative treatment group, right middle cerebral artery infarction 1 (25%), basal infarction 1 (25%) and basal ganglionic hemorrhage 2 (50%). Patients with paralytic type of left hemiplegia were all 8 patients (80%), less than 1 year (20%) were less than 2 years.

**Table 1: General characteristics on the subjects**

Variable	ISTG (n=6)	CTG (n=4)	p
age	59.67±7.52	56.25±14.3	.684
duration	7.50±3.08	9.25±6.07	.622
gender	male	6	4
	female	0	0
diagnosis	infarction	5	1
	hemorrhage	1	3
M±SD: mean and standard deviation, ISTG: individual somatosensory training group, CTG: conservative treatments group.			

Changes in body schema before and after treatment in groups

Changes in cognitive function and attention before and after treatment in groups

In the two groups, cognitive function test and MMSE-K pre-test and post-test were increased from 24.83 points to 28.17 points, and conservative treatment group increased from 22.75 points to 24.75 points, respectively. ISTG showed significant difference as shown in Table 2 ( $p < .05$ ).

**Table 2: Changes for attention, spatial orientation, and body orientation in groups**

Variable	ISTG				CTG			
	before	after	t	p	before	After	t	p
MMSE-K	24.83±4.40	28.17±1.94	2.774	.02*	22.75±4.79	24.75±5.56	2.191	.06
SCT	38.83±13.6	47.00±5.55	2.097	.04*	29.75±12.4	26.75±13.4	1.732	.09
BVSC	24.67±3.62	27.00±1.67	2.038	.49	23.25±2.87	24.00±2.16	0.323	.09

M±SD: mean and standard deviation, \*: p<.05, MMSE-K: mental status examination-korean version. SCT: star cancellation test. BVSC: body visualization and space concepts, ISTG: individual somatosensory training group, CTG: conservative treatments group.

**Changes in spatial perception before and after treatment in groups:** In the two groups, the somatosensory training group was improved from 69.35% to 83.93% in the SCT, while the CTG showed a decrease from 53.13% to 47.77% in the sensory group and statistically significant difference in ISTG as shown in Table 2 (p <.05).

**Changes in body position perception before and after treatment in group**

**Table 3: Changes for attention, spatial orientation and body orientation between groups**

Variable	ISTG	CTG	t	p
MMSE-K	3.3333	2.0000	0.883	.202
SCT	14.5833	-5.3571	2.620	.018*
BVSC	2.3333	0.7500	1.212	.132

M±SD: mean and standard deviation \*: p<.05, MMSE-K: mental status examination-korean version. SCT: star cancellation test. BVSC: body visualization and space concepts, ISTG: individual somatosensory training group, CTG: conservative treatments group.

In the BVSC, which was performed before and after the recognition of the body position, the ISTG improved from 24.67 to 27.00, and the CTG group improved from 23.25 to 24.00, but no statistically significant difference was observed (p>.05) (Table 3). And in the BVSC of the two groups, ISTG increased from 24.67 to 27.00 and CTG increased from 23.25 to 24.00, but there was no statistically significant difference as shown in Table 2 (p>.05).

**Difference of body cognition between two treatment groups after intervention:** After the intervention, MMSE-K was improved to 3.33 points in the sensory group and 2.00 points in CTG, and there was no statistically significant difference in ISTG and

CTG. SCT decreased 14.58% in ISTG and 5.36% in the CTG (p <.05). Although BVSC increased 0.75 points in CTG at 2.33 points in ISTG, there was no statistically significant difference as shown in Table 3 (p>.05).

## DISCUSSION

Various sensory functions as well as visual perception are used to effectively postural control against gravity acting as an external environment. The main senses involved in postural control are the vestibular organ, visual and somatosensory roles<sup>6</sup>. But somatosensory input such as tactile and proprioceptive, contributes to cognize vertical orientation and controlling each part of the body in space<sup>7</sup>. The body schema is defined as the ability to organize such sensory information and to maintain the body in an upright posture against gravity<sup>8</sup>. Thus, posture control is achieved through interaction between external factors, gravity, biomechanical characteristics of the body, and physiology in body<sup>9,10</sup>. Sensory input such as visual, vestibular, proprioceptive, contributes to recognizing and controlling each part of the body in space. And postural body schema provides an internal representation of body geometry, the body dynamics and the body orientation with respect verticality<sup>9</sup>. It is believed to be the basis for all motions. And disturbance in body schema can include asomatognosia, anosognosia, unilateral body neglect, impaired right and left discrimination and finger agnosia. Therefore, it can be said that the posture control is formed based on the internal representation through the interaction with the perception of external information and the cognitive function. Patients with hemiplegic stroke after stroke have impaired sensory, muscular, cognitive, and sensory impairments and in particular, lowering of body cognition during time and space has difficulties in postural control and functional activities<sup>11</sup>. The purpose of this study was to investigate the

difference of postural body schema compared applying individual somatosensory training 5 times a week for 4 weeks after physical therapy and occupational therapy to improve postural body schema of stroke patients. In SCT, there was no difference in the conservative treatment group before and after the treatment but there was a difference in the individual somatosensory training group. It is thought that spatial awareness is increased by providing specific opportunity to recognize the left and right discrimination and left neglect through IST. IST according to degree of sensory impairment of the patient may have helped to improve spatial awareness. IST of the hemiplegic patients is considered to be a body oriented approach based on the subjects, and the higher the efficiency of the gradual sensory feedback is likely to be positive for the body recognition, and this kind of approach may have helped to increase the concentration of the patient. An individual approach to the sensory input method may help improve cognitive function such as concentration by making interaction between perception and cognitive function more efficient<sup>12</sup>. In addition, body position recognition is generally known to be involved in the inferior parietal lobe. In particular, the damage of the left parietal lobe may have a problem of lack of body schema and the difficulty to recognize the body part or the body part of the other person.

However, previous studies suggest that backward damage to the frontal lobe, parietal lobe, temporal lobe, basal ganglia, thalamus, and internal capsules can cause problems with body cognition<sup>13</sup>. In a study of stroke patients with basal ganglia lesions, cognitive function in stroke patients with basal ganglia lesions was reported to be significantly reduced in all areas, particularly in patients with basal ganglia impairment of executive functions associated with frontal lobes<sup>14</sup>. In addition to damage to the parietal lobe, damage to the basal ganglia and thalamus can also cause problems with sensory input, perception, and cognitive impairment. The basal ganglia and thalamus are the pathways through which movement and sensory nerves connect the cerebral cortex and cerebral cortical structures. If the primary lesion develops there, various sensory input and perceptual impairments may occur in stroke patients<sup>13</sup>. The subjects of this study were also all patients with left hemiplegia, hemiplegia due to infarction of middle cerebral artery, infarction and hemorrhage of basal ganglia. These lesions may have different sensory input, sensory and cognitive functions than the right parietal lobe lesion,

which directly affects the body location. Therefore, this study suggests that appropriate individual sensory approach should be required by grasping the difference of the lesion causing impairment of body cognition and the relationship between each individual's sensory ability and function performance. It is difficult to consider various lesion areas and lesion range in patients with brain damage when selecting patients. It was difficult to generalize the results of the study because the conditions for selecting the subjects were selected as 10 male. There are many variables that affect the posture control so there are limitations in explaining the results of the study

## CONCLUSION

In this study, 10 patients were divided into two groups as SIG and CVG. Somatosensory individual approach was given to the SIG and conservative treatment was given to the CVG. In SIG, there was significantly improved MMSE-K, SCT ( $p < .05$ ). Also, there was significantly differences in AT and SCT between groups ( $p < .05$ ). Therefore the somatosensory individual approach is influenced for improving of the attention and spatial orientation relative with postural body schema

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# Study on Change of Muscle Tone and Stiffness According to Upper Trapezius Mild Pain of Young Adults

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## ABSTRACT

The purpose of this study was to compare the muscle tone of younger adults with mild pain in upper trapezius muscle. The subjects were composed of 90 young college students (M =26, F =64) with mild or no pain in upper trapezius. The degree of mild pain was divided into four groups of 10 point visual analog scale (VAS) 0, 1, 2, and 3 to compare muscle tone and stiffness. The subjects were measured pain (VAS), muscle tone, and stiffness of the trapezius in resting supine position. Statistical analysis was performed using one way ANOVA, correlation, and regression analysis on SPSS 24.0 version. There were statistically significant difference between groups in muscle tone and stiffness of trapezius ( $p < 0.05$ ). In the post hoc analysis, there was a difference between the VAS 3 group and the other groups. Correlation studies showed a correlation between pain, muscle tone and stiffness. The results of the regression analysis showed that the higher the pain and stiffness, the greater the muscle tone. Therefore, the difference in muscle tone due to pain was found in VAS 3 or higher and showed a strong relationship with muscle stiffness. In the future, the relationship between more severe pain and muscle tone will be needed.

**Keywords:** Visual analog scale(VAS), Muscle tone, Stiffness, Myotonometer, Upper trapezius

## INTRODUCTION

Trapezius myalgia is a common musculoskeletal disorder, characterized by pain, stiffness and tightness of the upper trapezius muscle. It is often work-related and results from prolonged static and repetitive work tasks<sup>1</sup>. Even with low-level trapezius muscle activity, it may be a risk of neck pain if the periods is longer<sup>2</sup>. Use of a smartphone for a long time is also included here, which can cause changes in cervical and lumbar posture and also in the inherent proprioceptors of the cervical spine<sup>3</sup>. And, postural abnormalities can cause more pain in the neck<sup>4</sup>, for these reasons, chronic nontraumatic neck pain were shown to have a more forward head posture than matched pain-free participants<sup>5</sup>. These chronic pain leads to changes in the muscle tone of the shoulders and trunk muscles<sup>6</sup>. Increasing stiffness in the upper trapezius muscle may contribute to imbalance of scapular motion, and result in shoulder and neck discomfort during shoulder flexion<sup>7</sup>.

Recent studies used the MyotonPRO, which has been tested for reliability, to measure muscle tone<sup>1,8</sup>, this device is a feasible tool to quantify upper trapezius stiffness as

well as changes in muscle stiffness<sup>7</sup>. Despite the high reliability, however, Lo et al.<sup>8</sup> suggested that the results should be interpreted with caution because the varying level of consistency between different muscles as well as between different parameters within a muscle varies.

Most of pain are measured by visual analog scale(VAS). VAS are commonly used to measure the intensity of pain, and their validity and reliability have been reported<sup>9</sup>. In order to investigate various changes of VAS and muscle, the relationship between VAS and EMG activity was studied<sup>6</sup> and VAS and pressure pain threshold (PPT) were studied<sup>10</sup>, but research on the relationship between VAS and muscle tone is rare. Therefore, in this study, we investigate to compare the muscle tone of younger adults with or without pain in upper trapezius muscle.

## METHOD

**Subjects:** The subjects were college students from Shinsung University in Dangjin, Chungnam, South Korea. The subjects were 90 young college students

(M = 26, F = 64). Among the study subjects were either orthopedic disease or upper trapezius with pain greater than or equal to VAS 4 were excluded. Also excluded are subjects taking physical therapy or medication due to neck or shoulder pain. The subjects of the study were asked to explain and consent to the protection of personal information, to explain the experimental method, purpose, and safety issues and agreed in writing to participate voluntarily. This study adheres to the Helsinki Declaration of Medical Research Ethics.

**Intervention:** The subjects used the 10 point visual analogue scale(VAS) as one of the commonly used pain assessment scales clinically in order to measure the degree of trapezius pain, and divided into four groups VAS 0, VAS 1, VAS 2, and VAS 3.

And we used the myotonometer to measure the muscle tone and stiffness of the upper trapezius by group. The measurement posture was made as comfortable as possible in the supine position.

**Measurement of the muscle tone and stiffness:** For this study, MyotonPRO(MyotonAS, Estonia) was used as a myotonometer(Fig. 1). The myotonometer consists of a main body with a measurement probe, and that is to measure the muscle tone for in vivo non-invasive measurement of soft biological tissues. MyotonPRO was based on exerting a damped mechanical oscillation of soft biological tissue by using an exterior, light, quick-release mechanical impulse under constant pre-load. The measurable parameters were state of tone and stiffness. The muscle tone were measured by natural oscillation frequency(Hz) and the stiffness(N/m) were measured by logarithmic decrement of natural oscillation. The interrater and intrarater reliability test of the measurement was referred to as over the  $r=.97^{11}$ .

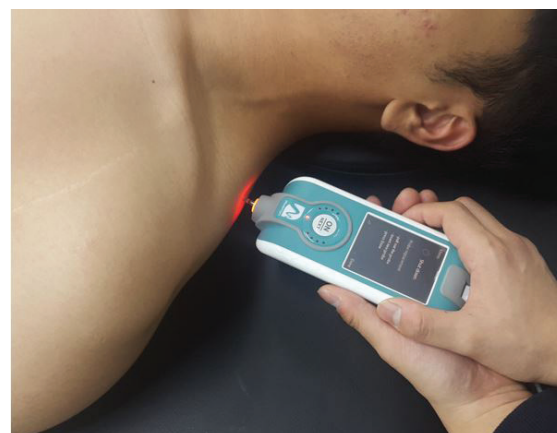
To measure the muscle tone and stiffness of upper trapezius, subjects is in a comfortable supine posture, and a mark was placed on the highest muscle belly of the upper trapezius on preference side. And the probe of myotonometer was placed vertically (Fig. 2). The average value of three trials was used as data.

**Table 1: General characteristics of the subjects (N=90)**

groups	VAS 0(n=45)	VAS 1(n=12)	VAS 2(n=25)	VAS 3(n=8)	total(N=90)
age(years)	20.69±1.10	21.17±0.93	20.96±1.24	20.75±1.17	20.83±1.12
height(cm)	167.07±8.72	165.08±8.55	161.00±5.50	162.63±7.82	164.72±8.16
weight(kg)	64.11±14.15	65.50±16.42	59.00±9.85	53.63±7.44	61.94±13.25



**Figure 1: Myoton PRO (MyotonAS, Estonia)**



**Figure 2: muscle tone and stiffness measurement posture**

**Statistical processing:** A statistical analysis was performed using one way ANOVA for the mean comparison between groups. Correlation analysis was performed to analyze the correlation between variables. Multiple regression analysis was performed to analyze the effect of each variable on the muscle tone on SPSS 24.0 version. Statistical significance was 0.05.

## RESULTS

**Subject characteristics:** Of the 90 subjects, 26 were male and 64 were female. The average age of subjects was 20.83±1.12 years, the average height was 164.72±8.16cm, and the average weight was 61.94±13.25kg. There were 45 subjects with VAS 0 in the category of pain, 12 subjects with VAS 1, 25 subjects with VAS 2, and 8 subjects with VAS 3 (table 1).

**Comparison of the upper trapezius muscle tone and stiffness according to pain:** The muscle tone and stiffness of the upper trapezius were compared with the VAS 0, VAS 1, VAS 2, and VAS 3 groups. There was

a statistically significant difference both muscle tone and stiffness between groups( $p < 0.05$ ). In the post hoc analysis, VAS 3 group differ from other groups(Table 2).

**Table 2: Comparison of the upper trapezius muscle tone and stiffness between groups (N=90)**

groups	VAS 0(n=45)	VAS 1(n=12)	VAS 2(n=25)	VAS 3(n=8)	F
muscle tone (Hz)	12.18±0.87	11.90±0.75	12.08±1.01	13.63±0.96†	7.122*
stiffness(N/m)	170.56±28.45	161.67±16.59	160.48±20.72	191.50±25.74†	3.525*

M±SD

\*: $p < 0.05$

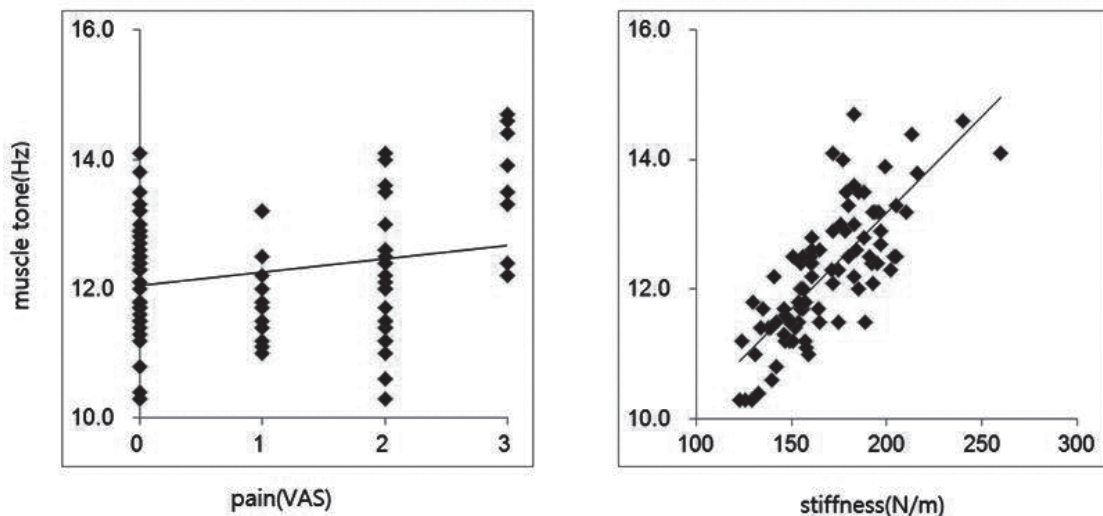
†: difference in VAS 0, VAS 1, and VAS 2

**Correlation analysis between pain, muscle tone and stiffness:** As a result of analyzed the correlation between pain, muscle tone, and stiffness of the upper trapezius, there was a strong positive correlation between muscle tone and stiffness(correlation coefficient=0.776,  $p < 0.05$ ), And there was a weak positive correlation between muscle tone and mild pain(correlation coefficient=0.219,  $p < 0.05$ ), and there was no correlation between mild pain and stiffness(correlation coefficient=0.030,  $p > 0.05$ ). Table 3 and Figure 4 show the correlation and scatter plot of each variables.

**Table 3: Correlation analysis between pain, muscle tone and stiffness (N=90)**

		muscle tone	pain(VAS)	stiffness
Pearson	muscle tone	1.000	0.219	0.776
	pain(VAS)	0.219	1.000	0.030
P-value	muscle tone	.	0.019*	0.000*
	pain(VAS)	0.019*	.	0.389
	stiffness	0.776	0.030	1.000
		0.000*	0.389	.

\*: $p < 0.05$



**Figure 4 : Scatter plots of muscle tone and pain(VAS), and stiffness (N=90)**

**Regression analysis of the effect of pain and stiffness on muscle tone:** Multiple regression of muscle tone with pain and stiffness of the upper trapezius revealed that an increase in muscle tone resulted in an increase pain and stiffness( $p < 0.05$ )(Table 4).

**Table 4: Coefficients in regression analysis of the effect of pain and stiffness on muscle tone of the upper trapezius (N=90)**

Model		Unstandardized Coefficients		t	Sig.
		B	Std. Error		
1	(Constant)	7.108	0.421	16.878	0.000
	stiffness	0.029	0.002	11.984	0.000
	VAS	0.182	0.060	3.052	0.003

dependent variable: muscle tone

adjusted R square: 0.633

## DISCUSSION

Musculoskeletal pain conditions including myofascial pain syndrome are some of the most important chronic problems that arise in clinical practice<sup>12</sup>. This study began with questions about how young college students in their 20s usually have neck and shoulder pain, and selected the upper trapezius muscle, which frequently complained myalgia and was relatively easy to measure<sup>13</sup>. Even with low-levels muscle activity of trapezius, a longer period can be a risk of neck pain. Østensvik et al.<sup>2</sup> was that low-level trapezius muscle activity in periods longer than 8 min may constitute a risk for neck pain. And Ahlgren<sup>14</sup> suggested that the pain was found to be transient and the pain ratings decreased to pre-test level within 24h. Our study was based on the fact that the students in their twenties were exposed to the use environment of various smart devices, Unexpectedly, only about 50% had trapezius pain, this is not because of long-term use of high-intensity muscles, and probably because of the young age group.

VAS was used to measure the degree of pain. VAS has been used extensively in research and many researchers have adopted millimeter precision to measure acute and chronic pain intensity<sup>15</sup>. VAS score is interpreted marking 1/4, 1/2, 3/4 positions on a VAS, corresponding to mild (25 mm), moderate (50 mm), and severe (75 mm), McKechnie and Brodie<sup>9</sup> are influenced by the same factors that affect the error of the visual bisector, and should be distinguished between left-handed and right-handed for more accurate measurements. In this study, a 10-point scale was used without the use of millimeter accuracy, as it was intended to measure changes due to pain intervention. Sharma et al.<sup>13</sup> was the result of a survey average of 3.5 points to 15 subjects in the VAS score in the upper trapezius, but this study, the mean value of the remaining 45 patients, excluding 45 patients

with a VAS value of 0, was 2 because the pain was so severe that normal conditions were measured except for subjects receiving other therapeutic interventions.

For this study, MyotonPRO (MyotonAS, Estonia) was used as a myotonometer. MyotonPRO had very high within-day and high between-day reliability<sup>13</sup>. Because of this high reliability, many recent studies related to the measurement of muscle tone use this device. It is used to measure the degree of spasticity in patients with neurological disorders such as stroke<sup>16</sup>, as well as measuring the degree of muscle stiffness of subjects with myalgia<sup>17</sup>. Waling et al.<sup>10</sup> showed as no correlation between VAS ratings and pressure pain thresholds (PPTs) of trapezius myalgia was found, the results indicate that the instruments measure different characteristics of pain. This result is the same as the results of this study, in which the degree of pain is not related to muscle stiffness. However, it is in contrast to our study that there was a correlation between muscle tone and pain. In addition, in this study, it was found that the natural oscillation frequency of muscles in mild and over pain was increased the difference of muscle tension in VAS 3 and above.

## CONCLUSION

This study was to compare the muscle strength of younger adults with mild pain in upper trapezius muscle. Therefore, the difference in muscle tone due to pain was found in VAS 3 or higher and showed a strong relationship with muscle stiffness. In the future, the relationship between more severe pain and muscle tone will be needed.

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# Effects of Expressive Writing on Emotional Intelligence of Nursing Students

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## ABSTRACT

The purpose of this study is to investigate whether emotional intelligence and related variables are enhanced by expressive writing activities after mental theme film appreciation and reading tasks among nursing students. This study applied an experimental, single group pre-post design. Before implementing the expressive writing activity, general characteristics, emotional intelligence, mental health, and mental illness attitudes were measured. After the experimental treatment, emotional intelligence, mental health, and mental illness attitudes were measured again. The participants were 41 fourth-grade nursing students in D city. After conducting the expressive writing activity with 41 students, data from 41 subjects (100.0%) were analyzed. The general characteristics of the subjects were as follows: 37 subjects were less than 21 years old (90.2%), 4 were more than 22 years old (9.8%), and 38 were female (92.7%). After the expressive writing activity, significant improvement was found in emotional intelligence ( $t = -2.26$ ,  $p = .029$ ) and the authoritarianism of mental illness attitudes ( $t = -2.07$ ,  $p = .045$ ). In conclusion, the findings suggest that developing a program that contains a variety of expressive writing activities, which can foster emotional intelligence, is recommended for nursing students.

**Keywords:** *Expressive writing, Emotional intelligence, mental health, Mental illness attitudes, Nursing students*

## INTRODUCTION

**The necessity of this research:** With the imminent fourth industrial revolution and an era of artificial intelligence (AI) threatening the human race, the field of education is in need of a new perspective, particularly one that emerges from the simple knowledge-learning method—one in which AI excels—and stresses the learning and improvement of emotional intelligence<sup>1</sup>. Emotional intelligence is a type of social intelligence that refers to the ability to adjust thinking and behavior by detecting one's own emotions and those of others as well as through an ability to use information that helps distinguish different emotions<sup>2</sup>. The concept of intelligence in the modern era is generally accepted to be multidimensional and not bound to mere intellectual abilities; human intelligence is understood to comprise seven different dimensions: bodily-kinesthetic, interpersonal, intrapersonal, verbal-linguistic, logical-mathematical, musical-rhythmic and harmonic, and visual-spatial<sup>3</sup>. This multidimensional quality is what distinguishes human intelligence from AI, which is relatively simple and is focused on the intellectual dimension. In particular, interpersonal intelligence—recognition of others' emotions—and

intrapersonal intelligence—recognition of one's own emotions—suggested by Gardner<sup>3</sup> are in line with emotional intelligence, which refers to the ability to sensitively recognize others' emotions while controlling one's own emotions and impulses to prevent worries from hampering one's ability to think<sup>4</sup>.

According to previous studies, emotional intelligence is associated with mental health<sup>5,6,7,8,9</sup>, psychological happiness<sup>10</sup>, and conflict resolution style<sup>11</sup>. As a method of promoting emotional intelligence by improving emotional capacity, Moon<sup>12</sup> investigated an emotional intelligence developing program for children that comprises contents on the recognition, expression, adjustment, and use of emotions. Moon<sup>12</sup> suggested the need for emotional intelligence programs tailored to the specific developmental stage of the participants. When these implications are applied to programs for nursing students, expressive writing activities after watching a movie or reading a book may be a good alternative. Humans have expressed emotion through writing throughout history; particularly, expressive writing refers to repeated writing about deep thoughts and emotions about a stressful incident<sup>13</sup>. According to

a study on college students by Penne baker and Beall<sup>14</sup>, an expressive writing group visited a physician for an illness 43% less frequently than a non-expressive writing group. In other words, college students who engaged in expressive writing for four days experienced higher health benefits and emotional stability by expressing their deep emotions through writing. It has been reported that expressive writing not only has health benefits<sup>15,16</sup> but also facilitates social stability as well as helping individuals become better talkers, listeners, and friends to others<sup>17</sup>. However, whereas many studies have investigated the impact of writing on emotion in high school students<sup>18</sup>, there is a paucity of studies examining the impact of expressive writing on emotional intelligence; in fact, Ha's study<sup>19</sup> on elementary school students is the only study investigating the topic.

This study aimed to promote nursing students to emerge from simple learning of knowledge and expand their perception and gain deeper insights by indirectly experiencing psychiatric incidents through a related movie or book and expressing their thoughts and emotions through expressive writing. That is, nursing students had an opportunity to deeply experience psychiatric nursing knowledge they had learned in the Psychiatric and Mental Health Nursing course through a movie or book and were given an expressive writing task about the experience. Through such an activity, this study sought to identify the effects of expressive writing on students' attitudes toward patients with mental illnesses as well as on their own mental health and emotional intelligence. Thus, this study investigated whether expressive writing activity after watching a movie or reading a book about psychiatric nursing improves nursing students' emotional intelligence, mental health, and attitudes toward patients with mental illnesses and to examine the correlations among them.

**Purpose of this study:** The purpose of this study is to investigate whether emotional intelligence and related variables are enhanced by expressive writing activities after watching a movie or reading a book with a psychiatric theme among nursing students. The detailed purposes were as follows.

1. Identify the general characteristics of the participants.
2. Identify the correlations among emotional intelligence, mental health, and mental illness attitudes of the participants.

3. Investigate the effects of expressive writing activities after watching a movie or reading a book with a psychiatric theme on emotional intelligence, mental health, and mental illness attitudes of the participants.

## MATERIALS AND METHOD

**Study design:** This study applied an experimental, single-group pre–post design.

Before implementing the expressive writing activity, general characteristics, emotional intelligence, mental health, and mental illness attitudes were measured. After the experimental treatment, emotional intelligence, mental health, and mental illness attitudes were measured again [Table 1].

**Table 1: Research design**

Group	Pretest	Treatment	Posttest
Experimental group	Ye1	X	Ye2

**Participants:** The participants were 41 fourth-grade nursing students in D city. The sample size was calculated using G\*Power 3.1.9.2<sup>20</sup>. For a t-test, an effect size of .5, a significance level of .05, and a test power of .80, the recommended number of participants was 27. After conducting the expressive writing activity with 41 students, data from 41 participants (100.0%) were analyzed.

### Instruments

1. Emotional intelligence was measured using a 20-item questionnaire from the checklist by Moon<sup>21</sup>. This tool is a self-reporting test on situation-based performance developed for adults and consists of emotional perception, emotional expression, empathy, emotional regulation, and emotional utilization. For all questions, one option should be chosen out of 4. Each option has different points assigned from 0, 5, 10, and 20 points, and each question has a different scoring criterion. A higher total score is better. A score of 204 is considered to be low, 205~264 to be moderate, 265~309 to be high, and 310 or higher to be very high.
2. Mental health was measured using 60 questions from the General Health Questionnaire (GHQ) developed by Goldberg and Hillier<sup>22</sup> for

discrimination and early detection of mental illnesses in normal adults. The inventory questions respondents on how their psychological state had changed over the last 2 to 3 weeks compared to the normal state to detect the problems in their current state. It originally consisted of 60 questions, but our study applied the simplified version of 12 questions translated by Park et al.<sup>23</sup>. The GHQ-12 has a structure consisting of 2 factors, “depression and anxiety” and “social dysfunction.” A higher score means stronger psychological distress. In this study, a Likert scale was applied to test the factor structure of the GHQ-12, and the affirmative questions (questions 1,3,4,7, and 12) were inversely scored. In a study by Picardi et al.<sup>24</sup>, the test–retest reliability of a one-week interval was 0.72, and Cronbach’s  $\alpha$  was .88. Cronbach’s  $\alpha$  in this study was .76.

3. Mental illness attitudes were measured using 40 questions from the Community Attitudes toward the Mentally Ill (CAMI) inventory developed by Taylor and Dear.<sup>25</sup> The CAMI comprises four domains—authoritarianism, benevolence, social restrictiveness, and community mental health ideology—with 10 items for each domain. Authoritarianism refers to an authoritative attitude, insisting that mentally ill patients must be strictly restricted in terms of interpersonal relationships and other social activities because they are inferior and are different from normal people. Benevolence represents a compassionate view that mentally ill patients should be treated in a humane and accepting manner. Social restrictiveness represents an attitude that mentally ill patients should be socially restricted even after discharge because they pose a threat to their family and society. Community mental health ideology represents an attitude that mentally ill patients should dwell among normal people in communities and that communities are responsible for taking on therapeutic roles of providing mental health services. For each subscale, there are five positively worded items and five negatively worded items with each item rated on a five-point scale. A higher score is more positive for authoritarianism and social restrictiveness items, and a lower score is more positive for benevolence and community mental

health ideology items. The reliability of the CAMI scale was .68 for authoritarianism, .76 for benevolence, .80 for social restrictiveness, and .88 for community health ideology at the time of the development<sup>25</sup> and .73 for authoritarianism, .69 for benevolence, .72 for social restrictiveness, and .75 for community health ideology in this study.

**Experimental treatment:** This program consisted of two expressive writing tasks assigned during the Psychiatric and Mental Health Nursing course (3 units/3 hours), which is a required major course taken in the first semester of the third year, and the program was administered in the following four stages. In the first stage (introduction), the professor explained the purpose of the program and provided task details. In the second stage (first activity), students freely selected a movie about psychiatric nursing, watched it, and engaged in expressive writing based on their own experience. In the third stage (second activity), students freely selected a book about psychiatric nursing, perused it to gain knowledge about this topic, and engaged in expressive writing based on their own experience. In the fourth stage (integration), students organized the things learned and their thoughts that they had written in the expressive writing activity through speaking and integrated them into a writing task for submission.

The specific instructions for expressive writing were provided in reference to the method suggested by Penne baker<sup>26</sup>. The two types of writing activities, one after watching a movie and one after reading a book, were performed in a two-week interval. Penne baker<sup>26</sup> suggested writing activities to be performed for three or four consecutive days, but, because there is a report that writing once a week for four consecutive weeks may be better<sup>27</sup>, this study applied the latter method (once a week for four weeks). In other words, students were instructed to write after watching a movie once a week for two weeks and after reading a book once a week for two weeks, totaling to four writing activities in four weeks. The duration of each writing activity was set to 15–20 minutes in one day. Both hand writing and typing on the computer were accepted as the two methods were found to have no significant difference<sup>28</sup>.

The preliminary survey was administered in the introduction stage on March 3, 2016, the first day of the course. Writing activities were performed for four weeks in April, and the post-experimental survey was administered in the integration stage on May 4, the last day of the course [Table 2].



**Table 2: Expressive writing program**

Progressive Step		Guided Content	Remarks
Introduction		Goal guidance Motivating the task	pretest
Activity 1	Watching a psychiatric theme film	Watching with attention to the theme	
	Expressive writing	Reflective writing based on your own experience	
Activity 2	Reading a psychiatric theme book	Reading with interest in the theme-related knowledge	
	Expressive writing	Reflective writing based on your own experience	
Integration		Checking your feelings and learned points Submitting an assignment	posttest

**Ethical consideration:** The aim and procedure of the research and the guarantee of anonymity were explained to the participants, and they were informed about their freedom to withdraw their participation at any point in the research without any disadvantage.

**Analysis:** The data collected in the present study were analyzed using SPSS 22.0.

1. The general characteristics of the participants were analyzed using descriptive statistics.
2. The correlation variables of the participants were analyzed using Pearson’s Correlation Coefficient.
3. The effects of expressive writing activities after watching a movie or reading a book based on a psychiatric theme on variables between pretest and posttest of the participants were analyzed using paired t-tests.

**RESULTS**

**General characteristics of the participants:** The general characteristics of the participants were as follows: 37 participants were younger than 21 years old (90.2%), 4 were older than 22 years old (9.8%), and 38 were female (92.7%) [Table 3].

**Table 3: General characteristics (n = 41)**

Characteristics	Categories	N(%)	Mean(SD)
Gender	Male	3(7.3)	
	Female	38(92.7)	

Conted...

Age (years)	≤20	17(41.5)	20.08 (1.005)
	21–22	21(51.2)	
	23≥	3(7.3)	
Religion	None	26(63.4)	
	Protestant	8(19.5)	
	Catholic	4(9.8)	
	Others	3(7.3)	
Motivation for admission	Admission grade	5(12.2)	
	Nearby suggestions	10(24.4)	
	Service sprit	2(4.9)	
	Aptitude	9(22.0)	
	Employment	13(31.7)	
	Etc.	2(4.9)	
Satisfaction in major	Very unsatisfied	0(0.0)	3.49(.637)
	Unsatisfied	2(4.9)	
	Usually	18(43.9)	
	Satisfied	20(48.8)	
	Very Satisfied	1(2.4)	
Whether you want to work in psychiatry	I don’t want to	4(9.8)	
	I hope	12(29.3)	
	I don’t know	25(61.0)	

**Correlations of variables:** Nursing students’ emotional intelligence was significantly correlated with mental health ( $r = -.32, p = .043$ ) and the social restrictiveness of mental illness attitudes ( $r = .58, p = .000$ ) [Table 4].

**Table 4: Correlation among variables (n = 41)**

Variables	1)r(p)	2)r(p)	3)r(p)	4)r(p)	5)r(p)	6)r(p)
Emotional intelligence <sup>1)</sup>	1					
Mental health <sup>2)</sup>	-.32(.043)*	1				

Conted...

CAMI	A <sup>3)</sup>	.26(.101)	.00(.998)	1			
	B <sup>4)</sup>	-.02(.926)	-.02(.891)	-.61(.000)	1		
	S <sup>5)</sup>	.58(.000)**	-.16(.317)	.58(.000)**	-.50(.001)**	1	
	C <sup>6)</sup>	-.28(.080)	.07(.662)	-.39(.012)**	.51(.001)**	-.70(.000)**	1

\*p &lt; .05, \*\* p &lt; .001

CAMI = Community Attitudes toward the Mentally Ill,

A = Authoritarianism, B = Benevolence, S = Social restrictiveness, C = Community mental health ideology

**Differences of variables between pretest and posttest:** After the expressive writing activity, significant improvement was found in emotional intelligence ( $t = -2.26, p = .029$ ) and the authoritarianism of mental illness attitudes ( $t = -2.07, p = .045$ ) [Table 5].

**Table 5: Differences of variables between pretest and posttest (n = 41)**

Variables M(SD)	Pretest	Posttest	Difference	t(p)	
	M(SD)	M(SD)			
Emotional Intelligence	203.3(56.29)	219.8(61.40)	-16.46(46.61)	-2.26(.029)	
Mental Health	23.6(5.89)	23.5(5.94)	0.73(0.47)	1.00(.323)	
CAMI	A	37.1(4.00)	38.3(4.45)	-1.29(4.00)	-2.07(.045)
	B	22.4(3.37)	21.6(3.62)	.73(3.54)	1.32(.194)
	S	34.4(4.03)	35.4(4.41)	-1.02(3.62)	-1.81(.077)
	C	25.2(4.29)	24.6(4.98)	.61(4.54)	.86(.395)

CAMI = Community Attitudes toward the Mentally Ill,

A = Authoritarianism, B = Benevolence, S = Social restrictiveness, C = Community mental health ideology

## DISCUSSION

This study aimed to investigate whether expressive writing activity after watching a movie or reading a book about psychiatric nursing improves nursing students' emotional intelligence, mental health, and attitudes toward patients with mental illnesses and to examine the correlations among them.

The results showed that emotional intelligence is significantly correlated with social restrictiveness (mental illness attitude). In the GHQ, a mental health scale, a higher score indicates more severe psychological stress; hence, the results indicate that high emotional intelligence is associated with better mental health. According to a stratified random study on 348 high school students in Neka<sup>8</sup>, emotional intelligence is directly related to mental health and is also a predictor of mental health. The correlation between emotional intelligence and mental health was also confirmed in a study on

100 male and 100 female college students<sup>7</sup>. These previous findings are in line with the findings of this study, implying that enhancing emotional intelligence is important to improve students' mental health.

Because a higher score indicates a more positive attitude toward social restrictiveness, the results can be interpreted to suggest that students with higher emotional intelligence have more positive attitudes in terms of social restrictiveness. A previous study on emergency department staff<sup>29</sup> found that emotional intelligence is correlated with stigma on mental illness ( $r = -.514, p < .001$ ) and that it also significantly interacts with familiarity with mental illness ( $R^2 = .269, F[3, 38] = 4.653, p = .007$ ). These findings are in line with the findings of this study, suggesting that enhancing emotional intelligence is important to promote friendly attitude toward mentally ill individuals, particularly toward social restrictiveness.

According to the findings of this study, expressive writing substantially improves nursing students' emotional intelligence and brings about positive changes in their authoritative attitudes toward mentally ill individuals. The result that expressive writing improves emotional intelligence is in line with a previous finding<sup>19</sup>. This is also contextually in line with a previous finding that an integrated literature therapy program significantly decreased the psychological signs of depression in college students<sup>30</sup>. This is presumably because expressive writing helps students to recognize, discern, and understand their own emotions by frankly expressing their thoughts and feelings instead of suppressing them in the fear of others' responses<sup>26</sup>. Further, emotional intelligence is based on the ability to control emotion and, thus, is fundamentally different from an authoritative attitude, which values maintaining order through dogmatic control or authority<sup>31</sup>. Therefore, the result that expressive writing has positive effects on authoritarianism toward the mentally ill seems natural. This can be partially supported by a previous finding about elementary school students<sup>32</sup>, which showed that children of parents with controlling child-rearing attitudes had the lowest emotional intelligence.

In conclusion, this study confirmed the usefulness of expressive writing in improving emotional intelligence to some degree, but additional studies with larger samples are needed to substantiate this further as this study had limited generalizability because of a limited sample comprising nursing students in D city.

## CONCLUSION

The finding that emotional intelligence—the ability to detect one's own emotions and those of others and adjust thinking and behavior—may correspond with the social restriction of the mentally ill has significant implications. The results of this study emphasize the importance of improving emotional intelligence as part of psychiatric and mental health nursing education for nursing students. However, one weak point of this study is that the study population was conveniently sampled, calling for follow-up studies with randomized designs to generalize findings.

In conclusion, we suggest that an expressive writing program should be developed to improve nursing students' emotional intelligence. This study is meaningful in that it presented a learning method called

expressive writing, which helps students to emerge from the traditional simple knowledge learning and gain deep emotional experiences and insights, thereby contributing to improving emotional intelligence in nursing students who will be required to adapt to future hospital environments.

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**Source of Funding:** Self

**Conflict of Interest:** NA

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# Dose Reduction by Body Mass Index: Different Protocol in Low-Dose Chest Computed Tomography

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## ABSTRACT

We investigated the effects of exposure involving reduction of automatic exposure control value based on body mass index and image quality using the AAPM phantom in low-dose computed tomography (CT). The study was carried out on subclinical, normal persons without lung diseases among students in a single university. The examination was the same as the phantom experiment. Scan protocol conditions in the phantom study were always tube voltage 120 kVp, 30 mA tube current, 0.5 sec rotation time, 360 mm field of view, and dose modulation (Fixed, D-DOM, Z-DOM, D-DOM+automatic current selection (ACS), Z-DOM+ACS). Comparison and analysis was based on D-DOM. In the fixed mode, the volume CT dose index (CTDI<sub>vol</sub>) and dose length product (DLP) value was 1.94 mGy and 26.2 mGy·cm, respectively. In D-DOM the respective values were 1.47 mGy and 20.1 mGy·cm. For D-DOM+ACS, the respective values were 1.70 mGy and 23.2 mGy·cm, and the CTDI<sub>vol</sub> value of Z-DOM and DLP was 1.82 mGy and 24.9 mGy·cm, respectively. For Z-DOM+ACS together, CTDI<sub>vol</sub> was 2.22 mGy and DLP was 30.4 mGy·cm; in case of ACS, CTDI<sub>vol</sub> was 2.46 mGy and DLP was 33.2 mGy·cm. Improvement of exposure dose and the image quality of obese patients could result using a protocol that offers more appropriate image quality and minimum dose

**Keyword:** BMI, chest CT Dose Reduction

## INTRODUCTION

Public interest in personal health has increased the awareness of, and concern with, radiation exposure during medical and diagnostic examinations. Sustaining the image quality with reduced exposure dose is an area of interest. (Singh et al., 2011<sup>[16]</sup>, Tsapaki et al., 2006, Manowitz et al., 2012<sup>[14]</sup>, Lim et al., 2015<sup>[12]</sup>, Kim et al., 2013<sup>[8][10]</sup>, Kim et al., 2012<sup>[9]</sup>, Keyzer et al., 2004<sup>[6]</sup>, Earls et al., 2008<sup>[2]</sup>, Johnson et al., 2012<sup>[5]</sup>)

As the frequency of medical examination increases, more studies are focusing on computed tomography (CT) examination. While CT is used relatively less frequently, it has a high exposure dose. The frequency of CT examinations were predicted to increase by 13% in the next year based on 2002 data from the Korea Health Insurance Review & Assessment Service, with claim frequency increasing by 18% in 2005 (Health Insurance Review & Assessment Service, 2003, 2005).

The use of low-dose CT has been increasing based on the associated reduction in lung cancer-related mortality (National Lung Screening Trial Research Team, 2011). There are several ways to reduce the radiation exposure dose in low-dose CT delivered from diagnostic medical equipment. Representative methods are the Adaptive Statistical Iterative Reconstruction Algorithm (ASIR) and Body Mass Index (BMI). BMI is applied in accordance with body shape of patient to reduce unnecessary exposure dose. BMI-mediated CT dose reduction has been studied for the heart and abdomen (Kim et al., 2013<sup>[8][10]</sup>, 2015<sup>[11]</sup>).

Maintaining image quality and reducing exposure dose are necessary for accurate diagnosis. But, there is still no standardized and accurate clinical standard dose protocol and the optimal standard for low dose CT (Lee et al, 2012). The present study explored the effects of the reduction of previously established automatic exposure control (AEC) dose using BMI protocol, and image quality using an American Association of Physicists in Medicine (AAPM) phantom in low-dose CT.

**MATERIAL AND METHOD**

The AAPM phantom used to examine image quality at the Korean Institute for Accreditation of Medical Imaging had a diameter of 32cm. When two phantoms are connected, an elliptical shape results that is similar in shape to the human body. A Brilliance TMCT 64slice apparatus (PHILIPS, The Netherlands) was used (fig. 1a) to find the optimal exposure dose based on BMI, a Quality Assurance Water Phantom (GE Healthcare, USA) was positioned in the gantry. Image quality and exposure dose depending on variations by using dose report supplied from the manufacturer were determined in five chest measurements with changes in dose modulation (Fixed, D-DOM, Z-DOM, automatic current selection (ACS), D-DOM+ACS, Z-DOM+ACS) at low-dose protocol parameters of 120kVp and 30mAs; Fixed mAs. The results were compared (fig. 1b)



**Fig. 1: AAPM Head Phantom (a) and Dose report of CT (b)**

The study was carried out from July 20, 2015 to August 20, 2015 at K University Medical Center, Seoul, South Korea. The volunteer subjects were students in the Radiology Department of Chungnam H University. They were sub-clinically normal without lung diseases. Their examinations were done identically as the phantom experiment. The subjects agreed to participate after it was explained to them that the exposure dose will be reduced depending on body shape.

The average age of the 12 subjects (six males, six females) was 22.4 years (range, 23-26 years). Their average BMI was  $24.2 \pm 4.1 \text{ kg/m}^2$  (range, 16.4-33.4  $\text{kg/m}^2$ ). Low weight (A), normal weight (B), and obese (C) groups (n=4 per group) were defined as BMI <18.5  $\text{kg/m}^2$ , 18.5-24.9  $\text{kg/m}^2$ , and 25.0-29.9  $\text{kg/m}^2$ , respectively. After examination, the image quality and the dose was compared and evaluated (Table 1)

**Table 1: Information of Patients**

No.	Height (cm)	Weight (kg)	Age	Sex	BMI	Division
1.	156	43	23	F	17.6	A
2.	165	46	22	F	16.9	A
3.	158	45	20	F	18.0	A
4.	154	42	24	F	17.7	A
5.	163	52	21	F	19.5	B
6.	177	71	23	M	22.6	B
7.	179	66	21	M	20.6	B
8.	173	65	23	M	21.7	B
9.	172	76	26	M	25.6	C
10.	162	80	21	F	30.4	C
11.	175	82	23	M	26.7	C
12.	170	78	22	M	26.9	C

The scan protocol in each phantom study was 120 kVp tube voltage, 30 mA tube current, rotation Time 0.5 sec, field of view 360 mm, and dose modulation (Fixed, D-DOM, Z-DOM, D-DOM+ACS, Z-DOM+ACS), and was compared and analyzed based on D-DOM, which gave the lowest dosage value.

In the second clinical study, each subject was positioned supine on the CT table with the arms as relaxed as possible. Meditational images at the level of carina bifurcation in non-contrast images were not using obtained with the low-dose chest CT protocol used in clinical experiments; instead, the dose modulation protocol was used. The evaluation of exposure dose was analyzed by recording the volume CT dose index ( $\text{CTDI}_{\text{vol}}$ ) and dose length product (DLP) calculated through automatic computation with the fixed group, in whom dose modulation was not applied, and the D-DOM group, in whom dose modulation was applied. Noise was calculated by designating the region of interest of the obtained image.

**RESULTS**

Fixed  $\text{CTDI}_{\text{vol}}$  and DLP values were 1.94 mGy and 26.2  $\text{mGy}\cdot\text{cm}$ , respectively. For D-DOM, the respective values were 1.47 mGy and 20.1  $\text{mGy}\cdot\text{cm}$ . For D-DOM+ACS, the respective values were 1.70 mGy and 23.2  $\text{mGy}\cdot\text{cm}$ , the  $\text{CTDI}_{\text{vol}}$  value of Z-DOM was 1.82 mGy, and the DLP value was 24.9  $\text{mGy}\cdot\text{cm}$ . For

Z-DOM+ACS, the  $CTDI_{vol}$  value was 2.22 mGy and the DLP value was 30.4 mGy·cm. For ACS, the respective values were 2.46 mGy and 33.2 mGy·cm.

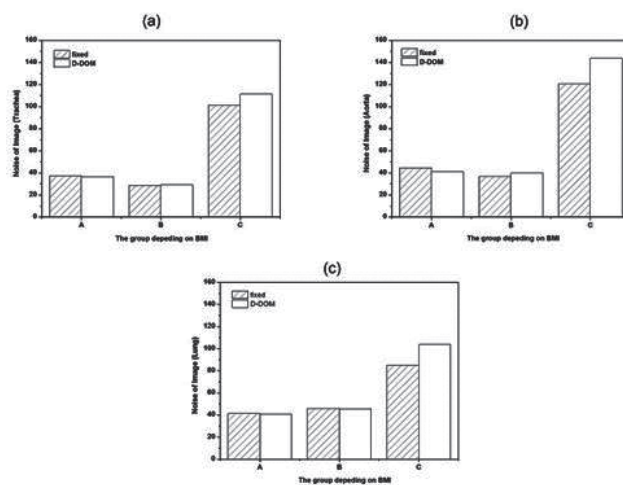
Using the same protocol condition used for the examination targets, changes of exposure dose, in case of  $CTDI_{vol}$  on dose modulation depending on BMI were observed. In the low weight group, the fixed ( $CTDI_{vol}$ ) was 1.94 mGy, and D-DOM ( $CTDI_{vol}$ ) was 1.60 mGy, representing a difference of 0.34 mGy. The exposure doses of the normal weight group were 1.94 mGy for Fixed ( $CTDI_{vol}$ ) and 1.56 mGy for D-DOM ( $CTDI_{vol}$ ), representing a difference of 0.38 mGy. For the obese group, the fixed ( $CTDI_{vol}$ ) value was same as the values of low weight and normal weight, and D-DOM ( $CTDI_{vol}$ ) was 1.55 mGy, representing a difference of 0.39 mGy.

$CTDI_{vol}$  did not change with the difference exposure doses based on BMI. However, in case of DLP, in low weight group, fixed (DLP) was 82.07 mGy·cm and D-DOM (DLP) was 68.40 mGy·cm, representing a difference of exposure dose of 13.67 mGy·cm. As the normal weight subjects received a higher exposure dose than low weight subjects, the fixed (DLP) was 84.92 mGy·cm and the D-DOM (DLP) remained 68.4 mGy·cm. The difference between the two exposure doses was 16.52 mGy·cm, which differed by 2.85 mGy·cm from low weight subjects. In the obese group, fixed (DLP) was 79.85 mGy·cm and D-DOM (DLP) was 64.6 mGy·cm, representing a difference of 15.25 mGy·cm; the obese subjects received less exposure dose than normal weight subjects (Table 2).

**Table 2: Ctdivol and Dlp Results According to Bmi**

Group		Dose	
		$CTDI_{vol}$ (mGy)	DLP(mGy·cm)
A.	Fixed	1.94	82.07
	D-DOM	1.60	68.40
B.	Fixed	1.94	84.92
	D-DOM	1.56	68.40
C.	Fixed	1.55	79.85
	D-DOM	1.55	68.40

By designating three targets as the region of interest (trachea, aorta, and lung), the difference of noise value was found to be highest in obese subjects. Noises in low-weight subjects for fixed and D-DOM were similar (fig. 2).



**Fig. 2: Comparison of noise value in ROI of image, trachea (a), aorta(b), Lung(c) according to BMI**

**DISCUSSION AND CONCLUSIONS**

Radiation dose exposure in CT can be damaging to patients and radiological technologists.(Brenner et al, 2008, Khawaja et al., 2014) Because of this, low-dose CT is becoming more widely being used. In a study using standard CT, 120kVp and 250mA yielded an average DLP value of ATOM dosimetry phantom of 182.80 mGy·cm 14. Presently, conditions of 120kVp and 30mA produced an average DLP and D-DOM value of the AAPM phantom of 26.2 mGy·cm and 20.1 mGy·cm, respectively In case of low weight group, Fixed ( $CTDI_{vol}$ ) was 1.94 mGy, and D-DOM ( $CTDI_{vol}$ ) was 1.60 mGy; therefore, the difference between two values came out to be 0.34 mGy. Exposure dose of normal weight group were 1.94 mGy Fixed ( $CTDI_{vol}$ ) and 1.56 mGy D-DOM ( $CTDI_{vol}$ ), and the difference between two values was 0.38 mGy, and in case of obese group, Fixed ( $CTDI_{vol}$ ) value was same as the values of low weight and normal weight, and D-DOM ( $CTDI_{vol}$ ) was 1.55 mGy, and the difference between two values came out to be 0.39 mGy. In case of  $CTDI_{vol}$ , it could be known that there was no change of exposure dose depending on BMI. However, in case of DLP, in low weight group, Fixed (DLP) was 82.07 mGy·cm, and D-DOM (DLP) was 68.40 mGy·cm; therefore, the difference of exposure dose came out to be 13.67 mGy·cm. As normal weight received higher exposure dose than low weight, Fixed (DLP) came out to be 84.92 mGy·cm, but D-DOM (DLP) came out to be 68.4 mGy·cm, which was the same value. The difference between two exposure doses was 16.52 mGy·cm, which had difference of 2.85 mGy·cm from low weight, and,

in obese group, Fixed (DLP) was 79.85 mGy·cm and D-DOM (DLP) was 64.6 mGy·cm. The difference was 15.25 mGy·cm, which means that obese subjects received less exposure dose than normal weight subjects

The exposure dose measured 82.07 mGy, 84.92 mGy, and 79.85 mGy in low weight, normal weight, and obese subjects, respectively. The fixed and D-DOM DLP values using low-dose CT showed a minimum difference of 102.95 mGy·cm. Such a reduced dose might be anticipated to decrease the incidence of new cancer relative to standard CT.

Along with dosage, image quality is important as well. If the image quality decreases as the value of tube current, low-dose CT might not be used. However, the images of low weight and normal weight groups using low-dose CT had similarly low noise. Noise was appreciable for obese subjects, similar to a prior study (Szucs-Farkas et al., 2008). Image quality using low-dose CT was similar and suitable for the low weight and normal weight subjects group, but differed for obese subjects, also similar to prior evidence<sup>14</sup>.

Improved exposure dose and image quality for obese patients may be best realized by developing a protocol that offers more appropriate image quality using a minimum dose, rather than adjusting fixed kVp and mAs, which is commonly used in hospitals.

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# Prefrontal Activation in the EEG Biofeedback Training using a General-Purpose Brainwave Meter

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## ABSTRACT

Commercialized EEG monitoring technologies present no standard for evaluating conditions on practicing brain self-regulation; in order to verify the standardization of brain self-regulation through a Human Computer Interface(HCI) reference posture. Both Autogenic Training(AT) and ANSI/HFES 100 HCI reference postures were studied for similarities and differences. From these, six postures were similar and two other postures were somewhat different. To verify availability in applying the reference posture of ANSI/HFES 100-2007 in measuring brain waves as a standard posture, this thesis measured the brain wave of users after practicing AT in an upright sitting posture, for those already having acquired AT. Brain waves recorded for 120 seconds from 6 participants at an upright sitting posture, who had acquired the ability to enter an autogenic shift within 10 seconds. The  $\alpha$ -wave made up 16~21% while the  $\theta$ -wave was 27~29% of the brain waves. Training was applicable to all the users despite the users having differences positioning their head downward or not and their arms and hands resting on their knees or not, with differences in the leaning posture of AT and the comfortable workspace posture of ANSI/HFES 100. The results indicated that measuring brain waves after training for self-regulation just like the reference posture allows for maintaining a state of very high concentration. As such, there is a need for defining concentration standards by conducting a comparison of brain waves in general and after training self-regulating brain, both under the HCI conditions. In addition, a study on brain wave changes for untrained and subsequently trained users, both at the HCI posture, seems necessary. The methodology allows for quantifying how much concentration is present for a user interacting with a computer in situations such as controlling equipment remotely or in an education setting.

**Keyword:** Brain wave, HFES 100, HCI, Alpha wave, Theta wave.

## INTRODUCTION

The World Health Organization (WHO) defines health as having “physical, mental, social wellness.” This emphasizes that the importance of physical health, but also the concepts of mental and social adaptation being significant for the overall health status of an individual(WHO, 2016). Maintaining brain health, required for mental and social wellness along with various health elements, has become a difficult problem in the society and the goal of significant research. The research areas involves studying the self-regulating brain as part of the healthy brain research as part of in various fields of studies such as psychology, cognitive science, medicine and computer engineering (H. B. Park and H. M. Sung, 2006<sup>[7]</sup>) (J. H. Kim and J. D. Seol, 2003<sup>[10]</sup>) (S. J. Cho and H. S. Yoon, 2011<sup>[13]</sup>) (W.

K. Kang, et al., 2009<sup>[15]</sup>). One representative training is Autogenic Training and NeuroFeedBack training (H. B. Park and H. M. Sung, 2006<sup>[7]</sup>) (L. Gladbeck and K. Schmidt, 2003<sup>[11]</sup>) (A. R. Yang and D. Y. An, 2014<sup>[1]</sup>) (M. Mikicin, et al., 2015<sup>[12]</sup>). Currently, the brain health can be examined by brain wave measurement through a self-regulating brain(H. M. Mallikarjun, et al., 2016<sup>[8]</sup>) (W. J. Cho, et al., and 2015<sup>[15]</sup>).

Brain wave measurement involves recording the electrical rhythm in a curve of leading and increasing the differences in electric potential representing the activity of the brain cell. It was first described by the German psychiatrist Hans Berger in 1929, and became a significant physiological signal measurement in psychiatric and brain function monitoring applications. Even when just lying around or sleeping, brain activity

never seizes and complicated waveforms are present. Brain wave is used in a wide array of diagnoses for brain-related conditions such as epilepsy, brain tumor, sleep disorder, stress relief and others(H. B. Park and H. M. Sung, 2006<sup>[7]</sup>).

The types of brain wave are the delta waves (frequency of 0 ~ 3Hz) for deep sleep, theta waves (4~7 Hz) for sleep, alpha waves (8~12 Hz) for stable and resting condition, beta waves (21~50 Hz) for when performing a task, or when in stressed or excited conditions. A major objective is to use brain wave activity to study and seek improved brain health as the electric signals are a reflection of the natural electrical biorhythms due to brain action and the subject’s thinking.

Currently with improvements in computer technology, there is also brain wave measuring equipment of different types. Also, the EEG (electroencephalography) brain wave measuring devices have become more portable and are available commercially (EMOVIVE, 2016) (Biosensors, 2016), and this includes brain monitoring and brain feedback technologies. In addition, uses have expanded from medical applications to gaming, security, education and training. The study of brain waves and monitoring has also expanded in the field of medicine; however, its use is just starting to develop in the fields of education and training. The uptake in these two areas is very slow due to characteristics of the brainwave(J. H. Kim and J. D. Seol, 2003<sup>[10]</sup>) (M. Mikicin, et al., 2015<sup>[12]</sup>) (C. J. Lee, 2009<sup>[5]</sup>) (C. H. Jeong, et al., 2004<sup>[4]</sup>) (B. J. A. Rani, 2015<sup>[2]</sup>).

A study of how brain training may be useful in conditions of human and computer interaction is required, and also on how this interaction is maintained. This study uses portable brain-wave measurement equipment to assay the various alpha/theta wave control and improvement protocols. The findings may be directly put to use for cases of promoting remote-control learning through brain-wave control, in applications such piloting planes and ships by remote control.

## TECHNOLOGY OVERVIEW

**Lighter and more affordable EEG equipment:** Among various technologies for obtaining physical information on the human body and for measuring micro signals from the brain, EEG has been the traditional method. Recently, there have been many EEG equipment on the market, varying in portability and price(EMOVIVE, 2016) (Biosensors, 2016). The price range for the equipment has been from hundreds to more than a thousand dollars. With IoT experimental equipment, there is also rapid assessment and integration with Internet. As part of a 4th industrial revolution, EEG is developing to a major technology with applications in a hyper-connected society that is quickly becoming hyper-stimulated society. Moreover, most portable equipment is now being developed linked to a smart phone and being improved for ease of use in data collection, and for EEG, assaying for brain-wave changes.

**Development of self-regulating brain control technology:** It has been shown that neurofeedback and Autogenic Training, reflecting changes in alpha and theta wave-forms, improve body stabilization and concentration (H. B. Park and H. M. Sung, 2006<sup>[7]</sup>) (L. Glodback and K. Schmid, 2003<sup>[11]</sup>) (M. Mikicin, et al., 2015<sup>[12]</sup>). In terms of maintaining the brain waves in the alpha mode, there is a need to objectively measure how the status can be accurately sustained as required for using remote-control equipment and educating the users utilizing such technology. Advances in technology for computer and human interaction through self-regulating brain training is becoming significant, and autogenic and biofeedback training in which the trainer directly affects the brain wave improves alpha and theta wave generation, and increases concentration. Alpha and theta brain wave is also known as a major index in measuring whether the human intelligence is integrated.

**Table 1: Contents and Process of Autogenic Training**

Week	Title	Content and Activity	Objective and Effect
1	Heaviness training	<ul style="list-style-type: none"> <li>● Introduce the therapist and group members</li> <li>● Explain the concept of training and relaxation</li> <li>● Experience heaviness of the right side of arm</li> <li>● ‘Right arm is heavy’</li> <li>● Significance of a week of training and assignment, explain how to conduct assignment</li> </ul>	Muscle Relaxation

Conted...

2	Warm sensation training	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Experience warm sensation on the right arm</li> <li>● Provide a guide to warm sensation</li> <li>● Prior formula + 'Right arm is warm'</li> </ul>	Relaxation
3	Breathing training	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Experience natural and relaxed breathing</li> <li>● Provide guide to relaxed breathing</li> <li>● Prior formula + 'Still and regular breathing'</li> </ul>	Breath tuning
4	Mid-term review	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Review the entire heaviness, warm sensation and breathing from week 1 to 3.</li> <li>● Share the uncomfortable or relaxed feeling experienced during practice</li> <li>● Training enhance through dissolving inconvenience and discouragement element for assignments.</li> </ul>	
5	Abdomen practice	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Concentrate on the autonomic nervous system and experience relaxation of the abdomen</li> <li>● Prior formula + 'Feel the warmth in the solar plexus'</li> </ul>	Abdominal relaxation
6	Forehead cold fiber practice	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Experience the cool feeling on the forehead</li> <li>● Prior formula + 'Feel the coolness on the forehead'</li> </ul>	Thoughts and emotion cleansing
7	Heart practice	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Concentrate on heart and experience relaxation in heart</li> <li>● Prior formula + 'Feel the coolness on the forehead'</li> </ul>	Heartbeat tuning
8	Total review and examination	<ul style="list-style-type: none"> <li>● Promote the weekly training</li> <li>● Check if the experience of relaxation has changed</li> <li>● Individual guideline for practice</li> </ul>	

NeuroFeedback is a type of biofeedback, also termed EEG biofeedback. The technique of biofeedback was introduced to the psychiatric clinics long time ago and has been in use ever since (H. B. Park and H. M. Sung, 2006<sup>[7]</sup>) (M. Mikicin, et al., 2015<sup>[12]</sup>). Excluding the autonomic nervous system, NeuroFeedback only applies to brain waves. This is applying the EEG operant conditioning to the brain wave. Recently, the brain wave became capable of being analyzed according to the time and space coordinates and biofeedback was conducted by choosing the brain wave from a specific portion.

Autogenic Training is a self-training method first developed by the German doctor J.H. Schultz in 1926, which uses a step by step implication, starting from controlling muscles to addressing the circulatory system, heart, breathing, abdomen, and cephalic systems. In this

training, the trainer repeats the self-proposed formula inside ones brain to conduct autonomous relaxation mentally and physically. This training is a significant self-control training method that improves the alpha and theta waves generated along with biofeedback training(L. Gladbeck and K. Schmidt, 2003<sup>[11]</sup>) (A. R. Yang and D. Y. An, 2014<sup>[1]</sup>). This study uses the program proposed by Rhee Jyoo-Hi (2006), who acquired it from Germany and later proposed 8 weeks of standardized composition. The program is described in Table I. Each step has a relevant formula, and according to the instruction from the instructor, the formula is adapted to go into passive concentration focusing on a specific body part(A. R. Yang and D. Y. An, 2014<sup>[1]</sup>).

There are two ways for human and computer to interact: direct interaction and an indirect interaction

through a medium. The direct interaction includes interaction with sensors on the skin or under the skin, or an interaction accepting information through vision and hearing. For indirect interaction, there is medium that recognizes and decides on the information through the five senses, and then operating the input devices such as mouse and touch pad as a result(HFES, 2007).

In November 2007, the American National Standards Institute approved ANSI/HFES 100-2007, Human Factors Engineering of Computer Workstations as an American National Standard. It provides specific guidance for design and installation of computer workstations, including displays, input devices, and furniture that will accommodate a wide variety of users.

The ANSI/HFES 100-2007 provides for standards in design and engineering to enable an optimal interaction between the computer and person sitting at a computer workstation. The standards are utilized to see if a normal recognition function properly provides for a concentrated environment when regularly using the workstation. By improving its availability, the workstation allows for learning to become easier. This is accomplished by improving the operation ability and error restoration on the part of the user, and maintaining a minimized posture change to maintain user ability. The four ANSI/HFES 100-2007 reference postures are described in Fig. 1.

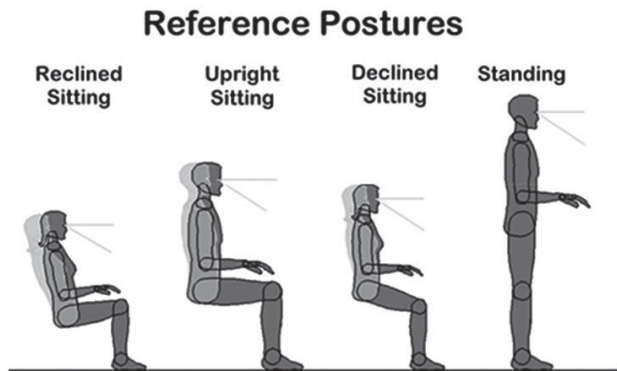


Fig. 1: Four Reference Postures at ANSI/HFES 100-2007

The standard recognizes that VDT users frequently change their working postures to maintain comfort and productivity, and the four reference postures used in this standard represent a range of postures observed at computer workstations(HFES, 2007). ANSI/HFES 100-2007 proposes a comfortable workspace. In detail, it specifies that the shoulders be lowered, and having the arm and hand be in a straight line, and the elbow-lower arm be laid horizontally with the floor or a bit higher.

The lower back is supported, the thigh is horizontal and the head and monitor has 45~70 cm (18~28 inch) gap in between them. The upper screen is on the eye level or a bit lower. The height of the monitor is adjusted by supporting the monitor with objects and heightening the operation desk, such that the monitor should avoid reflected light. There should be no object under the desk and the feet are laid flat on the floor(HFES, 2007).

Such posture is very similar to the lean-on and sit posture among the postures in the AT field. Lowering shoulder, making hand and arm a straight line, and flattened feet make for a comfortable posture.

**Preceding studies:** “The Effects of the Concentration and Imagery Through the Regulation of the Brain Wave on the Performance Learning of Golf Putting” by Kim Jae Hun conducted an experiment in which the computer simulated shooting of the target starts when the subject generates the alpha wave(J. H. Kim and J. D. Seol, 2003). In the reports, “A Study on the Improvement of Concentration through Serious Games” by ChoSeungJu and “Development of the Game for Increasing Intensive Power using EEG Signal” by Lee Chang Jo and others(S. J. Cho and H. S. Yoon, 2011<sup>[13]</sup>) (C. J. Lee, 2009<sup>[5]</sup>), experiments were conducted using the brain-wave concentration index with the index defined as follows:

$$\text{Power Ratio of } \frac{\text{SMR} + \text{Mid}\beta}{\theta} \dots(1)$$

Table 2: Similarities of Leaning and Sitting Postures and Comfortable Workspace Posture of ANSI/HFES100

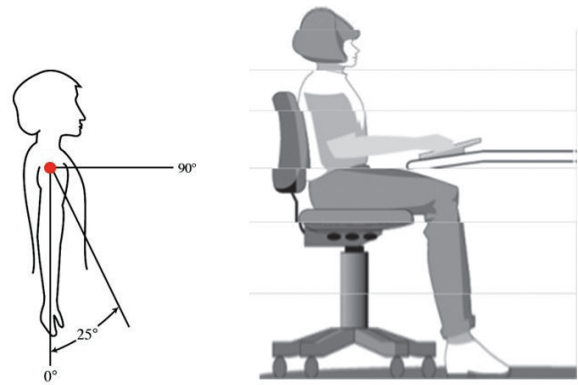
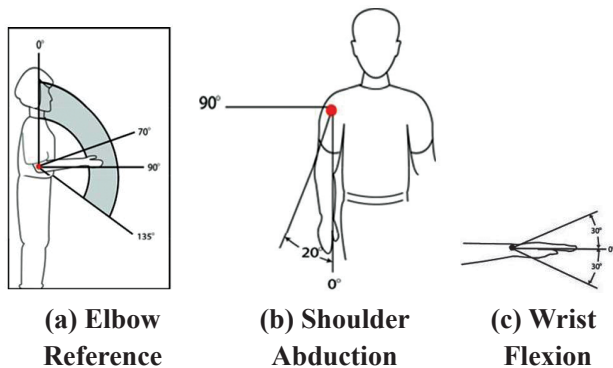
Autogenic Training Posture	Comfortable workspace at ANSI/HFES 100-2007
Relax shoulder in comfortable condition	Lower shoulder
Support back on the chair	Support the lower back
Put thigh horizontally	Put thigh horizontally
Stick sole on the floor and make it comfortable	Put feet on the floor flattened.
Put arm and hand lightly on both knees.	Put arm and hand in a straight line
	Make arm(elbow) horizontal or a bit higher than horizontal
Put arm and hand lightly on both knees.	Put arm and hand in a straight line and make arm(elbow) horizontal or a bit higher than horizontal

“The Comparison of EEG Activity by Computer Assisted Cognitive Rehabilitation Program in the Normal Elderly” and “The Elderly With Dementia” by Kang Won Ku studies have conducted experiments which defines concentration point as the ratio of the concentration index (SMR/ $\theta$ ) and activation index ((slow  $\beta$ )/ $\alpha$ ) (W. K. Kang, et al., 2009<sup>[15]</sup>). Those studies on defining concentration through EEG mainly relied on simulation screen moves or quantifying concentration through the concentration index using the brain wave ratio calculated by EEG.

**STUDY METHOD**

With applications in the education field, this study was to verify whether self-regulating brain training could become a fundamental evaluation material for remotely controlled equipment. The equipment used brain-wave interaction for developing concentration abilities and the subject was in the standard posture for HCI (Human Computer Interface). The study subjected users who could get into a relaxation mode within 10 seconds through AT. The reference posture of ANSI/HFES 100-2007 was applied for interaction with the computer. The study subjects first conducted AT in the upright sitting position and also monitored their brain wave patterns. The recommended postures between both are described in Fig. 2.

The study subjects first learned AT, and were then explained the differences with ANSI/HFES 100-2007 reference posture. They were then conducted the experiment. It was verified that all the postures from Fig. 2—namely, (a) elbow reference(see elbow), (b) shoulder Abduction(widened shoulder), (c) wrist flexion(bent wrist), (d) shoulder flexion(bent shoulder), and (e) torso to thigh reference(see upper body and thigh)—were similar to the postures from AT. The similarities between them are described in Table II.



**Fig. 2: Recommended Postures**

**Table 3: Differences of Lean and Sitting Posture of at and Comfortable Workspace Posture of ANSI/HFES100**

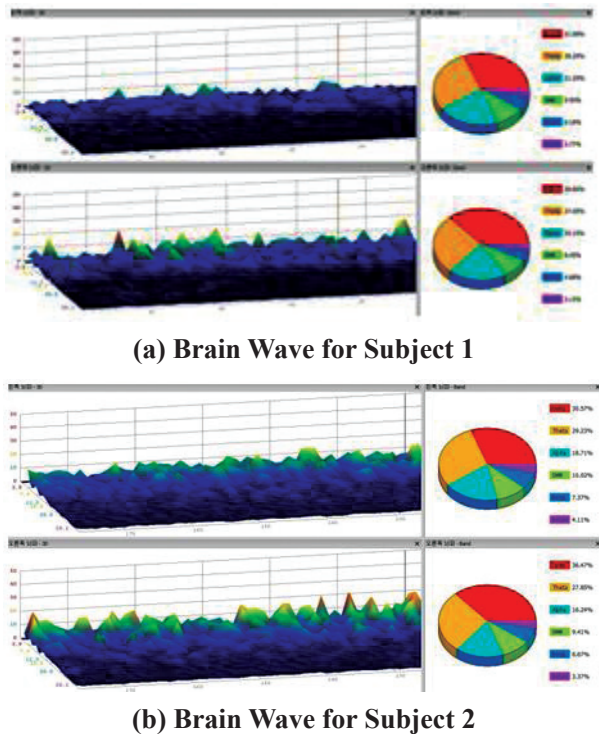
Autogenic Training Posture	Comfortable workspace at ANSI/HFES 100-2007
Lower the head	Have the head face the screen horizontally.

The similarities and differences of leaning posture for AT and the comfortable workspace postures for ANSI/HFES 100 were distinguished. As shown in Fig. 2, the reference and the AT positions for shoulder, back, thigh and sole are similar. The arm and hand positions show some differences, but there are within the allowed range for the reference posture. The AT neck position is different from that of the reference posture. This, however, does not deviate from elbow reference, shoulder abduction, and wrist flexion as in Fig. 2. The differences are described in Table III.

Therefore, when operating a computer screen after AT, the two movements, raising head and using the computer mouse were different.

**Experimental method and results:** As for the brain wave training with EEG-NFB, a two-channel brain wave measuring equipment developed by the Korea Psychiatry Institute was used. Also, the Autogenic Training to conduct alpha wave improvement training was adapted from the standard AT program conducted at the Rhee Jyoo-Hi Research Lab. The study started with 2 groups of 10 people each, but there were only 6 subjects who achieved the ability to enter into an autogenic shift within 10 seconds, and that was the goal of Autogenic Training after 8 weeks of training. The 6 subjects were

measured for brain wave activity for 120 seconds in a waiting position after AT in an upright sitting posture. Fig. 3 shows the brain wave from 2 subjects.



**Fig. 3: Brain Wave During the Waiting Condition After AT**

### DISCUSSION

For a more elaborate study, the brain wave examination in the HCI reference posture from more users is needed. The experimental data in this study recorded 16~21% alpha wave and 27~29% theta wave during 120 seconds as shown in Fig. 3 from the subjects. The results indicated that the subject with measuring brain waves after a self-regulating training in reference posture could maintain very high level of concentration. As such, the technique in the study quantifies concentration based on a mutual comparison of the brain wave after self-regulating brain training and the brain wave in general both under the HCI conditions. A comparative study would also have to analyze the brain waves during self-regulating training conditions with the subject attached to brain wave monitoring equipment and interacting with a computer, thus allowing to assay relevant indexes, including the extent of concentration. Such studies would allow for distinguishing various brain wave forms such as studying in the HCI condition and concentrating on learning. The findings would allow for developing novel means of interacting method between a student and an

instructor such as in a remote-control based education setting. In particular, as the SMR wave accounted for about 10% of the brain waves, the recording allowed an assay of the creative form of the brain. It seems there is a need for future studies on how to maintain a high SMR wave in computer interaction settings.

### CONCLUSION

Brain wave measuring equipment based on BCI (Brain Computer Interface) have evolved into ones that are both affordable and portable. Recently, the brain monitoring and the brain controlling technologies have been in the spotlight and may become popularly applicable. With such technologies, applications to the alpha wave generated by neurofeedback training and Autogenic Training allows for improvements in physical and mental stability along with better concentration for the subject using them. There is a definite need to incorporate the ability to maintain the brain wave in the alpha mode as a method of maintaining a high concentrated condition with remote-control equipment or in the field of education utilizing such technology.

This study has conducted alpha wave improvement training through 8 weeks of Autogenic Training along with EEG-NFB(EEG Neurofeedback Training). The study observed brain wave of 6 subjects who obtained alpha wave controlling ability, and there is a need for additional studies for developing a concentration standard through a mutual comparison between brain wave in general and after self-regulating brain training both under the HCI conditions. Also, a comparative study will be able to calculate the relevant indexes after brain wave measuring under self-regulating brain training conditions and interacting with a computer.

**Ethical Clearance:** Taken from

**Source of Funding:** Self Hanseo University

**Conflict of Interest:** NA

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# Basic Psychological Needs Satisfaction of Player and Non-player for Mobile Games

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## ABSTRACT

Many smartphone users enjoy mobile games and others don't. Authors assume they appreciate the experience of game differently than players. Why different is their experience in view of basic psychological needs?

The perception of people's game experience is measured by the satisfaction of three basic psychological needs in the Cognitive evaluation theory. We hypothesized that players who frequently enjoy mobile games perceive higher level of satisfaction for playing games than that of non-players, and statistically tested them by using the data measured through the survey about the usual game experience of smartphone users.

The players showed a greater satisfaction of all three basic psychological need dimensions than non-player. However, the assumption that the order of satisfaction of BPN in player and non-player groups will be different is rejected. Non-players were less satisfied with mobile games than players, but the order was the same. Player's need for autonomy, Non-player's satisfaction for relatedness need was relatively larger.

The results from the understand ingusers' psychological needs we can acquire a customer clustering strategy to optimize the features embedded to new products.

**Keywords:** *Non-player, mobile game, basic psychological needs, competence, autonomy, relatedness, satiation*

## INTRODUCTION

By playing games we have fun, even somebody enjoy it to the extent it is too much. There is no refutation that we enjoy playing them by the reason. Game developers are doing their best to make their product interesting for gamers. Most of new games, however, disappear in six months after service launching and the period is getting shorter and shorter<sup>1</sup>. It's not because they are not interesting, but because they don't get the gamers' choice for other unknown reasons. Game developers and researchers are turning their sight to who don't play games to find out the reason. Unlike arcade games, console games and PC games, mobile games are performed mainly on the smartphone everyone carry everyday. With Apps Market, you can install and execute games easily. Smartphones as a game console has only small display and touch screen input as an input-output interface. Due to them, all game characters are tiny and controlling them is also simple and limited. For this reason, mobile games are often treated as the alternative of computer games.

Game play is done for your own intrinsic rewards, unlike the behavior of learning or working for external rewards. To kill free time, to maintain good relationship with others, to get high ranking, or to be fun, the purpose to play varies from persons and from contingencies. With the view of the Basic Psychological Need theory or the Cognitive Evaluation theory which belong the Self-Determination theory in psychology<sup>2</sup>, game play experience can be measured by satisfaction of competence, autonomy, and relatedness needs<sup>3</sup>. Authors adopt the view to compare the degree of satisfaction of players and non-players for mobile games.

Non-players (or hereafter NP) in this study are smartphone users who currently do not play mobile games. They negatively perceive playing game behavior such like waste of time and vigor. They are the people who have installed some games and erased them because of uninteresting and forgot the fact they hold them still on their phone. On the other hand, players (or hereafter PP) in this paper are people who perceive more pleasure in games. In the previous game research, they have mainly

been dealt as research subjects with game behavior. There are not enough research works to look out non-players. They have the characteristics of inactive game players who play but inactively. They are not profitable to developers because they usually do not pay cash in playing. In this study, we compare the perception of playing game experience for PP and NP and analyzes the difference between them. If a smartphone user handle well applications on it, it can be assumed that they had experience of playing mobile games albeit those happened a long while ago or can understand playing game because they have indirect experience from news and word of mouth. The purpose of this study is summarized as research question as follows.

- The magnitudes of competence, autonomy, and relatedness need satisfaction of player and non-player for mobile games are different (within group difference).
- The order of weights with competency, autonomy, and relatedness need for players and non-player are different (between groups difference).

In the following Literature review sections, we arrange the definitions about the NP and PP, three Basic Psychological Needs and the previous research. In the Research methods section, the procedure for statistical test and for survey is going to be presented. In the Test result section, we arrange the test results of hypotheses. After discussing the results in the Discussion section, we summarized the conclusion and limitations of our study in the Conclusion section.

## LITERATURE REVIEW

Three basic needs are common perceptions that people experience as results of their goal-directed behavior<sup>4</sup>, which in turn motivates to continue the behavior. However, the proportion of these needs may vary from person to person, depending on the circumstances of the behavior<sup>5</sup>.

**Non-player and player (NP and PP):** Those who self-reported themselves as NP among smartphone users are a very interesting consumer group for game developers. This is because they have the remarkable characteristics with the inactive players among gamers who play passively and have a possibility to stop playing at any time in near future<sup>6</sup>. Lurkers who use social networking services but do not post anything<sup>7</sup>, people who log in Internet

always but do not shop through the online<sup>8</sup>, people who do not transact via Internet banking service<sup>9</sup>, there have been many studies those have analyzed the people don't accept new artifacts. They suggested creative insights to understand the psychological barrier thwarting the un-doer including the shy doer shy. Unlike the research in the view of Technology Acceptance Model<sup>10</sup> which analyzes those who are reluctant to adopt new technologies based on the concepts of usefulness or easy of product, many new trials to seek the reason of service failures from other factor, such as consumer's social class<sup>5</sup>, personality<sup>11</sup>, personal epistemic curiosity<sup>12</sup>. They commonly found out them from how different we experience when we consume the services and the experience affects our next purchasing behavior. Authors in the research focus on the experience of NP of mobile games.

Any smartphone user can easily access mobile games. If you are familiar with using apps on smartphones, though you don't play games currently, you must have experience of playing games directly long ago. At least you have experience for games indirectly from nearby players<sup>13</sup>. This is the basis for the authors to measure non-players' satisfaction with the survey for smartphone users.

**Basic psychological needs satisfaction:** In view of the Basic Psychological Needs theory which belongs the Cognitive Evaluation theory, people's goal-directed behavior is in accordance with their intrinsic will<sup>4</sup>. The theory says, people evaluate the experience of their behavior, and the results influence the psychological well-being or ill-being and act as an intrinsic motivation for the next action<sup>2</sup>. This view has been applied to people's behavior in areas such as Education, Healthcare, Psychology, Sports & Exercise, and Organization<sup>14</sup>.

The gamer's play experience satisfies or sometimes dissatisfies players, specifically their basic psychological needs which motivates subsequent game play behavior. The research considering the immersed playing game as the addiction could be a myopia because they regard human game play behavior as passive sensory responses to visual and auditory stimulation by games rather than goal-directed behavior from our innate needs<sup>15</sup>. Human behavior of game play, however, involves the pursuit of goal and epistemic curiosity to the extent that games such as pong and Tetris and the online Paduk (or Go) abstracted into extremely simplified black and white icons are still capturing interests of many gamers<sup>1</sup>. In this study, we postulate that like the playing behavior

of video game<sup>3</sup>, the mobile game play behaviors are also the goal-directed and the experience for them will determine the magnitude of satisfaction in the dimension of autonomy, competence, and relatedness needs.

**Competency (COMP):** Human expects their behavior to bring the desired result. Especially, when they show excellent performance compared to others, they experience competence, but deficiency if not. Digital games are good objects for the pursuit of the need. Above all this is the most traditional reason we enjoy the game as we check our competence<sup>16</sup>.

**Autonomy (AUTO):** As the most fundamental need for the goal-directed behavior, Autonomy is mainly satisfied when people behave by their own will and judgment. It is especially important to meet Autonomy needs for creative and difficult behavior such as learning, work. Forcing coercion, prizes, and penalties into the serious behavior such as business, learning, and games can lead to long-term ill-being rather than well-being in individuals<sup>2</sup>.

**Relatedness (RLTD):** Human is a social animal. We continuously try to connect with other people. Sometimes the connecting with others becomes the purpose of playing games<sup>15</sup>. Without audience to watch ranking billboard the meaning of high ranking will be reduced. The modern often come across the loneliness. The cyber world digital games have provided us the contact points people communicate under the name of game. Unlike other social networking services, the gamers met in a virtual space have the same mission and purpose, who have common interests. The need for relationship also supports two other basic needs. It is also evident from the explosive growth of the social network game that people's game behavior is related to their need of relatedness.

The BPNs are universal needs for people, but the magnitudes of their propensity vary from person to person. Among the players, the importance of people who play casual games like Candy Crush and those who enjoy MMORPG like Lineage M must be different<sup>10</sup>. Moreover, PP and NP are differently motivated from the same games. PPs are, of course, being motivated by the current game, thus their needs for game play is greater than that of NP. This hypothesis is summarized as follows.

**H1:** Players' competence (H1.1), autonomy (H1.2), and relatedness (H1.3) need from direct playing experience is greater than those of NP.

The three dimensions of BPN, Competence, Autonomy, and Relatedness, can be the different lens to view the playing game. Most games have the elements of joy that satisfy these needs at the same time, but, the extent by which we are satisfied must be distinct by game genre or game feature<sup>15</sup>. Most of the games in the stand-alone genre, which were in the form of early mobile games, mostly satisfy the need for competence. This requirement will fulfill when conundrums caused with endless enemy ships, fast-pile bricks are diminished and start again a new higher-level game. The experience of satisfaction mostly motivates them to start a new level of game. Autonomy needs are strongly met mainly when performing RPG (role play games). Once you understand the mission given before starting game, you decide to act whatever you imagine. To escape the present dungeon, the gamer re-reads the mission and chooses one from alternatives under consideration. The experience of successfully escaping from it and achieving the mission will be the motivation for the next challenge. The growth of social network game is the most representative example of emerging the Relatedness need to mobile games. In some extent, the purpose of game play is to build human networking with another netizen even though they are machine. If the communicating and collaborating with other players in the virtual world were successful, they are motivated to continue the game<sup>17</sup>. In the case of the Second Life, the Relatedness desire is fulfilled in the virtual world that mimics reality. If there weren't other people without me in the space, would I like to enter there?

A game or a game genre has the feature satisfies gamers remarkably in a dimension of BPN. Recent blockbuster games, however, are equipped with the characteristics of all three needs at the same time. The kind of Bricks break games is traditional cases for Competence. Recent version of brick breaker, however, equipped a narrative mode, where a narrator in the game tells me how vicious the villain who throws me bricks and why I should break the wall of bricks. We can also invite other people or join into other communities and chat about the winning method. In MMORPG (massive multiple online role playing game) mainly, huge blockbuster games, these three factors coexist clearly. They should be enjoyed as a community or a group, rather than alone, and they should choose one of myriad alternatives to choose their character and game items<sup>18</sup>. If you don't play it not with automatic mode, sometimes you touch screen of smartphone to the extent your head off because all the touching screen could be related the points you acquire. When the game starts, you make many decisions as

attacking your opponent or gather resources by mining. Here Autonomy, Relatedness, and Competence are mixed as motivation of playing those games.

Each person's favorite game genre is different<sup>19</sup>. This means that people have different playing reason in views of these three needs. NP and PP might have different reasons to play game behaviors. We postulate a hypothesis that the order of satisfaction of these three BPNs is different by players and non-players.

**H2:** The players' weights of competence (H2.1), autonomy (H2.2), and relatedness (H2.3) need is different from those of non-players.

## RESEARCH METHODS

**Statistical variables:** The variables for statistical tests for hypotheses are measured from the direct and indirect experience of smartphone users on the mobile game. Authors' main interests are the relative magnitude and order of basic psychological need satisfactions by game experience of smartphone users. All smartphone users are divided into PP and NP depending on whether they have experience playing mobile games, and COMP, AUTO, and RLTD of the two groups are evaluated and compared [see Table 1]. Hypothesis H1 and H2 are tested by independent sample t-test and one-way ANOVA.

**Table 1: Observed and latent variables**

Acronym	BPN	Observed items	Materials
AUTO	autonomy	I feel very strongly that the way I exercise fits perfectly the way I prefer to exercise.	Vlachpoulus et al.(2006)
		I feel that the way I exercise is definitely an expression of myself.	
COMP	competency	I feel that I execute very effectively the exercises of my training program.	
		I feel that exercise is an activity in which I do very well.	
RLTD	relatedness	I feel extremely comfortable when with the other exercise participants.	
		I feel that I associate with the other exercise participants in a very friendly way.	

Questionnaire consists of two parts. In first part, participants answer whether the participant enjoys the mobile game or not. Q1) If you have a game app for your smartphone, write it down. If not, write "None". Q2) If you don't have any games but have played mobile games in the past 6 months, write them down. If not, write "None". Q3) If you play a mobile game but can't remember the name of them, write "player" or "non-player". Second part, it is the domain of perception of game plat behavior. The questions in this area are to measure BPN for game behavior. For those who responded that they are non-players, we asked they recall old game experience he or she had or their knowledge and information heard from close people who enjoys the game around him. The gender and age of the participant were not asked because they were already extracted from the survey panel database system.

## SURVEY

We surveyed 500 smartphone users about mobile game play experience through the survey app on their smart phones. Whether to participate in the survey,

to answer the question, or to compensate for the participation as a small reward were provided through a dedicated application provided by the mobile survey agency. The survey was conducted in April 2016 through a Korean mobile research agency. Participants were randomly extracted from the agency's panel database. The male and female ratios were sampled randomly as rate of 50%: 50%, and their age was evenly distributed among the 5 groups, such as under 19, 20~29, 30~39, 40~49, and above 50. Excluding the incomplete answers, the number of final answer submissions was 500 as 100 for each age group and 50 for men and 50 for each age group. The game is mostly enjoyed by young men. Researchers used this stratified sampling method to control the gender-age factor as much as possible in this game satisfaction survey. Two questionnaires were assigned for each need, and each question was short and easy to read to express one item on the smartphone screen without scroll touch. The entire question was expressed as open-ended questions and five-point Likert scale questions, and the total time to complete response was adjusted to no more than 15 minutes through modification and three pilot surveys.

The average age of the players was 32.36 years and the average age of non-players was 42.76 years as shown in table 2. Researchers sampled the respondents as evenly distributed among five age groups, and if the flat age restraint condition were canceled we could predict the actual average age of gamers will get lower and that of non-players gets higher. The average sex of gamer is slightly above 1.5, which means that in mobile game player there are more males. This rate also can be changeable when the stratified sampling condition inferring from many previous reports about demographic data of consumers<sup>20,21</sup>.

**Table 2: Non-player vs. player (age and gender)**

Mean (std. dev)	Non-Player (n=104)	Player (n=396)	Difference F-value (Sig.)
Age	42.76(12.51)	32.36(12.50)	57.024 (.000)***
Gender	1.58(.50)	1.48(.50)	3.115 (.078)*

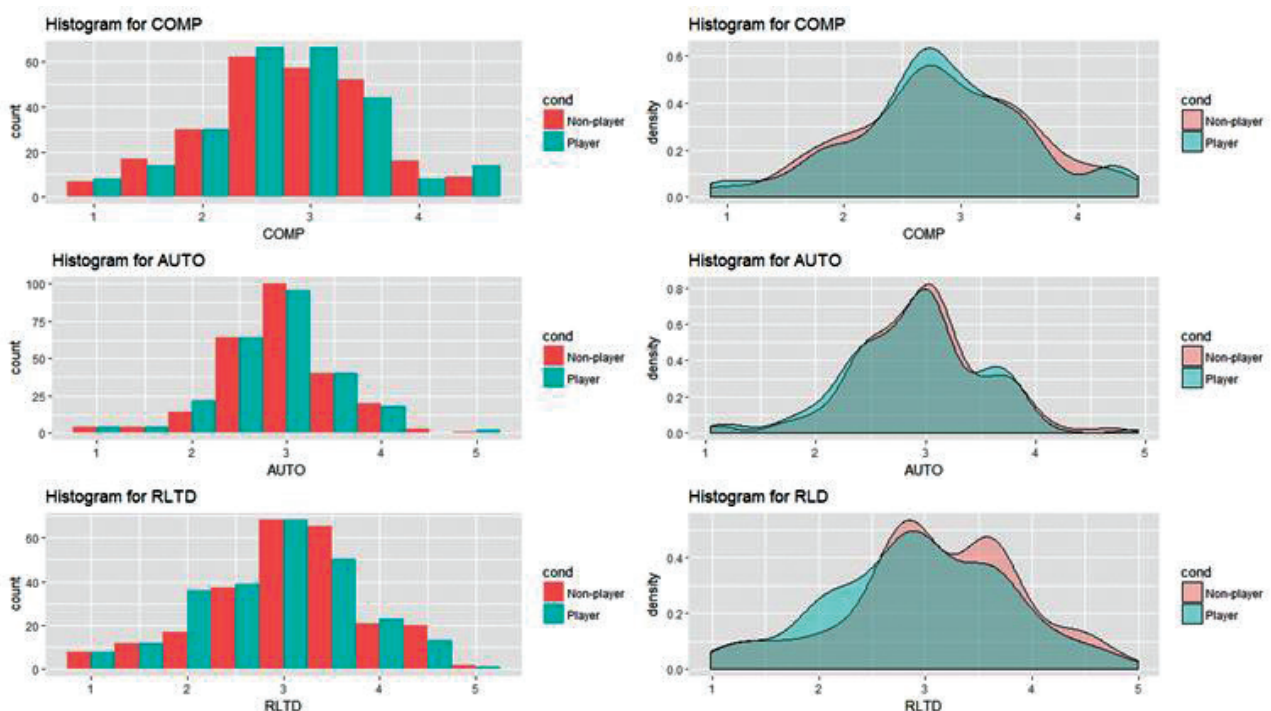
\* p < 0.1, \*\* p < 0.5, \*\*\* p < 0.1

**Test results:** The measurement questions were adopted from materials which have already proven to be reliable and validated to evaluate the basic psychological need for exercising behavior of sports facilities<sup>14</sup>. Authors modified these items to match the game experience [see Table 1]. Of the total respondents, 396 were answered the name

of the game app that they currently enjoyed or enjoyed before, and defined themselves as a player although they did not remember the name correctly. Among them, 206 were males. Other than these, 104 non-players responded to the questions based on the indirect game experience and impression they own subjectively.

**Confirmatory Factor Analysis:** The BPNs were averaged by factor scores on each of the two observed items. In this case, confirmatory factor analysis was executed on three BPN models to see if the factor scores had data validity and reliability. As the index of fitness for the default model, CMIN / DF = 116.02 / 42 = 2.762. Other indices were RMR (0.357), GFI (0.954), AGFI (0.914), CFI (0.964), RMSEA (0.067) and PCLOSE (0.028). They all exceeded the thresholds<sup>22</sup>. The CR (composite reliability) value were calculated as COMP (0.821), AUTO (0.75), and RLTD (0.773), they all exceeded 0.7 as excellent for variables validity and reliability<sup>23</sup>.

**Basic psychological needs:** The average needs satisfaction is distributed between 1 and 5 for each COMP, AUTO, RLTD, and the histograms and density of relative frequencies distributions for each need are shown in Figure 1. Respondents in both groups have similar distributions of COMP and AUTO desires for games, but different for RLTD. The RLTD distribution of NP is viewed as skewed to right. NP is more likely to recognize positively in view of RLTD needs than the actual experience of PP.



**Figure 1: Non-player vs. player (Distribution of BPN)**

The results of the t-test on the difference between the two groups are shown in Table 3 based on the mean and standard deviation of need satisfaction. Table 3 shows that there was no significant difference in the ratio of male to female in PP and NP of smartphone users ( $p = 0.078$ ). However, the mean age of the two groups

differed. The mean age of the players was 32.36 years, lower than that of non-players ( $p = .00$ ). This difference can be larger when considering that there are more participants in the above the 40s-aged group than in the actual game player.

**Table 3: Player vs. non-player (demography and BPN)**

Mean	Player	Non-player	t-value	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
						Lower	Upper
Std. Deviation	(n=396)	(n=104)					
SEX	1.48(.5002)	1.58(.4964)	-1.765	498	.078	-.20525	.01100
AGE	32.36(12.50)	42.76(12.51)	-7.551	498	.000	-13.11036	-7.69675
COMP	3.099(.7098)	2.538(.8975)	6.765	498	.000	.39798	.72376
AUTO	3.357(.5754)	2.757(.7958)	8.677	498	.000	.46400	.73563
RLTD	3.166(.8018)	2.682(.9701)	5.237	498	.000	.30268	.66611

The null hypothesis that players will not differ in non-players in the satisfaction of COMP, AUTO, and RLTD can be rejected by each level of 2-tailed significance (Thus, H1.1, H1.2, H1.3 supported). Therefore, it is deduced that the average satisfaction of players' three needs is greater than non-player. Second, it is the order of magnitude of player and non-player's desire satisfaction. Though there was a difference in the size of desire satisfaction, both groups have the highest AUTO satisfaction, followed by RLTD and AUTO. We can't say that two orders of needs satisfaction are same (H2.1, H2.2, H2.3 rejected).

## DISCUSSION

Player(PP) and non-player (NP) focused in this study is the people who skillfully handle the app on the smartphone because they are those who join the mobile survey service using mobile applications themselves, can apply for a variety of surveys and get a small amount of return by faithful answers. Even non-players, the reason they don't play games is not necessarily because they do not have the knowledge to accept new technology to run the game app. They are people who generally respond negatively to their mobile game play and those of their relevance, and at least they are subjectively reacting that their status is not suitable for playing games.

Player and non-player in this study are who are familiar with using smartphone apps, but are satisfied with game playing experience in terms of the basic

psychological needs dimension. All of competence, autonomy, and relatedness need satisfaction of the player is higher than that of the non-player. It can be understood that non-players comprehend that playing game means the waste of time, because the proportion of people who tend to perceive the benefits of the action as negative is larger<sup>24</sup>. However, it was unexpected that the order of magnitude of the three needs is the same with that of PP as Autonomy>Relatedness>Competency.

We have two issues to note from these results. First, non-players correctly understand the benefits of mobile games. Second, Competency, traditionally seen in video game genres<sup>25</sup>, is higher than Relatedness in mobile games but relatively lower than Autonomy is the focal point. Thinking about the first issue, non-player groups who know how to use smartphones well can understand mobile games well also even by indirect experience in other games genre, such as computer games. Thus, they can start mobile game at any time, given the proper motivation. Mobile games can be played anytime on a smartphone that is always on the go, and can be enjoyed anytime by using slack time of everyday, but it is difficult to immerse in the game because of the small screen based on touch input. Mobile games are a growing game genre invigorated with the social games<sup>25</sup>. Community function using the address book built in the smartphone is a core feature of the mobile game. Therefore, the features by which non-players can be attracted into the game can be considered as a primary target to satisfy their relatedness needs.

**Conclusions and limitations:** The Cognitive Evaluation theory explains why people play games because their gameplay behavior satisfies their needs for competence, autonomy, and relatedness. In this study, we surveyed the fact that this applies to people who enjoy mobile games and those who do not. Non-players among smartphone users are people who do not consciously play games. Though mobile games are easy to set up to enjoy games, with little load of price, the consumers of this group refuse to enjoy them consciously. The factors owned to the non-player show us more clear factors which inactive players in view of wanting to enjoy their game playing.

They understand the mobile game well, but they are generally less satisfied with the three basic psychological needs than the players. In fact, their past game experiences are not motivating new game play behavior. If a game development is planning to design new games for inactive players or non-players as a new product having competent power, it is not appropriate to strengthen the game elements that satisfy the needs for autonomy or competence of the active players prefer. Rather, it can be expected that it is better to strengthen what can satisfy the relatedness needs of the smartphone users. For example, strengthening social networking game elements such as game community functions and location information of oneself and other parties is expected to be useful as a new game product strategy. Mobile games are not designed to steer only for some enthusiasts, but mass is its potential audience. Still, smartphone users are much larger than the mobile game population. So, the non-player, the inactive-player ought to be the new target for profitable market for game developers.

In this study, the basic psychological needs of smartphone users were measured based on their indirect or direct game play experience and compared each other. However, to make the comparison of the two groups objectively, the experiences of the player and the non-player must compare under the experimental control about the need measurement conditions in the laboratory environment. In this study, we just controlled the cause from participants' technical acceptance by allowing the participants to join in case they can handle smartphone and application on it. But still we have more condition to manage the objective comparison test. Second, the non-players defined in this study are those who have never played games or have experienced them long ago. The need satisfaction of the game is measured from

old memory and indirect experience. Therefore, the comparison with the direct experience of the players couldn't acquire the reasonable objectiveness. Some studies have used simple ways to play non-players in a laboratory environment to learn about their game experience. A mobile game is a hedonic product that you enjoy for a while without any special purpose. It is not appropriate to see the effects of game experience in the experimental environment on satisfaction mechanically. We should eager to get better solutions for thee question on how to measure the experience of emotional consumer goods and objectively.

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**Conflict of Interest:** NA

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# Elite Taekwondo Athletes' Injuries and their Coping Strategies

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## ABSTRACT

This study examined athletes' injuries and their coping strategies, targeting 185 athletes registered with the Korean Taekwondo Association. To meet the purpose of this study, questionnaires were used, and descriptive statistical analysis and  $\chi^2$  (Chi-square analysis) were conducted to process collected data. The following conclusions were obtained through these methods. First, the time of experiencing athletic injuries by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. Second, the rounds in which athletes were injured by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. Third, causes of athletes' injuries by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. Fourth, first aid treatment by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. Fifth, injury treatment methods by demographic characteristics revealed a statistically significant difference in their weight and careers. Personal treatment was most frequently used by weight and careers. Sixth, perceived methods of preventing athletic injuries by demographic characteristics revealed a statistically significant difference in their weight, grades, and careers. As a result of this study, elite taekwondo athletes' injuries were incurred and repeated by many causes regardless of demographic characteristics. To prevent and minimize injuries, careful attention from athletes, coaches, hands-on staff and educators is needed. In addition, injury prevention programs for athletes should be implemented to minimize injuries and accurate treatment should be applied through comprehensive education on athletic injury prevention.

**Keyword:** *Elite Taekwondo Athletes', Injuries, Coping Strategies, Demographic Characteristics, Injury Prevention Programs.*

## INTRODUCTION

Athletes are using new training methods and systematically enhancing their training to achieve better records and acquire more skills. Their scientific and systematic training improves their performance<sup>[1]</sup>. However, an obsession with improvement of their performance may lead to a failure in preventing injuries and protecting themselves. Athletes' injuries lower their athletic performance and may cause unstable psychological conditions. Injuries may also have a fatal effect on their lives.

In sports, an overheated competition is inevitable since score results or renewal of the highest records determine victory or defeat. Combative sports such as taekwondo bring a high risk of physical injuries. In taekwondo, various forms of attacks and defensive movements instantly change and are connected to each other producing a formidable destructive power.

Taekwondo requires multiple directional changes, a high level of technical changes, and spontaneous and accurate judgment during a given space and time<sup>[12]</sup>. Unlike other sports, taekwondo is a combative sport in which hands and feet are used, which makes many athletes vulnerable to injuries during training and in competition. Since taekwondo is about attacking the most critical and vital points of the human body with spontaneous and concentrated force, it may cause fatal injuries. Also, since it is a fierce sport that requires athletes to engage in body-to-body combat with opponents, it causes more diverse and frequent injuries compared to other sports. In addition, since overexcitement during matches impairs their attention, aggravating risk of injury, they need to be more cautious in preventing injuries. Athletics' injuries in such sports as taekwondo have a significant impact on performance<sup>[8]</sup>. For athletes, minimizing injuries is a critical factor in improving performance. In this regard, the development and application of coping strategies has become essential for athletes and their coaches.

Currently, taekwondo has evolved into a sport focused on Gyeonggi (Competition) and so various attempts are being made, such as the reduction of the size of the arena and introduction of differential scores and sudden death systems, etc. to present it as a more fun and exciting sport<sup>[9]</sup>. With trends changing, the likelihood of athletes being injured is increasing as they engage in more intense training and practice immoderate attack techniques to win. High levels of immoderate attack techniques that are being practiced to compensate for losing scores caused by the introduction of the differential score system is also contributing to a high incidence of athletic injuries, but their coping strategies are insufficient. Measures such as ensuring that athletes wear protective gear during competition are being practiced but various forms of injuries related to potential risks may happen at any time.

Athletic injuries make it impossible for athletes to compete or reduce their performance in the short term. In the long term, such injuries have a negative effect of reducing performance because of anxiety about injuries, lack of training, non-attendance at practices, etc. Clinically, athletes need to know about the injury mechanism to prevent injuries. Studies on the mechanism and injuries are necessary for improvement of athletes' performance and for prevention. Many studies on athletes' injuries are being conducted. More specifically, there are studies on causes of injuries, frequency of injuries, the time when athletes are injured, locations of injuries, injury prevention, and first aid treatment methods. Also, in terms of sports medicine, there are studies on factors of injuries, clinical studies on prevention and treatment of injuries, and on rehabilitation from sports trauma<sup>[3], [6]</sup>. Recent studies have focused on causes of injuries arising from potential risks of taekwondo and analysis of real conditions<sup>[8]</sup>. There are few studies on injuries relative to taekwondo athletes' demographic characteristics. Previous studies on taekwondo-related injuries have been extensively conducted in various fields but not on analysis of real conditions relative to simple injuries. Therefore, it is necessary to investigate elite athletes' injuries and coping strategies. These studies will provide measures to prevent injuries and offer effective preventive and coping strategies when injuries arise. This study will provide coping strategies that address Taekwondo athletes' typical injuries by examining real conditions of athletes' injuries and their coping methods.

## METHODOLOGY

**Study subjects:** This study selected taekwondo athletes registered with the Korean Taekwondo Association as a population. A group of 200 subjects was selected using a convenience sampling method. A total of 185 questionnaires were used for the final analysis, excluding 15 questionnaires with unreliable responses. General characteristics of the subjects are shown in <Table 1>.

**Table 1: General characteristics of subjects**

Variable	Classification	Frequency (n)	Percentage (%)
<i>Class</i>	1 Class	97	52.4
	2 Class	56	30.3
	3 Class	21	11.4
	4 Class	11	5.9
<i>Weight</i>	58kg under	32	17.3
	68kg under	71	38.4
	80kg under	38	20.5
	80kg over	44	23.8
<i>Athlete career</i>	5years under	43	23.3
	7years under	37	20.0
	9years under	65	35.1
	9years over	40	21.6

**Tools:** Questionnaires that <sup>[2]</sup> and <sup>[10]</sup> used were selected as the research tool for this study, after being reconstructed to meet the purpose of this study.

The questionnaire consisted of the demographic characteristics (3 items: grade, weight, and athlete career), athletes' injuries (4 items: the time when they experienced injuries, the rounds in which they were injured, and causes of injuries), and coping strategies (3 items: first aid treatment, injury treatment methods, and perceived methods of preventing injuries).

**Research procedures:** To survey elite taekwondo athletes' injuries and coping strategies, the author(s) visited a high school taekwondo arena. The author(s) asked coaches for permission before conducting the survey. The caveats in responding to the questions and their purpose and content were explained to coaches and athletes before distributing the questionnaires. The subjects were asked to respond to questions based on self-assessment. Completed questionnaires were immediately retrieved.

**Data Processing:** A total of 185 questionnaires were used for the final analysis, excluding inaccurate and

unreliable responses. Descriptive statistical analysis and  $\chi^2$  (Chi-square analysis) were conducted of collected data using the SPSS 21.0 statistical software.

## RESULTS

**Time of athletes' injury experience by demographic characteristics:** The result of crossover analysis to identify the time of injury experience by elite taekwondo athletes' demographic characteristics. Athletes' injuries during competition were experienced most by 4th graders (81.8%), followed by 2nd graders (19.6%), 1st graders (17.5%), and 3rd graders (9.5%). Those during training were experienced most by 3rd graders (71.4%), followed by 2nd graders (50.0%), 1st graders (47.4%), and 4th graders (0.0%). Those during practice competition were experienced most by 1st graders (35.1%), followed by 2nd graders (29.8%), 3rd graders (7.0%), and 4th graders (3.5%). The time of athletes' injury by grade revealed a statistically significant difference between variables ( $\chi^2=31.016$ ,  $p<.001$ ). Athletes' injuries during competition were experienced most by those weighing more than 80kg (31.8%), followed by those weighing less than 80kg (43.2%), those weighing less than 58kg (21.9%), and less than 88kg (21.9%). Those during practice were experienced most by those weighing less than 80kg (65.8%), followed by those weighing more than 80kg (43.2%), those weighing less than 68kg (40.8%), and those weighing less than 58kg (20.0%). Those during practice were experienced most by those weighing less than 68kg (46.5%), followed by those weighing less than 58kg (28.1%), those weighing more than 80kg (25.0%), and those weighing less than 80kg (10.5%). The time of athletes' injury by weight revealed a statistically significant difference between variables ( $\chi^2=19.700$ ,  $p<.01$ ). Athletes' injuries were experienced most by those with more than nine years of career taekwondo (30.0%), followed by those with less than nine years (26.2%), those with less than five years (14.0%), and those with less than seven years (10.8%). Those during training were experienced most by those with less than 5 years of career taekwondo (65.1%), followed by those with less than nine years (52.3%), those with more than nine years (47.5%), and those with less than seven years (21.6%). Those during practice were experienced most by those with less than seven years of career taekwondo (67.6%), followed by those with more than nine years (22.5%), those with less than nine years (21.5%), and those with less than five years

(20.9%). The time of athletes' injury by year of career taekwondo revealed a statistically significant difference between variables ( $\chi^2=33.710$ ,  $p<.001$ ).

### **Rounds in which athletes were injured by demographic characteristics:**

The result of crossover analysis to identify rounds in which athletes were injured by elite taekwondo athletes' demographic characteristics. Athletes' injuries during the first round were experienced most by 3rd graders (19.0%), followed by 2nd graders (17.9%), 1st graders (5.2%), and 4th graders (0.0%). Those injured during the second round were experienced most by 4th graders (100%), followed by 3rd graders (47.6%), 1st graders (43.3%), and 2nd graders (25.0%). Those injured during the third round were experienced most by 2nd graders (55.4%), followed by 1st graders (48.5%), 3rd graders (9.5%), and 4th graders (0.0%). Injuries to the golden points were experienced most by 3rd graders (23.8%), followed by 1st graders (3.1%), 2nd graders (1.8%), and 4th graders (0.0%). The rounds in which athletes were injured by grade revealed a statistically significant difference between variables ( $\chi^2=51.819$ ,  $p<.001$ ). In some cases, they revealed no statistically significant depending on their weights. Athletes' injuries during the first round were experienced most by those with less than five years of career taekwondo (11.6%), followed by those with less than nine years (10.8%), those with more than nine years (10.0%), and those with less than seven years (8.1%). Those injured during the second round were experienced most by those with less than nine years of career taekwondo (53.8%), followed by those with less than five years (44.2%), those with more than nine years (42.5%), and those with less than seven years (16.2%). Those injured during the third round were experienced most by those with less than seven years of career taekwondo (75.7%), followed by those with less than five years (44.2%), those with less than nine years (33.8%), and those with less than nine years (27.5%). Injuries to the golden points were experienced most by athletes with more than nine years of career taekwondo (20.0%), followed by those with less than nine years (1.5%), those with less than five years (0.0%), and those more less than seven years (0.0%). The rounds in which athletes were injured by year of career taekwondo revealed a statistically significant difference between variables ( $\chi^2=45.245$ ,  $p<.001$ ).

**Causes of athletes' injuries by demographic characteristics:**

The result of crossover analysis to identify causes of athletes' injuries by elite taekwondo athletes' demographic characteristics. Injuries caused by a lack of warming up and cooling down were experienced most by 1st graders (17.5%), followed by 2nd graders (16.1%), 3rd graders (4.8%), and 4th graders (0.0%). Injuries caused by excessive training and techniques were experienced most by 1st graders (34.0%), followed by 2nd graders (33.9%), 3rd graders (9.5%), and 4th graders (0.0%). Injuries caused by wrong training methods were experienced most by 4th graders (81.8%), followed by 3rd graders (14.3%), 2nd graders (7.1%), and 1st graders (4.1%). Injuries caused by wearing no protective gear were experienced most by 3rd graders (33.3%), followed by 4th graders (18.2%), 2nd graders (10.7%), and 1st graders (9.3%).

Injuries caused by excessive desire for winning were experienced most by 3rd graders (38.1%), followed by 1st graders (27.8%), 2nd graders (21.4%), and 4th graders (0.0%). Injuries caused by lack of practice were experienced most by 2nd graders (10.7%), followed by 1st graders (7.2%), 3rd graders (0.0%), and 4th graders (0.0%). Reasons for experiencing injuries by grade revealed a statistically significant difference between variables ( $\chi^2 = 83.316$ ,  $p < .001$ ). Injuries caused by a lack of warming up and cooling down were experienced most by those weighing less than 58kg (28.1%), followed by those weighing less than 68kg (16.9%), those weighing more than 80kg (13.6%), and those weighing less than 80kg (0.0%). Injuries caused by excessive training and techniques were experienced most by those weighing more than 80kg (34.1%), followed by those weighing less than 68kg (33.8%), those weighing less than 80kg (23.7%), and those weighing less than 58kg (18.8%). Injuries caused by wrong training methods were experienced most by those weighing less than 80kg (21.1%), followed by those weighing less than 68kg (15.5%), those weighing more than 80kg (2.3%), and those weighing less than 58kg (0.0%). Injuries caused by wearing no protective gear were experienced most by those weighing more than 80kg (29.5%), followed by those weighing less than 58kg (15.6%), those weighing less than 80kg (7.9%), and those weighing less than 68kg (4.2%). Injuries caused by excessive desire for winning were experienced most by those weighing less than 80kg (47.4%), followed by those weighing less than 68kg (26.8%), those weighing more than 80kg (13.6%),

and those weighing less than 58kg (12.5%). Injuries caused by a lack of training were experienced most by those weighing less than 58kg (25.0%), followed by those weighing more than 80kg (6.8%), those weighing less than 68kg (2.8%), and those weighing less than 80kg (0.0%). The causes of athletes' injuries by weight revealed a statistically significant difference between variables ( $\chi^2=69.238$ ,  $p<.001$ ). Injuries caused by a lack of warming up and cooling down were experienced most by those with less than five years of career taekwondo (25.6%), followed by those less than seven years (21.6%), those with less than nine years (9.2%), and those with more than nine years (5.0%). Injuries caused by excessive training and techniques were experienced most by those with less than seven years of career taekwondo (51.4%), followed by those less than nine years (33.8%), those with less than five years (25.6%), and those with more than nine years (5.0%). Injuries caused by wrong training methods were experienced most by those with more than nine years of career taekwondo (37.5%), followed by those less than nine years (6.2%), those with less than seven years (2.7%), and those with less than five years (0.0%). Injuries caused by wearing no protective gear were experienced most by those with less than five years of career taekwondo (27.9%), followed by those less than seven years (16.2%), those with less than nine years (6.2%), and those with more than nine years (5.0%). Injuries caused by a lack of excessive desire for winning were experienced most by those with more than nine years of career taekwondo (40.0%), followed by those less than nine years (38.5%), those with less than five years (11.6%), and those with less than seven years (2.7%). Injuries caused by a lack of practice were experienced most by those with less than five years of career (9.3%), followed by those more than nine years (7.5%), those with less than nine years (6.2%), and those with less than seven years (5.4%). The causes of athletes' injuries by year of career taekwondo revealed a statistically significant difference between variables ( $\chi^2=89.045$ ,  $p<.001$ ).

**First aid treatment by demographic characteristics:**

The result of crossover analysis to identify elite taekwondo athletes' first aid treatment by demographic characteristics. Ice pack treatment was used most by 1st graders (36.1%), followed by 2nd graders (33.3%), 3rd graders (21.4%), and 4th graders (18.2%). Massage treatment was used most by 4th graders (81.8%), followed by 2nd graders (17.9%), 1st graders (17.5%), and 3rd

graders (9.5%). Pain relief spray treatment was used most by 3rd graders (57.1%), followed by 2nd graders (53.6%), 1st graders (38.2%), and 4th graders (0.0%). No first aid treatment was practiced most by 1st graders (7.2%), followed by 2nd graders (7.1%), 3rd graders (0.0%), and 4th graders (0.0%). First aid treatment by grade revealed a statistically significant difference between variables ( $\chi^2=34.849$ ,  $p<.001$ ). Ice pack treatment was used most by those weighing more than 80kg (56.8%), followed by those weighing less than 80kg (26.3%), those weighing -68kg (22.5%), and those weighing less than 58kg (15.6%). Massage treatment was used most by those weighing less than 80kg (36.8%), followed by those weighing less than 68kg (19.7%), those weighing more than 80kg (18.2%), and those weighing less than 58kg (6.3%). Pain relief spray treatment was used most by those weighing less than 58kg (65.6%), followed by those weighing less than 68kg (50.7%), those weighing less than 80kg (36.8%), and those weighing more than 80kg (20.5%). No first aid treatment was practiced most by those weighing less than 58kg (12.5%), followed by those weighing less than 68kg (7.0%), those weighing more than 80kg (4.5%), and those weighing less than 80kg (0.0%). Injuries caused by excessive desire to win were experienced most by those weigh less than 80kg (47.4%), followed by those weighing less than 68kg (26.8%), those weighing more than 80kg (13.6%), and those weighing less than 58kg (12.5%). Injuries caused by lack of practice were experienced most by those weigh less than -58kg (25.0%), followed by those weighing more than 80kg (6.8%), those weighing less than 68kg (2.8%), and those weighing less than 80kg (0.0%). Causes of athletes' injuries by weight revealed a statistically significant difference between variables ( $\chi^2=37.477$ ,  $p<.001$ ). Ice pack treatment was used most by those with less than five years of career taekwondo (67.4%), followed by those with less than nine years (27.7%), those with less than seven years (13.5%), and those with more than nine years (10.0%). Massage treatment was used most by those with less than nine years of career taekwondo (33.8%), followed by those with more than nine years (30.0%), those with less than seven years (8.1%), and those with less than five years (2.3%). Pain relief spray treatment was used most by those with less than seven years of career taekwondo (75.7%), followed by those with more than nine years (52.5%), those with less than nine years (36.9%), and those with less than five years (16.3%). No first aid treatment was practiced most by those with less than five

years of career taekwondo (14.0%), followed by those with more than nine years (7.5%), those with less than seven years (2.7%), and those with less than nine years (1.5%). First aid treatment by year of career revealed a statistically significant difference between variables ( $\chi^2=70.908$ ,  $p<.001$ ).

#### **Injury treatment methods by taekwondo athletes' demographic characteristics:**

The result of crossover analysis to identify elite taekwondo athletes' injury treatment methods by demographic characteristics. Treatment methods by grade revealed no statistically significant difference. Personal pain relief spray treatment was used most by those weighing more than 80kg (81.8%), followed by those weighing less than 58kg (71.9%), those weighing less than 80kg (68.4%), and those weighing less than 41kg (57.7%). Physical treatment was used most by those weighing less than 58kg (15.6%), followed by those weighing less than 68kg (5.6%), those weighing more than 80kg (2.3%), and those weighing less than 80kg (0.0%). Chinese medical treatment was used most by those weighing less than 68kg (31.0%), followed by those weighing less than 58kg (9.4%), those weighing more than 80kg (6.8%), and those weighing less than 80kg (5.3%). Massage and acupressure treatment were used most by those weighing less than 80kg (26.3%), followed by those weighing more than 80kg (9.1%), those weighing less than 68kg (5.6%), and those weighing less than 58kg (3.1%). Injury treatment methods by weight revealed a statistically significant difference between variables ( $\chi^2=39.788$ ,  $p<.001$ ). Personal pain relief spray treatment was used most by those with less than five years of career taekwondo (90.7%), followed by those with less than nine years (70.8%), those with more than nine years (60.0%), and those with less than seven years (45.9%). Physical treatment was used most by those with more than nine years of career taekwondo (10.0%), followed by those with less than seven years (8.1%), those with less than five years (7.0%), and those with less than nine years (0.0%). Chinese medical treatment was used most by those with less than seven years of career taekwondo (40.5%), followed by those with more than nine years (22.5%), those with less than nine years (7.7%), and those with less than five years (2.3%). Massage and acupressure treatment were used most by those with less than nine years of career taekwondo (21.5%), followed by those with more than nine years (7.5%), those with less than seven years (5.4%), and those with less than

five years (0.0%). Injury treatment methods by years of career taekwondo revealed a statistically significant difference between variables ( $\chi^2=48.222$ ,  $p<.001$ ).

**Perceived methods of preventing athletic injuries by demographic characteristics:** The result of crossover analysis to identify elite taekwondo athletes' perceived methods of preventing injuries by demographic characteristics. Appropriate training time was used most by 4th graders (100%), followed by 2nd graders (17.9%), 3rd graders (9.5%), and 1st graders (5.2%). Warming up and cooling down were used most by 1st graders (11.35%), followed by 3rd graders (4.8%), 2nd graders (3.6%), and 4th graders (0.0%). Full recovery from fatigue was practiced most by 3rd graders (42.9%), followed by 2nd graders (41.1%), 1st graders (37.1%), and 4th graders (0.0%). Adequate nutritional intake was practiced used most by 1st graders (13.4%), followed by 2nd graders (8.9%), 3rd graders (0.0%), and 4th graders (0.0%). Injury prevention education was practiced most by 1st graders (9.3%), followed by 2nd graders (7.1%), 3rd graders (0.0%), and 4th graders (0.0%). Wearing protective gear was used most by 3rd graders (42.9%), followed by 1st graders (23.7%), 2nd graders (21.4%), and 4th graders (0.0%). Perceived methods of preventing athletic injuries by grade revealed a statistically significant difference between variables ( $\chi^2=81.442$ ,  $p<.001$ ).

Appropriate training time was practiced most by those weighing less than 58kg (25.0%), followed by those weighing more than 80kg (15.9%), those weighing less than 80kg (13.2%), and those weighing less than 68kg (11.3%). Thorough warming up and cooling down was practiced most by those weighing less than 58kg (15.6%), followed by those weighing less than 68kg (8.5%), those weighing more than 80kg (4.5%), and those weighing less than 80kg (2.6%). Full recovery from fatigue was practiced most by those weighing less than 80kg (44.7%), followed by those weighing less than 68kg (42.3%), those weighing more than 80kg 36.4%), and those weighing less than 58kg (15.6%). Adequate nutritional intake was practiced most by those weighing less than 58kg (21.9%), followed by those weighing less than 68kg (9.9%), those weighing more than 80kg (9.1%), and those wearing less than 80kg (0.0%). Injury prevention education was practiced most by those weighing more than 80kg (13.6%), followed by those weighing less than 80kg (7.9%), those weighing less than 68kg (4.2%), and those weighing less than 58kg

(3.1%). Wearing protective gear was practiced most by those weighing less than 80kg (31.6%), followed by those weighing less than 68kg (23.9%), those weighing more than 80kg (20.5%), and those weighing less than 58kg (18.8%). Perceived methods of preventing athletic injuries by weight revealed a statistically significant difference between variables ( $\chi^2=26.927$ ,  $p<.05$ ). Appropriate training time was practiced most by those with more than nine years of career taekwondo (22.5%), followed by those with less than nine years (16.9%), those with less than five years (11.6%), and those with less than seven years (8.1%). Thorough warming up and cooling down was practiced most by those with less than five years of career taekwondo (14.0%), followed by those with more than nine years (7.5%), those with less than nine years (6.2%), and those with less than seven years (2.7%). Full recovery from fatigue was practiced most by those with less than seven years of career taekwondo (59.5%), followed by those with less than nine years (35.4%), those with less than five years (27.9%), and those with more than nine years (27.5%). Adequate nutritional intake was practiced most by those with more than nine years of career taekwondo (22.5%), followed by those with less than five years (16.9%), those with less than seven years 11.6%), and those with less than nine years (8.1%). Injury prevention education was practiced most by those with less than five years of career taekwondo (14.0%), followed by those with less than seven years (8.1%), those with more than nine years (5.0%), and those with less than nine years (3.1%). Wearing protective gear was practiced most by those with less than nine years of career taekwondo (33.8%), followed by those with more than nine years (22.5%), those with less than five years (18.6%), and those with less than seven years (13.5%). Perceived methods of preventing athletic injuries by years of career taekwondo revealed a statistically significant difference between variables ( $\chi^2=21.127$ ,  $p<.05$ ).

## DISCUSSION

Taekwondo is a sport requiring calculated movement with hands and feet, in which athletes must decide on techniques to use according to opponents' movements<sup>[11]</sup>. It is also a sport that requires quick responses, agility, ability to react instantly, and prompt and accurate judgment. In competition, according to the rules, scores are recognized only when techniques of hands and feet are used. Taekwondo athletes are highly prone to injuries because offensive and defensive movements frequently change

with use of hands and feet. [4] validated the seriousness of injuries in reporting that 98.6% of taekwondo athletes experienced injuries. Such injuries should be prevented or minimized when they occur. In this regard, this study investigated elite taekwondo athletes' injuries and their coping strategies. This study found that the period of experience of injuries by demographic characteristics revealed a significant difference in grades, weights, and careers. Fourth graders have the highest frequency of injuries during competition. They must achieve solid results in their performance in to make their debut in business taekwondo teams. Because of this, they overstrain themselves during competition. Third graders have the highest frequency of injuries during training. They are the main players on their teams, setting the scene for training and focusing their attention on it. Simulated competition-like practices with their juniors may be the cause for the highest frequency of injuries during training. Those weighing more than 80kg have the highest frequency of injuries. The heavier they are, the more destructive power they have. In addition, competitions use the heaviest electronic protective gear for heavyweight athletes. Since victory or defeat is determined in taekwondo competition, the power of heavyweight athletes is inevitable. Therefore, the heavier they are, the more prone to injuries. Those weighing more than 58kg and less than 68kg have the highest frequency of injuries during practice competition. Interschool practice competition are often played under agreement between coaches without certain rules. Therefore, they are forced to engage in practice competition with many others in the same weight class, and in some cases, with those heavier than them. This may cause athletic injuries. There were conflicting results depending on athletes' taekwondo careers. The longer their career, the higher the frequency of injuries during competition; the shorter their career, the higher the frequency of injuries during practice. Athletes with longer careers are injured by participating in competition without correcting wrong movements or habits because they are proud of themselves or perceive they are doing fine in their career. Those with shorter careers have higher frequency of injuries during training. Having short careers means that they have a low level of technical proficiency and completeness, directly related to injuries during competition or training. The rounds in which athletes were injured by demographic characteristics revealed a statistically significant difference in their grades and careers. Third graders have the highest frequency of injuries during the first round or when were injured during

golden points; fourth graders during the second round; second graders during the third round. Third graders should prevent injuries in the first round by practicing thorough warming up; second graders should be prepared for the risk of injuries caused by an excessive desire to win. Regardless of the length of athletes' careers, athletic injuries in every round always occur. Causes of injuries by athletes' demographic characteristics revealed a statistically significant difference in their grades, weights, and careers. For 1st graders, the lack of warming up and cooling down were the most frequent causes of injuries; for 4th graders, wrong training methods; for 3rd graders, wearing no protective gear and excessive desire to win; for 2nd graders, the lack of practice. What is unique here is that causes of injuries were different depending on their grades. Coaches' concern and efforts are needed to reduce athletic injuries. They need to provide 1st graders with adequate time for warming up and cooling down and develop methods for a step-by-step implementation of appropriate training and high levels of techniques. For 3rd graders, wearing no protective gear and excessive desire to win are causes of injuries. This is related to the fact that 3rd graders have the highest frequency of athletic injuries. The training method for 3rd graders is mainly Gyeorugi (Competition). Therefore, coaches need to require athletes to wear protective gear and caution them that an excessive desire to win may cause injuries.

First aid treatment by demographic characteristics revealed a statistically significant difference in their grades, weights, and careers. For 1st to 3rd graders, pain relief spray treatment was most frequently used; for 4th graders, massage treatment. Pain relief products and cooling sprays are used in pain relief spray treatment and are affordable and easy to use. Such products have an instant effect in relieving pain when used for muscle pain and bruises<sup>[13]</sup>. Pain relief products are standard medicines elite athletes use during competition and training. Such products are used by athletes regardless of their careers and weight. Injury treatment methods by demographic characteristics revealed a statistically significant difference in their weight and careers. Injury treatment by athletes' weight and careers means using pain relief and cooling sprays, patches, pain killers, etc, easily bought from drug stores. Physical treatment or Chinese medical treatment are costly and time consuming for elite athletes since they must visit a hospital in person for diagnosis and treatment. It is not easy for students

to receive treatment in a hospital because they have a difficult time coordinating their classes or training. Therefore, personal treatment was the most frequently used method.<sup>[5]</sup>also is in the same vein with this study, suggesting that taekwondo athletes are the main users of first aid treatment in emergency situations. Perceived methods of preventing athletic injuries by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. For 1st through 2nd graders, full recovery from fatigue was most frequently practiced as their injury prevention method; for 3rd graders, full recovery from fatigue and wearing protective gear; for 4th graders, appropriate training time. Those in lower grades perceived that they could prevent athletic injuries by allowing full recovery from fatigue, the result of accumulation of fatigue caused by overworking. Wearing protective gear among 3rd graders is related to the above report that wearing no protective gear may lead to athletic injuries. Also, appropriate training time among 4th graders is related to their perception that accumulated fatigue is one of the causes of athletic injuries. They perceive that appropriateness of training time would relieve accumulated fatigue and stress through use of their personal time. For elite taekwondo athletes, injuries during competition or training are inherently dangerous. Accidental mistakes or inattention may lead to injuries. Excessive competition and overtraining among elite taekwondo athletes expose them to risk of injuries by pushing them beyond the limit of their abilities. Therefore, for inevitable injuries, careful management should be implemented rather than depending on the use of pain relief & cooling sprays. As revealed in this study, first aid treatment or post-injury treatment was only primary treatment for elite taekwondo athletes. Treatment even in an emergency was likely to be on the personal level. Each team should educate athletes about causes of injuries arising during taekwondo training or competition, accurate coping strategies, and treatment methods. Rather than disregarding injuries as typical bruises, athletes should understand phased pain and implement treatment suitable for it. It is best to receive treatment from medical specialists. However, if circumstances do not permit such treatment from medical specialists, athletes should know the degree of their injuries so they can reduce burden from their injuries if provided with appropriate treatment methods.

## CONCLUSION

This This study examined athletes' injuries and their coping strategies, targeting 185 athletes registered with the Korean Taekwondo Association. To meet the purpose of this study, questionnaires were used, and descriptive statistical analysis and  $\chi^2$ (Chi-square analysis) were conducted to process collected data. The following conclusions were obtained through these methods.

First, the time of experiencing athletic injuries by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. For 1st, 2nd, and 3rd graders, injuries arose most frequently during training; 4th graders during competition. For those weighing less than 58kg and less than 68kg, injuries arose most frequently during practice; for those less than 80kg and more than 80kg during training. For those with less than five years of career taekwondo, less than nine years, and more than nine years, injuries arose most frequently during training; for those less than seven years during practice.

Second, the rounds in which athletes were injured by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. For 1st and 2nd graders, injuries arose most frequently in the 3rd round; for 3rd and 4th graders in the 2nd round. For those with less than five years of career taekwondo and less than seven years, injuries arose most frequently in the 3rd round; for those with less than nine years of career taekwondo and more than nine years, in the 2nd round.

Third, causes of athletes' injuries by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. For 1st and 2nd graders, use of excessive training and techniques were the most frequent causes of injuries; for 3rd graders, an excessive desire to win; for 4th graders, wrong training methods. For those weighing less than 58kg, lack of warming up was the most frequent cause of injuries; for those weighing less than 68kg and more than 80kg, use of excessive training and techniques. For those with less than five years of career taekwondo, wearing no protective gear was the most cause of injuries; for those with less than seven years, use of excessive training and techniques; for those with less than nine years and more than nine years, an excessive desire to win.

Fourth, first aid treatment by demographic characteristics revealed a statistically significant difference in their grades, weight, and careers. For 1st,



2nd, and 3rd graders, pain relief spray treatment was most frequently used for first aid treatment; for 4th graders, massage treatment. For those weighing less than 58kg, less than 68kg, and less than 80kg, pain relief spray treatment was most frequently used for first aid treatment; for those weighing more than 80kg, ice pack treatment. For those with less than five years of career, ice pack treatment was most frequently used for first aid treatment; those with less than seven years, less than nine years, and more than nine years, pain relief spray treatment.

Fifth, injury treatment methods by demographic characteristics revealed a statistically significant difference in their weight and careers. Personal treatment was most frequently used by weight and careers.

Sixth, perceived methods of preventing athletic injuries by demographic characteristics revealed a statistically significant difference in their weight, grades, and careers. For 1st, 2nd, and 3rd graders, full recovery from fatigue was most frequently used; for 4th graders, appropriate training time. For those weighing less than 58kg, appropriate training time was most frequently used; for those weighing more than 80kg, ice pack treatment. Regardless years of career, full recovery from fatigue was most frequently used.

As a result of this study, elite taekwondo athletes' injuries were incurred and repeated by many causes regardless of demographic characteristics. To prevent and minimize injuries, careful attention from athletes, coaches, hands-on staff and educators is needed. In addition, injury prevention programs for athletes should be implemented to minimize injuries and accurate treatment should be applied through comprehensive education on athletic injury prevention.

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# A Constancy Study for Quality Control of Digital Radiographic Images

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## ABSTRACT

The International Electro technical Commission (IEC) recommends quality control of images such as the Constancy Test and the detective quantum efficiency (DQE) for digital radiography quality control. However, this kind of image quality control has not been implemented in Korean digital radiography. In this study, constancy tests that are usually not conducted in Korea were performed and related items assessed. Based on the constancy tests measured values after three weeks and three months, the evaluation items were the signal-noise ratio(SNR), the contrast, the Modulation Transfer Function (MTF), the Noise-Power Spectrum (NPS), and the relative DQE. The reference values of the diagnostic radiation generation this study, were a contrast of 0.12 and a SNR of 4.02: Furthermore, the information transfer ability was 94% at 1.0lp/mm, 83% at 2.0lp/mm, and 73% at 3.0lp/mm. The MTF of 10% was 8.6lp/mm, the MTF of 50% was 4.6lp/mm, and the NPS 5.1 at 1.0lp/mm, 4.4 at 2.0lp/mm, and 3.5 at 3.0lp/mm. The relative DQE was 1.49 for 1.0lp/mm, 1.4 for 2.0lp/mm, and 1.3 for 3.0lp/mm. All measures decreased with time, based on Constancy Test. If currently implemented safety management items are reflected in the safety management evaluation radiation-generating devices change to digital versions, they will be of great help in the quality control of radiographic images.

**Keywords:** *Digital Radiography, Computed Radiography, Modulation Transfer Function, Detective Quantum Efficiency, Signal to Noise Ratio, Density*

## INTRODUCTION

Radiation-generating devices in Korea are managed by the “Rules for the Safety Management of Diagnostic Radiation Generators”<sup>1</sup>. Inspection of the diagnostic radiological apparatus as specified by the Ministry of Food and Drug Safety is carried out at the first installation, and if judged suitable, periodic check-ups are subsequently performed every three years<sup>2</sup>. However equipment which has been judged as conforming does not need these three-year quality inspections. The International Electro technical Commission (IEC) has continuously is used recommendations on digital radiography quality management: IEC 61223-2-11 recommends the Constancy Test<sup>3</sup> and IEC 62220-1 the Detective Quantum Efficiency (DQE), which is a performance management evaluation of detectors. Japan adopts the IEC recommendation 61223-2-11 and performs the Constancy Test for diagnostic radiation

generators to maintain image quality control<sup>4</sup>. Medical devices are regulated under the Health Professions Act through the Canadian Forces Medical Service (CFMS). In addition, safety management is carried out by changing test items in daily, monthly, three-month, six-month, and one-year cycles<sup>5</sup>. Korea also possess equipment for the quality control of radiological images Special medical equipment as specified in the National Health Insurance Fiscal Reform Special Act (Law No. 6620, January 19, 2002), has been used in yearly document inspections and thorough image quality controls every three years<sup>6</sup>. The non-compliance rate of s-special medical equipment was 6.7% in 2005, 7.8% in 2007, and 2.9% in 2009e.g. high at the beginning and gradually decreasing However, the incidence of non-compliance in general imaging tests rose from 17 in 2008 to 352 in 2012. Considering that the number of equipment for specialty medical devices is increasing, the nonconformity rate of quality control is decreasing, so the most commonly performed

general radiographic examinations for images should be evaluated promptly<sup>7</sup>. With this background, the purposes of this study are to appraise the Constancy Test of digital radiography detectors and image evaluation factors or the improvement of the regular safety inspection cycles conducted every three years, and to standardize the image management of diagnostic radiation generators.

### STUDY SUBJECTS AND METHOD

**Subjects:** The equipment used in this study was a diagnostic radiation generator (Gemss Medical, Apollon, R-800-150, Seong-nam City, Korea) at hospital A in the Seo-san area. An indirect detector (FDX4343R, ToshibaTokyo, Japan) was used for image acquisition. A 21 mm Al filter and a TX5 Tungsten Edge Filter (IBA Dosimetry,USA) to remove low-energy radiation(fig.1).

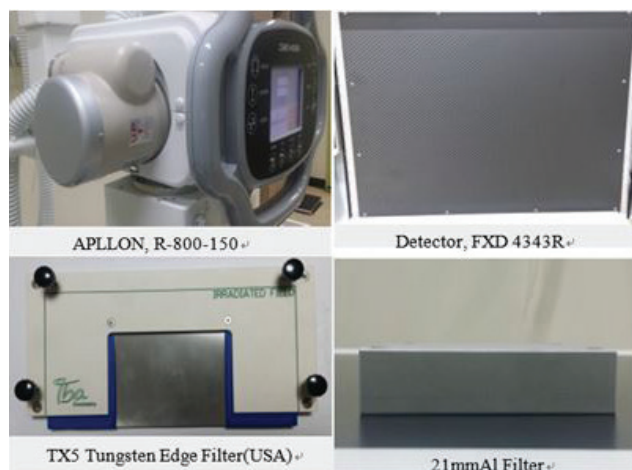


Figure 1: Measuring Tools

### METHOD

**Constancy test:** To set the initial average output's reference value according to IEC 61223-2-11, the contrast, the spatial resolution, the SNR, the MTF, the NPS, and the relative DQE(Detective Quantum Efficiency) w-ere measured once for five days with identical methods, the average values calculated, and used as reference values for the equipment. In order to observe changes in the equipment values over time, measurements were taken after three weeks and three months following calibration.and five measurements were taken in one measurement and compared with the first set values.

**Contrast and SNR measurement:** The contrast and SNR measurements of images were taken with DQE

parameters. For the contrast, the tungsten part of the edge filter was set to object fluencies(signal = B<sub>2</sub>) and the lead portion to background fluencies(signal = B<sub>1</sub>) (see Equation1). For the SNR, five measurements were taken in the edge filter's regions, the measured values averaged to compensate for the signal's uncertainty and inaccuracy-cy, its standard deviation calculated, and the SNR eventually measured using the following equation<sup>8</sup>(Equation1, Equation2), (Fig.2).

$$\text{Radiography Contrast} = \frac{B_1 - B_2}{B_1} \quad \dots(1)$$

$$\frac{\text{Background SI Avg} - \text{ROISI Avg}}{\text{ROISD}} \quad \dots(2)$$

**Measuring MTF:** The distance between the X-ray tube and the detector was 150cm.The edge filter's center portion in front of the detector was aligned with the center axis of the X-rays' effective range and a 21mm Al filter was attached to the collimator's front to remove radiation in the low energy region. To use more pixel values in the MTF measurement, assessments were made with a 3° angle The spatial resolution at the intersection of the MTF was 10% and the curve as well as the sharpness at the intersection 50% (Fig.2).

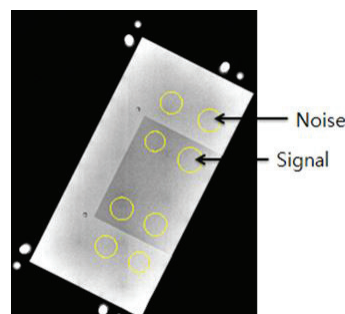


Figure 2: Noise, Signal Measurement

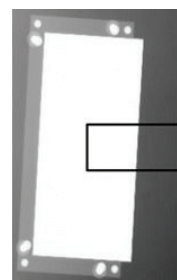


Figure 3: MTF Measurement

**NPS measurement:** The NPS measurement was performed in the same manner as the MTF, but the edge filter had been removed. The radiation area was set to square area of 125mm x 125mm at the 160mm back central point. Five images were obtained and the signal for noise analyzed, using the average noise.

**Relative DQE measurement:** The quantitative evaluation of the detector measured the relative DQE. The technical aspects of the e measurement were assessed by the IEC 62220-1 method. The distance between the X-ray tube and the detector was 150cm. The edge filter was aligned in front of the detector. The edge filter's center portion was within the X-rays' effective range.

**Measurement program:** Image J, version 1.46 was used, which edits ROI settings, as well as signal and noise measurements for certain image sizes. In order to measure DQE, formulae for measuring the NPS, the MTF, and for the DQE were provided to the health and environment research center of D University and commissioned as a DQE program. The relative DQE was measured with the Mat lab based DQE m-file. Matlab itself is a software for numerical analysis and provides a programming environment developed by Math Works Version R - 2014 a (The Math Works, Inc., Natick, MA, USA) was used.

## RESULTS

**Constancy test results:** IEC 61223-2-11 recommends to perform a Constancy Test to set reference values because the dos-e is reduced when keeping a proper image and

when the equipment characteristics differ. Therefore, measurements were taken in the same way for five days and the reference values of the diagnostic radiation generator used in this study determined 3,123 for the noise, 2,739 for the signal, 0.12 for the c-contrast, 4.02 for the SNR, and for the information transfer ability, the values were 1.0lp/mm 94%, 2.0lp/mm 83%, and 3.0lp/mm 73%. The MTF 10% was 8.6lp/mm, and the MTF 50% was 4.6lp/mm. NP-S was 5.1 for 1.0lp/mm, 4.4 for 2.0lp/mm, and 3.5 for 3.0lp/mm. The spatial frequency of 1.0lp/mm was 1.49, of 2.0lp/mm 1.4, and for 3.0lp/mm 1.3.

**Measurement of SNR and Contrast over time:** After three weeks and three months following calibration, the measured SNR was 3.55 at three weeks, which was lower than in the Constancy Test 4.02 and after three months, the difference was 0.57 according to the Constancy Test with a 0.1 difference from the three week measurement. After calibration, the value was 2.84, which was lower than 3.55 for three weeks and 3.45 for three months which was statistically  $p < .001$ . The contrast values in the Constancy Test after three weeks were similar with a contrast of 0.11 and a Constancy Test result of 0.12. Three month after calibration, all measurements similar values compared to three weeks which was statistically significant ( $p < .027$ ), (Table 1).

**Table 1: Measurements by period (unit: S.D, Aver)**

Detector Calibration After the Comparative Evaluation								
		1st	2nd	3rd	4th	5th	Aver.	p-Value
SNR	Constancy Test	3.76	2.95	4.91	5.00	3.62	4.02	0.01
	3 Weeks	4.18	2.58	3.07	3.42	4.79	3.55	
	3 Months	3.22	4.27	3.21	3.39	3.18	3.45	
	Calibration	2.05	2.99	3.00	3.03	3.05	2.84	
Contrast	Constancy Test	0.12	0.09	0.15	0.15	0.11	0.12	0.27
	3 Weeks	0.11	0.09	0.09	0.11	0.13	0.11	
	3 Months	0.12	0.16	0.12	0.13	0.12	0.13	
	Calibration	0.08	0.12	0.13	0.13	0.13	0.12	
*Aver: Average, S.D: Standard Deviation								

**MTF measurement over time:** Three weeks and three months after calibration, the MTF measurements were as follows. At the three week measurement which represents information transmission ability, it was 80% at 1.0lp/mm, 60% at 2.0lp/mm, and 50% at 3.0lp/mm which was lower than in the Constancy Test results. The mean was 8.6lp/mm at 10% MTF, but 7.0lp/mm at three weeks when

the resolution decreased. The MTF 50% was also 3.0lp/mm, which was lower than in the Constancy Test. After three months, information transmission deteriorated in performance. At MTF 10%, the Constancy Test showed an average of 8.6lp/mm at three weeks 7.0lp/mm. After three months, the measurement was the lowest at 3.7lp/mm and 4.9lp/mm lower than in the Constancy Test. At

MTF 50%, the Constancy Test revealed values of 4.6lp/mm, amen of 3.0lp/mm at three weeks, and the lowest measurement of 2.1lp/mm at three months. There was a difference of only 0.9lp/mm after three weeks, but 2.5lp/mm from the Constancy Test result. For MTF, 10% and 50% were all. The information transfer ability decreased with time according to the Constancy Test. The image quality improved after calibration, and the measurement

was similar to that of three weeks prior. MTF 10% showed a higher resolution than the measurements three weeks before. MTF 50% was also lower than in the Constancy Test, but higher than at three weeks and three months. The results after measuring the information transferability were MTF 10%, and MTF 50% of the detector calibration as seen in the MTF curve and these values were similar to those of the initial Constancy Test (Table 2).

**Table 2: MTF measurements over time(unit:lp/mm)**

MTF Comparison Analysis after Detector Calibration						
1.0		Information Transfer Capability			Resolution	Sharpness
		2.0	3.0	MTF 10%	MTF 50%	
1st	Constancy Test	95	86	78	9.8	5.1
	3 Weeks	83	65	50	6.0	3.0
	3 Months	81	60	41	4.8	2.7
	Calibration	86	73	65	8.7	4.3
2nd	Constancy Test	93	80	69	7.1	4.0
	3 Weeks	84	69	56	6.3	3.3
	3 Months	79	49	20	3.4	1.9
	Calibration	86	73	65	8.5	4.3
3rd	Constancy Test	94	85	72	9.0	4.8
	3 Weeks	85	70	57	7.0	3.5
	3 Months	79	49	20	3.4	1.9
	Calibration	86	73	65	8.0	4.3
4th	Constancy Test	94	85	75	9.8	5.1
	3 Weeks	85	70	58	7.0	3.5
	3 Months	79	49	20	3.4	1.9
	Calibration	86	73	65	7.9	4.3
5th	Constancy Test	92	80	69	7.1	4.0
	3 Weeks	85	70	58	7.0	3.5
	3 Months	79	49	20	3.4	1.9
	Calibration	86	73	65	7.8	4.3
Aver.	Constancy Test	94	83	73	8.6	4.6
	3 Weeks	84	69	56	7.0	3.0
	3 Months	79	51	24	3.7	2.1
	Calibration	86	73	65	8.2	4.3

**NPS measurement over time:** Three weeks and three months after calibration, the NPS was measured as follows. After three weeks, the NPS measurement was lower than in the Constancy Test, and after three months, it was lower than at three weeks. The NPS analysis after calibration showed that the values were higher than those measured at three months at 0.5lp/mm and 1.0lp/mm, but the lowest at the other spatial frequencies (Table 3).

**Relative DQE measurement over time:** Three weeks and three months following the calibration, the relative DQE decreased with a heightening spatial frequency according to the Constancy Test, but after it lowered irregularly like the SNR. After three months, the Constancy Test measured a relative DQE average of 1.45lp/mm, but it was 0.7 after three months. The

relative DQE was almost the same as the value at three weeks with a difference of 0. The relative DQE after calibration showed that the Constancy Test values were 1.49, 1.46, and 1.30 at 1.0lp/mm, 2.0lp/mm, and 3.0lp/mm, respectively.

After calibration, the relative DQE values were low with 1.16, 1.28, and 1.28 and while they decreased for three weeks and three months, the image quality improved with calibration (Table 3).

**Table 3: NPS and Relative DQE measurements over time(unit:lp/mm)**

NPS and Relative DQE measurement over time													
		NPS	DQE	NPS	DQE	NPS	DQE	NPS	DQE	NPS	DQE	NPS	DQE
Spatial Frequency(lp/mm)		0.5		1.0		1.5		2.0		2.5		3.0	
1st	Constancy Test	4.8	5.8	4.9	5.1	4.8	4.8	4.7	4.4	4.5	4.0	3.9	4.2
	3 Weeks	1.5	1.7	1.3	1.5	0.9	1.7	0.7	1.6	0.5	1.8	0.5	1.3
	3 Months	0.7	3.5	0.5	3.4	0.5	2.7	0.4	2.4	0.4	1.8	0.3	1.5
	Calibration	0.8	3.7	0.6	3.1	0.5	3.0	0.5	3.0	0.4	3.4	0.4	3.0
2nd	Constancy Test	5.6	1.2	5.5	1.1	4.9	1.1	4.7	1.0	4.1	1.0	3.7	0.9
	3 Weeks	0.9	1.3	0.9	1.1	0.8	1.0	0.7	0.9	0.6	0.9	0.5	0.8
	3 Months	1.1	0.6	0.7	0.6	0.6	0.5	0.1	0.3	0.1	0.2	0.4	0.2
	Calibration	0.7	1.5	0.8	1.4	0.6	1.5	0.5	1.6	0.4	2.0	0.3	1.7
3rd	Constancy Test	5.0	0.7	5.3	0.5	4.3	0.6	3.6	0.8	3.0	0.8	2.9	0.6
	3 Weeks	1.9	0.4	1.6	0.4	1.3	0.4	0.9	0.4	0.7	0.5	0.7	0.3
	3 Months	0.6	0.5	0.5	0.4	0.5	0.3	0.5	0.2	0.4	0.2	0.4	0.1
	Calibration	1.2	0.6	1.0	0.7	0.6	1.8	0.4	1.0	0.4	1.0	0.3	0.7
4th	Constancy Test	5.1	0.5	4.6	0.5	4.8	0.5	4.6	0.5	4.1	0.5	3.4	0.5
	3 Weeks	1.2	0.3	1.1	0.3	0.9	0.3	0.7	0.3	0.6	0.3	0.5	0.3
	3 Months	1.0	0.3	0.9	0.3	0.6	0.3	0.5	0.3	0.4	0.2	0.4	0.1
	Calibration	1.2	0.3	0.8	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.3	0.5
5th	Constancy Test	4.6	0.4	5.3	0.3	5.0	0.3	4.6	0.3	3.7	0.3	3.4	0.3
	3 Weeks	1.5	0.2	1.4	0.2	1.1	0.2	0.8	0.3	0.6	0.3	0.4	0.3
	3 Months	1.2	0.2	0.8	0.2	0.7	0.2	0.5	0.2	0.4	0.1	0.3	0.1
	Calibration	0.9	0.4	0.8	0.3	0.6	0.3	0.5	0.4	0.3	0.5	0.3	0.5
Aver.	Constancy Test	5.0	1.8	5.1	1.5	4.8	1.5	4.4	1.4	3.9	1.3	3.5	1.3
	3 Weeks	1.4	0.7	1.3	0.7	1.0	0.7	0.8	0.7	0.6	0.7	0.5	0.6
	3 Months	0.9	1.0	0.7	0.9	0.5	0.8	0.5	0.7	0.4	0.5	0.4	0.4
	Calibration	1.2	1.3	0.7	1.2	0.5	1.4	0.4	1.2	0.4	1.5	0.3	1.2

## DISCUSSION

As medical technology develops, imaging methods also rapidly advances and it has become an indispensable part in the diagnosis and treatment of diseases. Imaging equipment should be accurate. It can only can yield accurate test results and assess appropriate patient care if quality controlled. If a test is performed on a patient within adequately quality controlled equipment, the risk of misdiagnosis rises, which can increase the examination costs as well as the patient's radiation dose. However, diagnostic radiological equipment in Korea is at present

not subject to prescribed quality control and only safety management is performed. Research papers of Dong et al.<sup>9</sup>, Kang<sup>10</sup>, and Park<sup>11</sup> demonstrate the problems associated with quality control and they emphasize the necessity to regulate the improvement and timing of quality control. In this study, the Constancy Test based on the IEC 61223-2-11 recommendation was performed to set reference values for the equipment. Image quality degradations by the equipment were observed through time with these reference values. It is important to determine reference values for the equipment through

the Constancy Test. By setting reference values, image changes can be readily recognized. In this study, the image quality changes at three weeks and three months based on the reference value set by the Constancy Test were examined. After confirmation that the quality of the image deteriorated with time, the detector was calibrated and the quality of the image improved. Also, the relative DQE was measured and the resolution, the contrast, the SNR, the NPS, the MTF, as well as the DQE evaluated during the process of obtaining the relative DQE. The contrast and the spatial resolution can be estimated in the MTF, the signal and noise in the NPS, and the SNR in the signal and noise<sup>12</sup>.

Xiang et al.(2015) claim that the measurement of DRS should be measured simultaneously with the DQE. In addition, the possibility has been the spatial resolution, the MTF, and the dynamic range can only be measured with a DQE image, which is also the argument of this study<sup>13</sup>. The finding reveal that as the MTF and the NPS decrease, so does the DQE. Based on these results, detector calibrations were performed three months after the measurement's start, and the performance prior to the study was restored which can be useful from the time of medical image degradation to the image improvement and the image's quality control. If the image quality improvement has been adjusted during an adequate period, the radiation exposure of patients and workers in the medical field can be lowered. The patients' quality of life of the can also be enhanced with accurate diagnoses and the ensuing treatments. One limitation of this study constitutes measurements being conducted with a single digital radiography equipment.

### CONCLUSION

The conclusions of these study areas follows. First, it can be seen that the Constancy Test provides important data that can easily identify equipment changes. Therefore, it should be routinely conducted in Korea, which is currently not the case. Second, at three weeks and three months after calibration, items decreased according to the Constancy Test. However, following calibration, the measurements were higher than at three weeks and ---three months. Third, all of the digital image formation factors could be obtained through the relative DQE measurement. It could be determined that the evaluation and management of medical images changes continuously with the development of equipment. As the spread of

digital radiation generating apparatus accelerates their utilization for the standardization of digital radio-graphic image quality control can be expected.

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# The Effect of Knowledge about Cervical Cancer and Human Papilloma Virus (HPV) on the HPV Vaccination against Cervical Cancer of Nursing Students

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## ABSTRACT

The purpose of this study was to investigate the relationship between knowledge of cervical cancer, knowledge of Human Papilloma Virus (HPV) infection, and the preventive behavior of 113 nursing college students. Convenience sampling was performed to selected nursing students from two colleges. Data were collected using questionnaires. The real number and percentage were estimated for the participants' general characteristics and the differences in each variable by the general characteristics were analyzed through t-test, ANOVA, and Scheffe test. Pearson's correlation method was used to investigate the correlation between knowledge of cervical cancer, HPV knowledge, and HPV vaccination rate. As a result of this study, the mean age of the participants was  $21.55 \pm 1.61$ , 21 students (18.6%) were male and 92 (81.4%) were female. Of a total of 15 questions concerning knowledge about cervical cancer, the question, "What do you think is the examination for diagnosing cervical cancer?", got the highest answer rate (93.8%). Two of the items getting the highest answer rate were "HPV infection examination is important for every woman" and "HPV is transmitted through sexual contact" (96.5%, respectively). As for the sexual characteristics, 26 (23.0%) had sexual experience. Knowledge of cervical cancer and knowledge of HPV were scored  $.66 \pm .15$  (range of score 0-1) and  $.76 \pm .10$  (range of score 0-1), respectively. The HPV infection prevention rate in this study was 22.1%. There was no correlation between knowledge about cervical cancer ( $r = .092$ ,  $p = .596$ ) and HPV ( $r = .106$ ,  $p = .262$ ) and the HPV vaccination rate. Various strategies are needed to increase the vaccination rate of HPV vaccines, along with the continued provision of accurate information.

**Keyword:** Knowledge, Cervical cancer, HPV, Vaccination, Nursing, Student

## INTRODUCTION

Cervical cancer is an important condition that has a high prevalence rate—15% of women's cancer around the globe and accounts for 7.5% of the mortality from women's cancer [8] [32]; it is not specific to middle-aged women but is also found among young women aged 15-34 years [32].

What represents several risk factors for cervical cancer is Human Papilloma virus (HPV) infection [32], with Types 16 and 18 of HPV detected in  $\geq 70\%$  of the cases of cervical cancer (Kim, 2009). The direct route of HPV infection is sexual intercourse and HPV can be infected indirectly by genitals-genitals, hand-genitals, and mouth-genitals contact. It is reported that about 50% of the women having a sexual life are infected with HPV and that South Korea shows the second highest HPV infection rate after India among the Asian countries. The

United States gives attention to preventive measures since the rate is high for young women in their late teens and early twenties [32]; [11].

Since HPV infection can cause penile cancer, oral cancer, anal cancer, and pharyngeal cancer, both men and women need to make efforts to prevent it [4]. [12] reported that 65.2% of 1,160 men aged  $\geq 18$  in the United States, Brazil, and Mexico were infected with HPV and suggested that young men enjoying sexual activity take preventive measures against the infection and start getting vaccinated at the same age as women [5]. It is known that the vaccine is particularly very efficacious against cancer related to HPV Types 16 and 18 [10]; [33]. The United States is the first country that approved HPV vaccination in 2006 and CDC recommends 11- and 12-year-old girls to get vaccinated against HPV and suggests that older girls and women get vaccinated by the age of 26 years.

South Korea also recommends starting vaccination at school age since the age for starting sexual experience is gradually becoming younger [26].

In South Korea, while rapid economic development as well as development of culture for commercializing sex have made adolescents have the first sexual experience at a younger age, the problem is that they are less likely to do safe and responsible sexual behavior [15].

Since college students, who live by themselves or together with their friend away from home in pursuit of academic work, can be put in an environment where they are unintentionally likely to do high-risk sexual behavior, it is more necessary for them than for any other age group to obtain knowledge about HPV and get vaccinated [30]. Female college students in South Korea are less likely to get vaccinated against HPV (approx. 7.2-12%) and are less aware of the need for vaccination than those in other countries [1]; [25]. This study aimed to determine knowledge status concerning cervical cancer and HPV infection and the level of preventive behaviors in the population of nursing students, regardless of gender, who are pre-service health managers and need to get examination and management against the risk factors for sexual behaviors, and to analyze the association between knowledge and preventive behaviors.

## MATERIALS AND METHOD

**Research design:** This is a descriptive correlation study to examine knowledge about cervical cancer and HPV, and the HPV vaccination against cervical cancer in nursing students.

**Participants:** Convenience sampling was performed to select nursing students from two colleges in Cheonan. The sample size was decided on by statistical test to be used in the analysis applying Cohen's (1988) power analysis, which involved a G\*power 3.10 program. When an adequate sample size was determined by principal statistical methods, the adequate sample size necessary for correlation analysis was 138 persons in two-sided test with the 0.05 significance level ( $\alpha$ ), power (1- $\beta$ ) 95%, and the medium effect size (r) 0.3 and 118 persons in two-sided test with the 0.05 significance level ( $\alpha$ ), testability (1- $\beta$ ) 85%, the median effect size (f) 0.15, and 13 predictors. 130 questionnaires were distributed, taking a 10% missing rate into account; then, 113 copies were finally analyzed, with the exception of 16 having errors due to a poor understanding of items or insincere answers. The sample was large enough to meet the goal of this study.

## Outcome measures

**Knowledge about cervical cancer:** The scale for knowledge about the risk factors and screening for cervical cancer, which was developed by Han et al. (2007) and was revised by Park and Park (2012) with a gynecologist's advice by removing 2 out of 10 items, was used to determine the level of knowledge about cervical cancer. It is composed of items concerning how to diagnose cervical cancer, the goal of Pap smear, examination cycle, time for the first examination, meanings of examination results, and risk factors for cervical cancer. The risk factors for cervical cancer were listed in each item to get a total of 15 items.

The cervical cancer knowledge scale was composed of multiple-choice items, with 1 for a correct answer and 0 for a wrong answer. The scores ranged from 0 to 8, with a higher score meaning better knowledge about cervical cancer. Cronbach's alpha was .70 in Park and Park [17] and .68 in this study.

**Knowledge about HPV:** The instrument developed by Pitts et al. [29] was used. It was composed of a total of 13 items in such areas as diseases caused by HPV, association between cervical cancer and HPV, HPV infection channels, symptoms of HPV infection, and how to treat HPV infection. Each item was a yes-no question, with 1 for a correct answer and 0 for a wrong answer. The scores ranged from 0 to 13, with a higher score meaning better knowledge. Cronbach's alpha was .71 in this study.

**Data collection:** The researcher gave explanation about the purport and methods of this study to the participants and asked them to give a written consent to participation in the study before data collection from March to April 2017. The researcher personally distributed and collected self-administered questionnaires, which were completed in about 10 minutes. The collected data were neither published nor used for any other purpose than that of this study and the participants were given explanation about privacy and anonymity.

## DATA ANALYSIS

**The collected data were statistically processed using SPSS WIN 22.0 and the following analyses were performed:**

1. The real number and percentage were estimated for the participants' general characteristics and

the differences in each variable by the general characteristics were analyzed through t-test, ANOVA, and Scheffe test.

- The mean and standard deviation were used to analyze the level of knowledge about cervical cancer and HPV.
- The real number and percentage were estimated for the rate of getting vaccinated against cervical cancer.
- The correlation between knowledge about cervical cancer and HPV, and the HPV vaccination against cervical cancer by Pearson's correlation coefficient.

### RESULTS

**General characteristics:** The mean age of the participants was 21.55±1.61 years; 21 students (18.6%) were male and 92 (81.4%) were female. Of the 92 female students, 19 (16.8%) had menarche at the age of <12 years and 73 (64.6%) when they were ≥12 years old. 2 female students (1.8%) were married; 37 (32.7%) had a romantic relationship; and 4 (3.5%) had an acquaintance with cervical cancer as shown in Table 1.

**Table 1:General characteristics of subjects(N=113)**

Characteristics		Mean±SD	n(%)
Age (years)		21.55±1.61	
Sex	Male		21(18.6)
	Female		92(81.4)
Age of Menache (n=92)	below 12		19(16.8)
	above 12		73(64.6)
Marrital status (n=92)	Marriage		2(1.8)
	Single		111(98.2)
Dating	Yes		37(32.7)
	No		76(67.3)
Cervical cancer history of significant others	Yes		4(3.5)
	No		109(96.5)

**Sexual related characteristics:** As for the sexual characteristics, 26 (23.0%) had sexual experience and 87 (77.0%) had no sexual experience; 19 (16.8%) had the first sexual intercourse at the age of ≥21 years and 5 (4.5%) when they were ≤20 years. 13 (11.5%) had one

sex partner and 8 (7.0%) had 2-3 sex partners; 6 (6.5%) had sexual intercourse once a month or less frequently, 5 (5.4%) twice a month or more frequently, and 5 (5.4%) ≥4 times a month. 16 students (17.4%) used a condom for sexual intercourse and 11 (12.0%) used a condom for 75-100% of sexual intercourse as shown in Table 2.

**Table 2: Bisexual-related characteristics of the subject(N=113)**

Characteristics	Mean±SD	n(%)
Experience of sexual contact	Yes	26(23.0)
	No	87(77.0)
	20.08±1.76	
First sexual intercourse	Under 20	5(4.5)
	21 years old or older	19(16.8)
	Not applicable	89(78.7)
Number of Sexual partners	1 person	13(11.5)
	2-3 people	8(7.0)
	4-5 people	2(1.8)
	6 or more	2(1.8)
	Not applicable	89(78.8)
Frequency of sexual intercourse (n=16)	Less than 1 time / month	6(6.5)
	More than 2 times / month	5(5.4)
	More than 4 times / month	5(5.4)
Use a condom (n=17)	Yes	16(17.4)
	No	1(1.1)
Frequency of condom use (n=17)	<25%	4(4.4)
	25%~50%	1(1.1)
	>50%~75%	1(1.1)
	>75%~100%	11(12.0)
Responsible for contraception (n=17)	Myself	1(1.1)
	Partner	9(9.8)
	Couples (In all cases)	7(7.6)
Sex education experience in college	Yes	74(65.5)
	No	39(34.5)
Need for sexual education in college	Yes	107(94.7)
	No	6(5.3)
Need for differentiation of Sex Education for College Students	Yes	104(92.0)
	No	9(5.3)

Conted...

Reasons to Differentiate of Sex Education for College Student	Social characteristics	71(62.8)
	Personal characteristics	15(13.3)
	Situational characteristics	3(2.7)
	Environmental characteristics	16(14.2)

**Knowledge about cervical cancer:** Of a total of 15 questions concerning knowledge about cervical cancer, the question, “What do you think is the examination for diagnosing cervical cancer?”, got the highest answer rate (93.8%). Some of the items getting the lowest answer rate were related to knowledge about the risk factors for cervical cancer: “Having sexual intercourse before the age of 19 years is very likely to cause cervical cancer” (39.8%) and “HPV infection is very likely to cause cervical cancer” (38.9%) as shown in Table 3.

**Table 3: Knowledge about cervical cancer (N=113)**

		Correct		Not correct	
		n	%	n	%
1.	What do you think the test for the diagnosis of cervical cancer is?	106	93.8	7	6.2
2.	What do you think the pap test is?	91	80.5	22	19.5
3.	What do you think the purpose of cervical cytology is?	95	84.1	18	15.9
4.	How often are women recommended to undergo a cervical cytology exam?	57	50.4	56	49.6
5.	Since when should women be tested for cervical cytology?	93	82.3	20	17.7
6.	What do you think the normal findings of cervical cytology mean?	83	73.5	30	26.5
7.	What do you think the term ‘abnormal’ means in a cervical cytology test?	104	92.0	9	8.0
8.	If you have multiple sex partners, you are more likely to get cervical cancer.	63	55.8	50	44.2
9.	It is highly likely that if you experience sex experiences prior to 19 years of age, you are likely to suffer from cervical cancer.	45	39.8	68	60.2

Conted...

10.	If substances such as drugs and hemp are taken, there is a higher likelihood of cervical cancer.	93	82.3	20	17.7
11.	If you have had a sexually transmitted disease, you are more likely to have cervical cancer.	55	48.7	58	51.3
12.	If you smoke, you are more likely to get cervical cancer.	52	46.0	61	54.0
13.	If the nutritional status is bad, it is likely to get cancer of the cervix.	67	59.3	46	40.7
14.	Long-term oral contraceptive use is likely to lead to cervical cancer.	78	69.0	35	31.0
15.	If you are infected with HPV, you are more likely to get cervical cancer.	44	38.9	69	61.1
Total Knowledge about cervical cancer		Score of range 0-1		Mean±SD .66±.15	

**Knowledge of HPV:** Two of the items getting the highest answer rate were “HPV infection examination is important for every woman” and “HPV is transmitted through sexual contact” (96.5%, respectively) and those getting the lowest answer rate included “HPV infection causes cervical cancer for women in any case” (42.5%) and “HPV is infected from a toilet seat” (45.1%) as shown in Table 4.

**Table 4: Knowledge of HPV (N = 113)**

		Correct		Not correct	
		n	%	n	%
3.	HPV is a serious health problem.	13	11.5	100	88.5
4.	HPV causes ulcers and scars.	102	90.3	11	9.7
5.	HPV causes blisters.	98	86.7	15	13.3
6.	HPV causes genital warts.	98	86.7	15	13.3
7.	HPV infection is associated with an ‘abnormal’ outcome of cervical cytology.	102	90.3	11	9.7

Conted...

8.	Testing for HPV infection is important for all women.	109	96.5	4	3.5
9.	Women’s HPV infection always causes cervical cancer.	48	42.5	65	57.5
10.	HPV is transmitted through sexual contact.	109	96.5	4	3.5
11.	HPV is transmitted by skin contact between the genital and reproductive systems.	105	92.9	8	7.1
12.	HHPV is infected with skin and skin contact. (Ex : penis-anus, hand-penis, hand-anus)	81	71.7	32	28.3
13.	HPV is infected through toilet seat.	51	45.1	62	54.9
11.	HPV is treatable.	105	92.9	8	7.1
12.	Men have no way of knowing if they are infected with HPV.	76	67.3	37	32.7
	Total Knowledge about HPV	Score of range		Mean±SD	
		0-1		.76±.10	

Rate of HPV vaccination against cervical cancer

As for the HPV vaccination (against cervical cancer) rate, 25 students (22.1%) got vaccinated in three sessions and were under vaccinations shown in Table 5.

**Table 5: Rate of HPV vaccination (N=113)**

	Yes		No	
	n	%	n	%
Have you ever been vaccinated against HPV?	25	22.1	88	77.9

Correlation of knowledge about cervical cancer, knowledge about HPV, and rate of vaccination

There was no correlation between knowledge about cervical cancer and HPV and the HPV vaccination rates shown in Table 6.

**Table 6:Correlation of Knowledge about cervical cancer, Knowledge about HPV, and rate of vaccination (N = 113)**

	Knowledge about cervical cancer	Knowledge about HPV
	r (p)	r (p)
Rate of vaccination for prevent cervical cancer	.092(.596)	.106(.262)

**DISCUSSION**

Knowledge about cervical cancer and HPV scored higher than average .66 and .76, respectively. These scores are slightly higher than the score among college students in [8] about a half of 25 (12.27) and are similar to the mean score for knowledge about cervical cancer and HPV among South Korean men 4.88±1.45 out of 8 and 7.87±.48 out of 13, respectively[27].

Previous research reported that lack of correct information and education related to HPV infection and vaccines was associated with vaccination status[16]; [17]. [17] reported some issues that mothers were unaware of the need of HPV vaccination for their daughter at a middle-school age, who had no sexual experience, and that males were unaware of the need for the vaccination on the basis of the wrong information that it is confined to females and suggested the need for education and publicity.

Since 90% of the infected males are asymptomatic with no specific physical abnormality or lesion and no idea of the infection is likely to make females infected, they need to take special care [2]; [6]. As it was reported that about 10,000 males got cancer due to HPV on an annual basis in the United States (CDC, 2016) and that males’ vaccination was effective in preventing HPV infection when the vaccination rate for females decreased[28], it needs to be publicized positively so that males as well as females can make positive efforts to prevent it.

The HPV infection prevention rate in this study was 22.1%, which is higher than the vaccination rate (5.5%) in [22] and lower than 36.8% in [8]. These infection prevention rates are lower than the vaccination rate (40.5%) for female college students in the United States, where it is managed at the national level[9].

HPV is the most important risk factor for cervical cancer and the recently developed HPV vaccine not only reduces the risk of continuous infection by the high-risk HPV types 16 and 18, both of which particularly increase the risk of cancer, but also is effective in reducing the risk of precancerous of cervical cancer, such as CIN and AIS, as well as cervical cancer<sup>[28]</sup>. Such a low rate can be due to expensiveness and poor awareness and a decrease in HPV vaccination for males is caused by poor safety and side-effects, lack of information about vaccines and diseases, and the issue of costs; therefore, it is necessary to make a solution to these issues<sup>[18]</sup>,<sup>[19]</sup>,<sup>[24]</sup>. Since South Korea began to offer free-of-charge vaccination to those aged  $\geq 12$  years in June 2016, which is unknown to lots of people, it is necessary to publicize it in pursuit of active participation in vaccination<sup>[8]</sup>; because the problem is that information about HPV and vaccines fails to be given to the target group, emphasis is put on the need for efforts to raise the vaccination rate by increasing the amount of information to be socially disclosed<sup>[23]</sup>. To improve awareness of HPV vaccination, therefore, it is necessary to give a policy-based support by expanding the target group for free-of-charge vaccination to include secondary school and college students as well as by giving correct information and make a plan for creating a social atmosphere in which vaccination can be recommended positively.

This study found that knowledge about cervical cancer and HPV had no impact on the rate of vaccination against cervical cancer.<sup>[8]</sup> also found that there was strong intention to take a measure to prevent HPV infection—17.57 out of 21—but the actual vaccination rate was 36.7%.<sup>[7]</sup> reported that male college students in the course of healthcare who were systematically given information through lectures and others had better knowledge about HPV than those in the non-healthcare courses but no inter-group difference was found in the vaccination rate. It is necessary to possess information on a continuous basis and become aware of the importance of being motivated to get vaccinated with the objective of having the improvement in knowledge lead to promotion of practice<sup>[7]</sup>. Since giving correct knowledge about vaccination against cervical cancer can not only change attitudes toward vaccination but also help reduce the misunderstanding of or prejudices against vaccination<sup>[23]</sup>, efforts should be made to give correct information about the need and efficiency of vaccination, time for vaccination, and so on.

Since the present HPV vaccines fail to prevent infection with every HPV type related to cervical cancer, efforts should be made to build a continuous and systematic information delivery system in association with schools, hospitals, and communities by performing pap smear on a regular basis, regardless of vaccination status<sup>[20]</sup>, and by giving information about specific life strategies for preventing and detecting cervical cancer at its early stage in addition to vaccination.

In addition to the efforts to give correct information on a continuous basis, diverse strategies are required to raise the HPV vaccination rate; most of all, it is necessary to recommend using a condom with the aim of preventing HPV infection, which is a sexually transmitted condition, in case of exposure to sexual behavior and to encourage safe sexual behavior: reducing the frequency of sexual behavior and the number of sex partners, avoiding starting sexual experience at a too young age, and taking care to consider personal hygiene.

Another problem is that healthcare providers have poor knowledge about HPV<sup>[31]</sup>; therefore, expert groups need to obtain correct knowledge. In particular, since nursing students characterized by a high HPV infection rate, regardless of gender, are to be health managers as well as targets for health management, it is necessary to develop an effective management program so that they can do preventive actions based on correct information about vaccination.

## CONCLUSION

The purpose of this study was to identify the relationship between knowledge and preventive behavior by examining the degree of knowledge about Cervical Cancer and HPV, and the preventive actions against cervical cancer among male and female nursing students who are future health. In this study, the knowledge of cervical cancer and the knowledge of HPV did not affect the rate of cervical cancer vaccination. These results show that it is important to keep information constantly and to recognize the importance of vaccination, in order to not only increase the knowledge but also to promote the actual preventive behaviors. In addition, it is necessary to promote various prevention activities through accurate knowledge.

**Ethical Clearance:** Taken from, Dankook University

**Source of Funding:** Self

**Conflict of Interest:** NA

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# A Study on User IoT Information based Healthcare Service

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## ABSTRACT

IoT technology development has enabled convergent development with other industries. IoT service development is active in various fields such as smart farm, smart city, and healthcare. Especially, with the emergence of various healthcare devices, many studies are being conducted in the field of IoT-based health care services. In this paper, healthcare service is provided based on user's external generated healthcare information and information generated from IoT healthcare devices. The information generated by the user event is provided by the user using the Web and the application, and the information generated by the user's behavior or body change is collected through IoT healthcare devices. The collected user healthcare information classifies the user's hospital information and the information collected from the healthcare service into the standard value and the user reference value, and provides the healthcare service through comparative analysis with the user's healthcare information. In the IoT environment, healthcare is changing from disease management centered to prevention management centered. Changes in perceptions of health care and the development of IoT have increased the demand for quality improvement of individual health care. Because IoT paradigm is evolving into a computing environment in which the desired information can be exchanged in real time anytime, anywhere, there is much interest in IoT based healthcare. The IoT information-based healthcare service proposed in this study provides appropriate services for users to manage diseases and conduct prevention management. Because services are provided on the basis of medical information, the collection of information, the security of information management and the reference to personal information should be supplemented through institutional devices, and was not included in the consideration in the study. The aim is to build integrated medical information systems through collaboration of public institutions and hospitals by expanding the scope of application of healthcare based on IoT in the future. The healthcare service based on IoT information proposed in this paper adds the IoT information generated by the user to the existing health care service providing method to provide the service. In healthcare service provider-oriented service selection, by reflecting user's information, it is possible to choose a user-centered healthcare service that is not provider-centered.

**Keywords:** *IoT, Healthcare, data Extraction, healthcare service, IoT device.*

## INTRODUCTION

Interest in healthcare services is increasing due to the development of IoT technology and the emergence of various healthcare devices. Especially, many researches and developments have been made in the healthcare industry in public and private sectors including medical institutions<sup>1</sup>. Information technology using the network collects information generated through IoT, multimedia, interaction with people such as sensor networks and collaboration between devices, and is used in various fields<sup>2,3</sup>. An IOT environment is an environment in which devices constituting various IoTs provide services to users through a connection without user intervention<sup>4</sup>. Health care services can help users manage health effectively by

helping users manage preventive care. Currently, health care services are being expanded and applied to collect and analyze healthcare device data as well as medical information of users<sup>5</sup>. The use of healthcare information in the IoT environment should be studied with the aim of collecting all the information related to the user and providing appropriate services to the user<sup>6</sup>. There will also be a worldwide increase in aging trends and demand for health. A variety of customized healthcare services are required depending on these needs of users. IoT-based health care services are differentiated from the following areas. First, personal information analysis. Second, customized disease management, Third, provision of healthcare services regardless of time and place. The healthcare service attaches the IoT device to

the body, transmits the user's information to the server through the network, and operates with various sensors to provide services to the user<sup>7</sup>. In this paper, healthcare service suitable for users are provided based on user healthcare information using the IoT information based healthcare service system. The proposed method stores and manages provider information and user hospital information providing medical service and collects and analyzes various healthcare event information generated by users. The analyzed information is compared with the reference value of the collected data to suggest a healthcare service suitable for the user. Users can be provided healthcare services according to the situation.

## LITERATURE REVIEW

**IoT devices and key technologies:** For major IoT-related devices, various devices based on IoT such as Smart glass, Smart watch, happifork, and Smart pills are being released. It is possible to generate healthcare information through various wearable devices. It can measure user information such as user's exercise information, walking information, heartbeat, blood pressure, diabetes, calories, etc., and can provide various healthcare services in connection with IoT environment. Healthcare devices allows the user to manage the health and disease information of the user directly through the IoT environment and to provide appropriate care and services by sharing with the hospital or healthcare service provider. It is difficult for healthcare service to provide user-friendly service compared to other technologies because it is not easy to collect and manage disease information effectively, so there is a need for a method to efficiently collect and manage disease information<sup>8</sup>. The key technologies of IoT are shown in Table 1<sup>9</sup>.

**Table 1: IoT Key technologies**

Key technology	Overview
Sensing technology	With sensors that collect various information of objects and environment, it can extract more intelligent and high-dimensional information by using multiple sensing technology.
Wired/wireless communication and network infrastructure technology	All wired and wireless network technologies to connect people, objects and information services
Service and interface technology	Interface technology for organically linking services of various communication protocols and data standards

**IoT Healthcare:** Information and communication technology has a great impact on medical services as well as healthcare. Medical services are available to patients at remote locations, and it provide users with environment for preventive management by providing medical information service based on data. IoT healthcare services are rapidly evolving as interest in personal health care and disease prevention increases<sup>10</sup>. IoT-based healthcare services are provided through broadening and mobility orientation of services, convergence of networks, services and devices, and linkage of information and communication services. IoT Healthcare is closely associated with the growth of the related services industry and is growing in convergence with various service industries. Table 2.shows the main service types to which IoT is applied<sup>11,1</sup>.

**Table 2: IoT Main service types**

Service	Description
RFID Sensor	Application of RFID sensor to provide PC, PDA with real-time data such as patient's movement status, position, abnormality signs
Hospital information service	Implementation in the internal information system of the medical institution such as the patient's condition and information to provide integrated information through wired/ wireless terminals
Mobile healthcare	Management of health status in real time using Mobile
Wearable computer	Observe user status and provide collected information through wearables
Online consultation	Service support using online
Healthcare telematics	Services incorporating remote control, telematics, and emergency systems

**Previous studies on IoT healthcare:** Standardization work is being carried out simultaneously by international standards organizations such as IPSO Alliance, OMA, Zigbee IETF, and oneM2M. The IPSO Alliance is researching the use of Internet technologies to connect smart objects<sup>13</sup>. ZigBeeIP and CoAP in the IoT device department are researching the technology for transmitting the sensing data information measured by the sensor to the gateway<sup>14</sup>. Standardization organizations such as IETF and oneM2M are proceeding a standard that efficiently manages the data and resources that are sensed in the backend part<sup>15</sup> OMA is established a message standard for transferring measured data from IoT devices to the platform<sup>16</sup>. The IoT standard aims to provide a secure and reliable integrated service using web-based application protocol by utilizing various sensors equipped with internet protocol. These international standards-based platforms are essential to provide integrated, customized services that are interoperable across devices<sup>17</sup>.

**Proposed Work:** For IoT environment-based healthcare services and platforms, each service is served through its own platform. Because it is used independently and provides simple functions and services, it is necessary to provide converged integrated services. The emergence of various IoT devices and the interest of users in healthcare is increasing the demand for providing user-specific healthcare services. This section proposes a model that provides user-appropriate health care service by applying user-specific standard value and reference value based on information generated from devices and wearables based on IoT and user generated health information. The proposed method can quickly convey the physical changes that may occur in the user 's inattention, behavior patterns in life, and change of environment and aims to provide services that minimize

the deterioration of physical rhythms and health of the user. The proposed method provides the healthcare service using user IoT information.

**User IoTInformation based healthcare service system:** The study proposes and IoT information based healthcare system for providing user-centered healthcare system service. The proposed system collects user's healthcare information, IoT devices data, healthcare service information, and user hospital information. The healthcare data collector collects external information generated by user events and information generated using IoT healthcare Device. For the external information, the user can use the App and the Web so that the user can directly enter the healthcare information. The IoT healthcare device information is collected in the processed XML form and parsed and stored in the IoT device DB according to the healthcare information classification. The Healthcare Repository database collects and stores healthcare services and hospital information into standard values and user healthcare reference values. The information stored in the IoT device DB is called by the information analyzer and the data analysis module analyzes the valid information. Once the analysis is complete, the Decision module determines the services based on healthcare services and hospital user information collected in the healthcare repository database. A query is generated based on the information collected from the user's health status and disease status. The generated query calls healthcare service modules. The healthcare service module determines what type of service to provide through queries written in modules that execute the final service. The IoT information-based healthcare system can provide users with healthcare services tailored to their situation, enabling them to quickly respond to changes in user health and emergencies. (Figure 1) shows the IoT-based healthcare service.

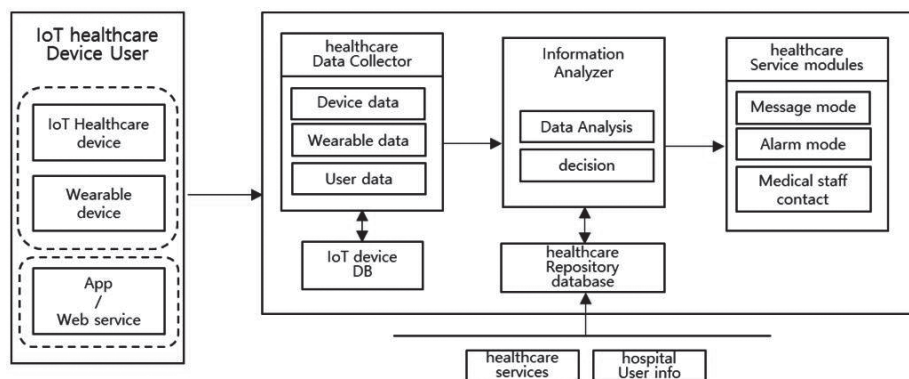


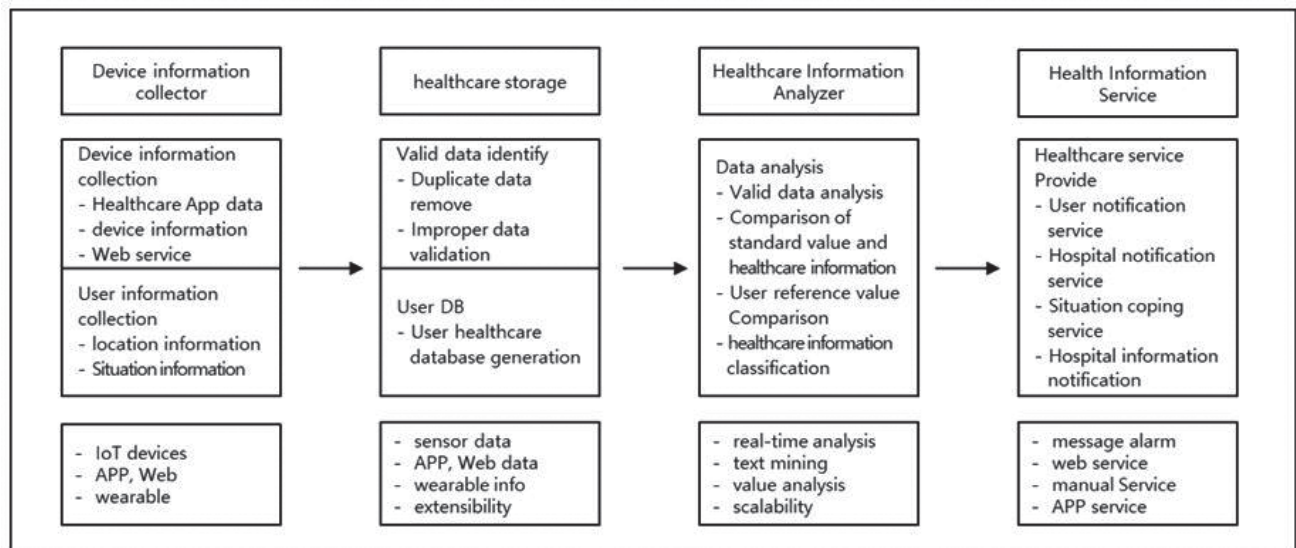
Figure 1: IoT information based healthcare system

**IoT health care information classification and collection:** IoT healthcare information collection is based on existing data collection, storage, and analysis, and extracts a set of structured or unstructured data of information and effective information defined from these data, and analyzes the extracted information. This classifies the characteristics of the information generated in various devices and applications, and measures and predicts the user’s health status to enable user-centered healthcare. Table 3.describes the types of health care data.

**Table 3: Healthcare data standardization comparison**

Definition	Description
Structured	Relational database with data stored in a field fixed in the Device
Semi-structured	Data that includes metadata, message, sensor value, etc. in Device
Unstructured	Data that can be analyzed with data that is not stored in a fixed field

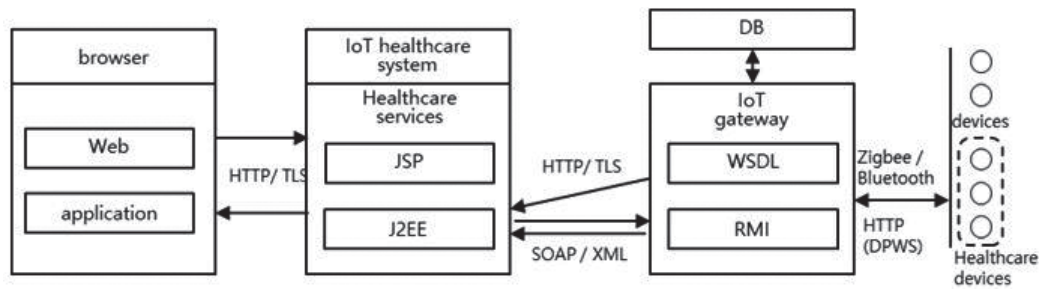
Healthcare information collection collects data generated from IoT devices and wearables in healthcare information collection and collects user generated data from App or Web. Healthcare DB accepts data generated from sensor data, application / web, wearable information, and data generated by input of the user, and stores the extended type information in the user DB. The healthcare information analyzer analyzes the valid data from the stored information and compares and evaluates user-specific standard values against the user’s reference values. The information evaluated in real-time analysis, text mining, and value analysis provides health information service such as message alarm, manual service, and web service according to healthcare information classification. (Figure 2) shows the health information collection stage.



**Figure 2: Design of Improved Healthcare information collection model**

**IoT Healthcare service interface:** In order to configure IoT healthcare services using various environments and devices, modules providing IoT healthcare services should provide functions such as interoperability, scalability, activeness, and universality. In order to control and manage IoT healthcare services, functions such as information management, service management, location management, traffic management, and security management are also required. The IoT healthcare service provided to users is provided in the form of web and application, and users can manage information and receive services using web and application. The

healthcare service system can provide device services to users through a healthcare gateway that manages each device. The healthcare gateway is located around sensors supporting home network and IoT environment to provide healthcare service to devices. The functions required by the IoT healthcare service module apply the service overlay network concept. In addition, it supports device profile management and sensing information management using healthcare gateway to provide device healthcare service management and information management. (Figure 3) shows the interface environment between IoT healthcare service system modules.



**Figure 3: IoT healthcare service module interface**

To provide healthcare service, it is necessary to construct an IoT service environment. The user sends a message using HTTP / TLS to the IoT healthcare system using a web browser and App. The database accessing the IoT healthcare system stores the user’s healthcare profile, service profile, and IoT gateway information. The information used by the IoT gateway manages the healthcare devices profile, sensing data, and the list of devices connected to the IoT gateway. The healthcare device and the IoT gateway use the dPWS message format, and the IoT gateway and the IoT healthcare system use SOAP, HTTP, and XML messages.

**COMPARISON ANALYSIS**

In this part, we went through a comparative analysis between healthcare information based Web service method and existing healthcare service method. The proposed system was evaluated by adding 4 evaluation items to the existing conventional method. In order to distinguish the difference between the existing method and the proposed method, Applicability, Healthcare Information Acquisition, Healthcare Service Information

Extension, and Service Information Reflection Point of time. The Applicability evaluates whether the defined information is understood by the user when it is applied to the service. Healthcare Information Acquisition is a method for users to input information into the system in order to use the healthcare service and actively acquire user’s healthcare information. The proposed method minimizes user intervention by collecting user healthcare information through IoT device and can immediately reflect changed user’s healthcare information. Expansion of information needed to provide healthcare services is accomplished not only by using the information input at the reference time but also adding additional information collected from user IoT device. In the conventional method, Service Information Reflection Point reflects the input point of information by the user or the service provider. On the other hand, the proposed method utilizes the IoT environment to reflect the healthcare information at the modified time point. Also, it is capable of supporting the service according to the user’s situation. Table 4. below shows a comparative evaluation between the existing and the proposed method.

**Table 4: Comparative evaluation between the existing and the proposed method**

Evaluation List	Existing Method	Proposed Method
Adaptability	Support	Support
Healthcare Information Acquisition	userinput information, provider input information	user input information, IoT information collector
Healthcare Service Information Extension	Defined information base	IoT healthcare device extended information
Information Reflection Point of time	Information input point	Information generated point

**CONCLUSION**

As IoT is popularized and generalized, interest in healthcare is continuing to increase. From previous care centered follow-up management to prevention centered,

it is changing from disease management centered to health care management centered. In addition, it is changing from a unilateral provider-oriented healthcare service that simply provides information, to an active form as customized healthcare service for each user.

This paper proposed a system that provides healthcare service based on IoT information. The proposed system stores the external event information generated by the user and the information of the IoT healthcare device that the user uses in daily life in the user IoT DB. The stored DB classifies valid healthcare information. The classified information is compared with the healthcare reference value of the healthcare repository database by the information analyzer. Using the analysis results, healthcare services suitable for the user is provided. The aim is to expand IoT information-based healthcare system to build an IoT information integrated medical information system. The integrated medical information system will integrate individual disease information and health information from such places as public institutions and hospitals, to make provision of personalized medical services possible.

**Ethical Clearance:** Taken from School of Information and Communication Systems, Jecheon, Korea

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Acoustic Characteristics and Quantitative Analysis for Safety Management of Noise Generated during MRI Scan

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## ABSTRACT

This study aimed to provide basic data for safety management against noise by identifying its acoustic characteristics generated in MRI examinations by quantitative analyses. Noise was measured from four different kinds of MRI equipment with various magnetic field intensities and sequences. The MRI equipment used was characterized by 0.35T, 1.0T, 1.5T, and 3.0T. To evaluate the noise in the MRI scan and control rooms, frequency and waveform characteristics from the noises were analyzed by their time history curves. The sequences were T1 of SE, T2 of FSE, T2\* of GE, and DWI of high-speed data collection. The frequency of the noise measured in the MRI scan and control rooms, and the magnetic field intensities at 500-1,000 Hz, as well as the noise frequency measured in the MRI scan room. However, the frequency of the noise in the MRI control room was measured in a diverse fashion. Analyses of the noises' wave forms revealed that most of the MRI scan and control room noises possessed the characteristics of steady and quasi-steady impulsive noises. In the 1.5T equipment, a repetitive impulsive noise was the salient feature. Research on the MRI safety should be conducted continuously and safety rules strictly enacted. It is expected that this study can be utilized by studies on MRI safety and that it will reinforce MRI safety management regulations.

**Keywords:** MRI, Acoustic noise, Hearing protection, Hearing loss, Safety management.

## INTRODUCTION

MRI equipment is a modern and high-precision medical appliance to obtain images inside bodies. Due to this hardware's many advantages, MRI has been established as an indispensable examination tool in diagnostic medicine. MRI equipment has been developed from low magnetic fields under 1T to high ones over 1.5T. Through the repetitive acquisition of images, the SNR and the image quality improved, while scan times became much shorter. In spite of such MRI advancements, the generation of high-level noise still remains as one of the major problems. MRI equipment uses a gradient coil to reduce the scan time, which produces loud noise causing anxiety and auditory disorders in patients during scans. The gradient coil is used in the MRI scan process to adjust the direction and intensity of the magnetic field and to acquire the scan image – these are the main reasons for the vibration and noise generation. The gradient coils repeatedly stop very shortly during scans. They are active for a very short time and even change direction. During these processes, the gradient coil is transformed by Lorentz's force in a

big magnetic field and the movement converts to high, noisy vibration. In addition, the eddy current produced in the reverted direction emits heat, energy, vibration, and sound.<sup>1</sup>

The vibration and the noise during the MRI cause anxiety in the patient. Also, the operator who carries out scans – the radiologist – is exposed to continuous noise and prone to suffer both physically and psychologically.<sup>1,2</sup> Prior research on noise-reduction methods focused on the noises' causes. Such reduction methods were divided into one to reduce the noise of high-frequency bands by the artificial creation of a noise's anti-phase; another method adds the coil to reduce Lorentz's force produced in the gradient magnetic field coil's direction perpendicular to the main magnetic field by use of the gradient magnetic field coil's characteristics.<sup>3,4</sup> Methods to eliminate the cause of noises are still under research. However, most current MRI equipment still generates distracting and distressing noises which affect the body in various ways, such as sleep disturbances, lowered academic performance, diminished job efficiency, or suboptimal physiological functioning.<sup>5,6</sup> It is particularly

the medical institution's responsibility to guarantee personal safety and to provide comfortable rest as well as sleep to the patients and the visitors and to allocate space for an optimum environment that does not cause any problems due to the scans.

The efforts to reduce the noises generated during MRI scans are reflected in many studies.<sup>7</sup> The present MRI noise-reduction methods are not very effective – it seems to take a long time to discover a permanent mechanical way for generalizable noise reduction. Therefore, for noise-protection facilities that can be easily and promptly applied to a variety of settings, the noise characteristics must be thoroughly analyzed to be usable as baseline data.

Therefore, this study performed a comparative analysis by measuring the noise of MRI equipment operated in medical institutions to propose measures that can reduce the noise generated during scans.

## MATERIALS AND METHODS

The MRI equipment's noise analysis and evaluation methods were determined by a literature review on this topic. MRI equipment of 0.35T, 1.0T, 1.5T, and 3.0T were used as shown in table 1. Noise is greatly influenced by the size, place, and precise location of the MRI equipment. To exactly evaluate the noises in

the MRI scan control rooms (Table 2), measurements of the space for the four kinds of MRI equipment, the furniture's sound absorption coefficients, and the rooms' finishing materials were taken. In a pre-investigation before the actual noise measurement, the noise was assessed five times in the MRI scan room and the control room with same signal arrangement for one minute each. In the waveform analysis of the pre-investigation, no size differences requiring repetitive investigations were found, because various waveforms would have different meanings. Therefore, it was decided to measure noise once in a pre-defined sequence. During the noise assessment, Brain MRI scans were taken, which are mostly used for stroke diagnoses. These scans—from low to high magnetic field equipment—could be used for the four noise measurements with the four sequences T1 of SE, T2 of FSE, T2\* of GE, and DWI of high-speed data collection. To identify the noise-measuring location within the MRI scan room, the range to prevent malfunction of the measuring equipment by magnetic forces was determined. For the MRI control room, the location of the actual control operations was selected. For the noise measurement, the sound level meter type 2236 of B&K (Brüel & Kjær Co., Nærum, Denmark) and the Symphonie dBFA software for the noise and vibration analysis, were used. To evaluate the noise environment, the AutoCAD and SketchUP programs were employed.

**Table 1: Information and specification of the MRI**

Equipment	0.35 Tesla	1.0 Tesla	1.5 Tesla	3.0 Tesla
Equipment name	Hitach AIRIS Elite	SIEMENS Harmony	PHILIPS Intera Achieva	PHILIPS Intera
Magnetic field	2.0m × 2.5m	2.5m × 3.9m	2.4m × 3.8m	3.0m × 5.2m

**Table 2: Dimension of the MRI scan room and control room**

Subdivide	0.35T		1.0T		1.5T		3.0T	
	Scan room	Control room	Scan room	Control room	Control room	Scan room	Scan room	Control room
Length (m)	5.7	7.3	6.0	13.9	12.1	7.23	1.1	13.9
Width (m)	4.4	8.6	4.5	16.2	4.5	5.4	5.0	16.2
Height (m)	2.6	2.6	2.8	2.5	2.6	2.7	2.8	2.5
Area (m <sup>2</sup> )	24.4	31.1	26.9	114.5	42.9	39.2	50.1	114.5
Volume (m <sup>3</sup> )	59.5	64.3	67.3	299.4	114.2	91.8	124.4	299.4



**RESULTS AND DISCUSSION**

**Noise Frequency Characteristics of MRI Scans:** The frequency of the four noises measured in the MRI scan room between 20 Hz and 20 kHz was analyzed within a 1/3 octave band.

**Sound pressure level by frequency in the MRI scan room:** For the frequencies and sizes of the 0.35 T MRI equipment, the highest value was 65.6 dB at 250 Hz of T1, 66.3 dB at 250 Hz of T2, 65.5 dB at 500 Hz of

DWI, and 58.5 dB at 250 Hz of GE. Regarding the 1.0T MRI equipment, the highest value was 89.2 dB at 1,000 Hz of T1, 82.6 dB at 1,000 Hz of T2, 87.8 dB at 1,000 Hz of DWI, and 87.4 dB at 500 Hz of GE. In the values for the 1.5T MRI equipment were 73.4 dB at 1,000 Hz of T1, 88.5 dB at 1,000 Hz of T2, 92.1 dB at 1,000 Hz of DWI, and 89.0 dB at 1,000 Hz of GE. For the 3.0T MRI equipment, the highest value was 74.2 dB at 500 Hz of T1, 90.8 dB at 1,000 Hz of T2, 100.3 dB at 500 Hz of DWI, and 78.0 dB at 500 Hz of GE (Table 3).

**Table 3: One third octave band sound pressure level and level weighting of sound pressure level in the MRI scan room**

Subdivide	Sequence	Frequency (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
0.35T	T1	49.3	52.8	65.6	59.7	51.4	38.2	33.6	33.8	60.4
	T2	47.7	48.5	66.3	63.6	58.8	46.1	38.7	34.2	64.0
	DWI	47.9	53.5	63.9	65.5	52.1	39.2	32.9	33.2	63.4
	GE	47.4	46.1	58.5	56.1	52.6	43.1	35.6	33.2	57.1
1.0T	WN	59.1	58.5	55.5	50.8	49.4	47.1	47.4	46.9	55.9
	T1	60.8	70.3	83.7	83.9	89.2	82.6	69.8	56.8	90.9
	T2	61.2	66.1	73.4	80.2	82.6	78.1	69.4	50.6	85.2
	DWI	67.3	70.5	77.7	85.0	87.8	84.1	71.5	54.7	90.5
	GE	59.4	73.7	81.2	87.4	87.2	77.9	69.3	52.9	89.5
1.5T	WN	65.9	61.0	58.2	54.7	50.3	46.8	45.0	44.4	57.0
	T1	66.9	69.3	68.0	68.6	73.4	58.5	48.1	45.2	74.4
	T2	71.3	72.4	83.5	83.1	88.5	84.6	64.5	51.8	90.9
	DWI	66.6	63.1	74.2	81.7	92.1	78.3	62.4	52.3	92.5
	GE	66.3	68.7	74.0	79.1	89.0	79.2	64.6	53.8	89.8
3.0T	WN	55.1	52.8	45.3	41.8	47.8	39.6	40.0	38.7	50.3
	T1	56.0	58.5	64.4	74.2	72.0	54.7	46.8	40.8	74.6
	T2	60.1	66.2	74.2	82.3	90.8	81.5	65.8	57.2	91.7
	DWI	63.8	70.8	74.5	100.3	90.1	83.2	76.4	73.6	98.1
	GE	54.7	68.6	68.9	78.0	77.2	64.4	53.1	42.4	79.4

※ WN=Shimming Noise, T1=Spin echo sequence, T2=Fast spin echo sequence, DWI=Diffusion Weighted image sequence, GE=Gradient echo sequence

**Sound pressure level by frequency in the MRI control room:** For the frequencies and sizes assessed in 0.35 T MRI equipment, the highest measured value was 57.5 dB at 500 Hz of T1, 57.5 dB at 500 Hz of T2, 56.5 dB at 250 Hz and 500 Hz of DWI, and 57.0 dB at 250 Hz of GE. In the 1.0T MRI equipment, 61.3 dB was assessed at 1,000 Hz of T1, 54.9 dB at 1,000 Hz of T2, 60.8 dB at 63

Hz of DWI, and 59.6 dB at 1,000 Hz of GE. For the 1.5T MRI equipment condition, the measurements were 56.6 dB at 125 Hz of T1, 56.5 dB at 63 Hz of T2, 60.1 dB at 1,000 Hz of DWI, and 57.0 dB at 1,000 Hz of GE. Lastly, in the 3.0T MRI equipment, the values were 55.4 dB at 63 Hz of T1, 55.2 dB at 63 Hz of T2, 60.2 dB at 500 Hz of DWI, and 55.0 dB at 63 Hz of GE (Table 4).

**Table 4: One third octave band sound pressure level and levelweighting of sound pressure level in the MRI control room**

Subdivide	Sequence	Frequency (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
0.35T	T1	40.0	49.5	56.0	57.5	51.9	43.7	38.2	30.5	61.3
	T2	41.6	49.3	55.7	57.6	52.5	43.4	38.1	30.5	61.6
	DWI	41.0	49.3	56.5	56.5	53.1	44.1	38.7	30.6	61.3
	GE	43.2	48.9	57.0	56.1	52.9	43.9	38.5	30.6	60.8
1.0T	WN	53.1	49.1	45.0	44.4	38.5	34.2	31.6	33.1	45.4
	T1	53.9	49.5	56.7	53.6	61.3	45.8	33.6	33.1	62.0
	T2	53.2	50.1	51.6	50.6	54.9	43.5	33.7	33.2	56.3
	DWI	60.8	52.8	54.9	57.1	60.3	46.2	34.3	33.2	61.6
1.5T	GE	54.2	52.1	57.4	54.0	59.6	43.8	33.6	33.3	60.6
	WN	54.6	55.2	46.5	42.5	38.2	34.8	30.8	31.4	45.7
	T1	54.9	56.6	46.9	43.6	43.3	34.9	30.7	31.3	47.7
	T2	56.5	56.3	51.7	52.5	55.7	51.0	33.4	31.4	58.2
	DWI	55.3	55.7	47.9	48.7	60.1	46.9	33.5	31.5	60.6
3.0T	GE	54.4	55.2	47.8	47.1	57.0	45.9	32.5	31.3	57.7
	WN	55.0	52.1	46.0	40.3	37.0	34.1	30.4	31.2	44.3
	T1	55.4	52.4	46.7	41.0	37.4	34.5	30.6	31.2	44.7
	T2	55.2	53.2	47.3	43.9	50.7	36.7	31.2	31.4	51.8
	DWI	55.2	51.9	46.8	60.2	47.1	38.7	37.0	34.8	57.7
GE	55.0	52.0	46.9	41.5	37.6	34.3	30.8	31.4	44.8	

※ WN=Shimming Noise, T1=Spin echo sequence, T2=Fast spin echo sequence, DWI=Diffusion Weighted image sequence, GE=Gradient echo sequence

### Time History Curves and Characteristics of Noise Waveform During MRI Scans

**Time history curves and waveform characteristics in the MRI scan room:** The noise generated in the scan room during the MRI operation was analyzed by waveforms based on the time history curve. Steady noise was measured from the four equipment types of T1 and 0.35T, as well as 1.0T and 3.0T of GE. Fluctuating noise was assessed in 3.0T of T2. Quasi-steady impulsive noise was captured in the 0.35T, 1.0T, and 1.5T equipment of T2 and the four

kinds of equipment for DWI. Repetitive impulsive noise was measured in 1.5T equipment of GE (Table 5).

**Time history curves and waveform characteristics in the MRI control room:** The noise generated in the scan room during the MRI operation was analyzed by waveforms based on the time history curve. Steady noise was assessed from three equipment types of T1, T2, and 3.0T of DWI, as well as the 1.0T and 3.0T hardware of GE. Quasi-steady impulsive noise was measured in the 1.0T and 1.5T equipment of DWI. Repetitive impulsive noise was captured in the 1.5T equipment of GE (Table 5).

**Table 5: Classification of acoustic noise in the MRI scan room and control room**

Subdivide	MRI scan room				MRI control room			
	T1	T2	DWI	GE	T1	T2	DWI	GE
Steady noise	○ ● □ ■			○ ● ■	● □ ■	● □ ■	■	● ■
Fluctuating noise		■						
Quasi-steady impulsive noise		○ ● □	○ ● □ ■				● □	
Repetitive impulsive noise				□				□

※ ○:0.35 Tesla, ●:1.0 Tesla, □:1.5 Tesla, ■:3.0 Tesla

## DISCUSSION

Most noises generated in the MRI scan room displayed the characteristics of steady noise and quasi-steady impulsive noise out of 16 operation noises and 12 noises from MRI equipment over 1.0T exhibiting significantly serious noise levels of 75 dB(A) to 99 dB(A). T1 noise showed a high noise level sufficient for “urine volume increase and difficulty in hearing” to occur and 1.5T and 3.0T generated noise between 70 to 75 dB(A) causing signs such as “peripheral vasoconstriction and a decrease of adrenocortical hormones.” T2 displayed a noise level high enough to cause “early water bag rupture in the 1.0T of the magnetic field” and in the 1.5T and 3.0T conditions, it produced noise that could result in “urine volume increase and difficulty in hearing” which affects patients the most, like the DWI noise in 1.0T, 1.5T, and 3.0T. The GE noise in 1.0T and 1.5T could cause “early water bag rupture.” In 3.0T, the noise level corresponded to a “start of hearing loss.”

Most of the noises generated in the MRI control room showed the characteristics of steady and quasi-steady impulsive noises and the 16 generated noises displayed levels of 45dB(A) to 63 dB(A). Since this corresponds to the health limit of noise, it was judged that there were no problems associated with sound. Since the physical and mental state of patients is more fragile than that of healthy equals, hospitals should pay attention regarding their protection. Soundproof MRI locations and surrounding spaces such as waiting rooms should be regulated in order to avoid unpleasantness.

Many studies found that damage to the organ of Corti is the cause of hearing loss in noise-induced deafness<sup>8</sup> because of mechanisms such as tissue damage by the generation of oxygen-free radicals due to the reduction of microvascular blood flow in the inner ear, vasoconstriction, increase of vaso-permeability, localized edemas in the inner ear, ischemia, and refusion.<sup>9,10</sup> There have also been many attempts to treat noise-induced deafness using medicines based on the specific pathophysiology, but no clear treatments emphasizing prevention and early diagnosis exist as of yet.<sup>11</sup> Research on “mechanisms of the prevention of noise-induced hearing loss” proposed that the preventive measure of noise-induced deafness is to avoid loud noise and if noise exposure is inevitable, its intensity should be minimized by hearing protection gear. It has also been claimed in animal experiments that taking micronutrients such as vitamins can reduce noise-induced deafness.<sup>12</sup>

The limitations of this study are as follows. First, the noise was only measured from MRI equipment by the magnetic field’s size. There are various MRI devices by different manufacturers installed in medical institutions and diverse signal arrangements exist, depending on the concrete type of hardware. There are no mentionable differences by manufacturers in the traditional signal arrangement; however in the signal arrangement using GE, the characteristics vary. In this study the noise of such diverse MRI equipment could not be evaluated. To achieve this, the permission from many medical institutions must be obtained, but within the human-resource limits of this study, it was too hard to request the cooperation of numerous medical institutions. Therefore, the noise of diverse equipment kinds by different manufacturers could not be assessed. Second, the position for measuring noise within the MRI scan room was an area out of reach of the magnetic field. Since MRI scans are performed when the patient enters the bore, the overall noise distribution in the MRI scan room needs to be examined. Therefore, the investigation of the exact overall sound distribution was insufficient.

## CONCLUSION

MRI is equipment that helps and influences the diagnosis of diseases tremendously, but there are several weaknesses related to safety. Among them, the impact of noise on the patient cannot be disregarded and may also cause occupational diseases in practitioners involved with MRI-related activities. The occurrence of noise-induced hearing loss and the associated pain vary, depending on personal sensitivity and there is no method to exactly predict such problems. However, reducing the noise generated during MRI scans can minimize the pain and anxiety felt by patients. The imaging scan for diagnoses should prioritize patient safety which requires that the practitioners in charge of patient examinations provide quality medical care, understanding the issues related to patient safety and the pertinent research. Studies on the safety of MRI must be continued and safety-related rules enacted. Hopefully, this study will contribute to research on MRI safety and the reinforcement of safety and management regulations.

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**Conflict of Interest:** NA

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# Designing Medical Service Management Model of Users using IoT Devices

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## ABSTRACT

IoT is used in various academic fields including healthcare. IoT is redesigning modern medical services from a technical, economic, and social point of view. Recently, IoT medical service has been attracting attention especially among various medical services. to prepare socially emerging elderly medical services. The proposal model not only enables disease management and diagnosis of patients who visited the hospital by using IoT device, but also assigns a probability value to the disease information attribute of the patient so that the diagnosis of the medical staff can be easily handled based on the information collected from the IoT device. In particular, the proposed model improves accessibility to patient disease information by providing health information to the diseases collected through IoT devices and linking them with each other. In addition, the proposed model guarantees the accuracy of disease information because it checks the similarity with existing disease by hierarchical structure of the information collected through IoT device. As a result of the performance evaluation, the accuracy of medical information processing of users receiving medical service using IoT devices was found to be 23.6% higher than that of users who do not use IoT devices. The efficiency of in - hospital medical service was improved by up to 31.8% than the users who did not use IoT device. Also, the processing time when IoT medical service was used was 25.9% less than when IoT medical service was not used. The higher the number of users who did not use IoT health services, the higher the average work overhead was on average 27.5% than the IoT health care users.

**Keyword:** *IoT, Medical Service, Healthcare, Management Model, Disease Information*

## INTRODUCTION

With the rise of the fourth industrial revolution in recent years, major technologies related to healthcare services (big data, robotics, biotechnology, cloud technology, etc.) have been studied in various fields<sup>[1]</sup>. Particularly, there are areas that can be partially or in the long term replaced by technological developments such as elderly caring services, health care services, medical expenses review and appropriateness assessment<sup>[2],[2]</sup>.

IoT medical services have significant implications in three aspects: economic development, technology development, and user protection. In terms of economic development, it is possible to expand the market size by improving domestic and international competitiveness and interoperability. In terms of technology development, advanced technology can be introduced early through technology standardization<sup>[4],[5]</sup>. Finally, in terms of user protection, the cost of use is lowered,

which can improve convenience for standard interfaces and standard usage. However, IoT medical services have yet to fully address the vulnerability of IoT devices<sup>[6]; [7]</sup>. This is because hospitals alone can not be responsible for providing the best patient experience and purchasing medical equipment by putting a huge IT budget on them. Therefore, IoT medical manufacturing companies as well as hospitals must seek ways to handle security vulnerabilities of IoT medical devices and to provide patch update policies in a short time(Catarinucci et al., 2015;<sup>[9],[10]</sup>).

Recently, IoT medical service technology research has been actively conducted by medical specialists in order to efficiently provide IoT medical services to patients<sup>[11],[12],[13],[14],[15],[16],[17]</sup>. For example, MtreeCare, a domestic IoT medical specialist, developed a smart thermometer that allows young children to measure and manage body temperature without visiting a hospital. Other implants in the body were also developed as

IoT devices. MtreeCare is already working on putting wireless sensors into various artificial joint-related devices, and Boston Scientific is developing a model where heart pacemakers transmit data to the outside. For this purpose, Scientific has developed a sensor technology that can operate at ultra low power by using various energy (body temperature or vibration) of the human body without battery. In Korea, Pusan National University Hospital uses IoT to provide services and guidance to maximize the convenience of hospital patients and caregivers.

In this paper, we propose a health care service model based on IoT device for the aging societies that are emerging socially. Using the IoT device, the proposed model not only enables various disease management and diagnosis, but also improves the quality of the user 's medical service. The proposed model is characterized by easily assigning probabilistic value to the patient 's disease information attribute and processing the diagnosis of the medical staff based on the information collected from the IoT device. The proposed model has the following two purposes in order to efficiently process user 's disease information by using IoT device.

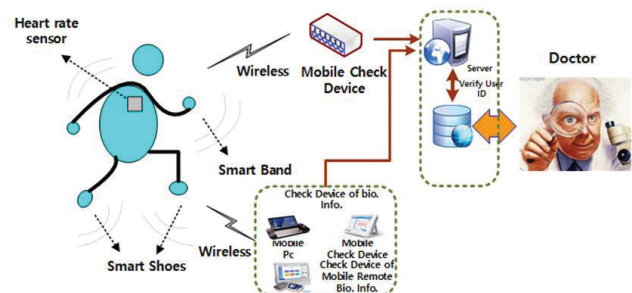
First, the proposed model provides probabilistic information to diseases collected through IoT device so that users visiting the hospital can easily process the hospital work, and by associating the user's disease information with each other, Improved accessibility. Second, the proposed model groups the information collected through the IoT device into a hierarchical structure according to the degree of similarity, thereby ensuring the accuracy of diagnosis of the user's disease information.

The proposed model examines the similarity of disease information in order to speed up the disease management and diagnosis of users using IoT devices among many outpatients visiting the hospital. Also, the proposed model classifies various attribute information such that the group size of the disease information is determined according to the priority of the hierarchically structured disease information, and the data included in the upper hierarchy includes the disease information of the lower hierarchy. The subdivided attribute information enhances the accuracy of the diagnosis of the disease.

The composition of this paper is as follows. Section 2 discusses IoT medical services and related research. In Section 3, we propose a medical service management model using IoT device. In Section 4, we evaluate the proposed model. Finally, Section 5 concludes the paper.

## RELATED WORKS

**IoT Medical Service:** IoT healthcare services are changing the way hospitals operate, patient care, and equipment maintenance through innovation of existing hospital medical services (Islam et al., 2015). In particular, IoT medical services are improving the quality of hospital medical services in monitoring patient care, monitoring healthcare assets, and tracking equipment usage. Patient monitoring monitors the physician's health status in real time and responds remotely using wearable sensors so that the patient can receive the most comfortable feeling in the home (Cui et al., 2016). Healthcare asset monitoring enables healthcare professionals to more effectively track and manage consumables and medications on the cloud platform, saving time spent searching and spending more time on patients. Critical equipment maintenance can be modified immediately before problems occur through predictive maintenance to immediately use the equipment most needed by the patient. Tracking of equipment use can improve the patient's medical welfare by tracking all equipment from hospital equipment to hospital management<sup>[7]</sup>; Catarinucci et al., 2015; <sup>[9]</sup>.






**Fig. 1: IoT Medical Service**

Figure 1 shows the IoT healthcare system, a large-scale IoT-based healthcare system<sup>[11]; [12]; [14]</sup>. As shown in Figure 1, IoT healthcare services generate medical data streams from real-time smart sensors, enabling healthcare professionals to run customized services. In Figure 1, some customized services can perform complex medical center functions such as emergency emergencies or epidemic surveillance.

Table 1 shows examples of Weka, GOJO and Liebherr using IoT medical services. As shown in Figure 2, Weka uses IoT healthcare technology to support reliable vaccine transport to address unsafe vaccine transport and storage at remote locations. GOJO uses the IOT to track hospital hygiene practices and report real-time compliance data using the Azure IoT Suite. Liebherr presented an intelligent pharmaceutical refrigerator for drug storage that can more effectively monitor, maintain and automate vaccine storage and distribution.

**Table 1: IoT Healthcare Use Cases**

Company	Weka(IBM, 2017)	GOJO(GOJO, 2015)	Liebherr (Libherr, 2017)
Usage Example			

**Healthcare Standard:** SO/IEEE 11073 PHD is a standard for providing personal health organizations and health managers. ISO/IEEE 11073-20601 and IEEE 11073-104xx. Standards such as ISO/IEEE 11073 PHD are characterized in that the OSI protocol stack is stacked and layered from layer 5 to layer 7<sup>[1]</sup>. The exchange protocol optimized for ISO/IEEE 11073-20601 is located in the upper communication protocol layer and consists of application layer services and data exchange. The application layer service defines commands such as PHD information and data format for reliable data transfer and connection management data exchange. The ISO/IEEE 11073-20601 standard consists of three models: a domain information model, a service model, and a communication model. The agent entity information of the domain information model (DIM) has an object set and one or more attributes. The service model provides a data access primitive that controls the behavior of the measurement data delivered to the manager and reports the status. The domain information model transmitted between the agent and the manager to exchange data includes GET, SET, ACTION, and event reports. The communication model supports the topology of one or more agents. A single manager over a point-to-point connection is defined by the dynamic system behavior link state system for each point-to-point connection<sup>[2]</sup>.

**Previous Study:** In recent hospital medical services, there are increasing number of hospitals that detect and treat patient medical services in real time based on the research on dispersion and parallel method of optimized medical services<sup>[11]; [12]; [13]; [14]; [15]; [16]; [17]</sup>. In addition, the hospital healthcare system is improving the healthcare industry’s architecture and platform based on IoT through the IoT paradigm<sup>[1]</sup>. (Catarinucci et al., 2015) proposes an emergency of the hospital system to effectively monitor and manage patients. <sup>[9]</sup> proposes a personalized IoT healthcare platform environment available at home. The system provides various physical parameter monitoring and web services to consumers.

<sup>[10]</sup> proposes monitoring of wearable sensor reviews for human activities. This method provides an important role of the wearable system for continuous monitoring of physiology.

Cui J et al. The model proposed a new health management platform named INS to improve hospital medical services<sup>[3]</sup>. Technique of <sup>[4]</sup> designed and developed an ambulance robot AED to improve the function of an ambulance that transports patients to the hospital in an emergency. Ullah K et al. The model proposed a new semantic model called ‘kHealthcare’ which improves the function of current healthcare<sup>[5]</sup>. Azimi I et al. Technique has proposed a new IoT-based patient monitoring approach to provide users with smart medical alerts<sup>[6]</sup>. The model of <sup>[7]</sup> proposed a sequential decision-making model for patients to provide smooth hospital care. However, this model has a disadvantage in that services processed through decision making can be duplicated.

**Design of medical service management model using IoT device:** As society becomes aging rapidly, research on medical services for the aging society has been rapidly increasing <sup>[18]</sup>. However, it is difficult to effectively manage the chronic disease patients suffering from various diseases only by medical services that are treated in hospitals. The research on health care that has been studied up to now provides various medical services to manage patients’ diseases as well as patients themselves, but it does not improve the quality of services that patients can satisfy <sup>[19]</sup>. In the proposed method, we propose a medical service model that can improve the patient ‘s disease management by using the IoT device that the user uses in real life.

**OVERVIEW**

Hospitals that offer IoT medical services are applying various IoT technologies (such as hospital vaccine refrigerators, autocheck in hospitals, patient

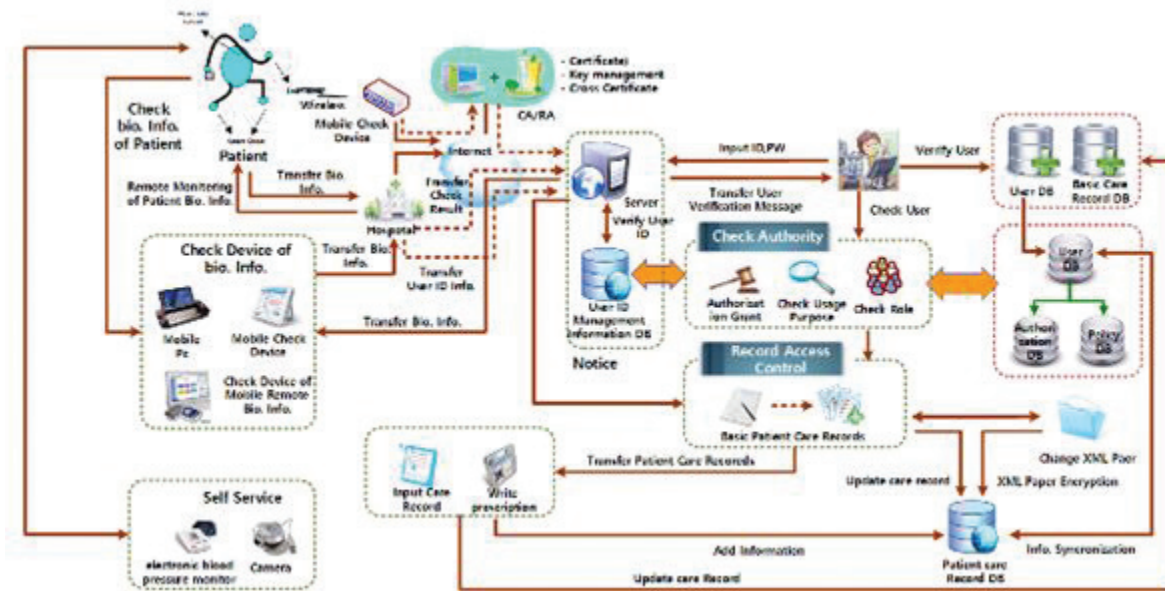
care, equipment maintenance, and hospital operations) to improve the quality of care for users . IoT medical services should provide functions such as consistency, convenience, safety, and sociality that should be fundamentally provided in hospitals as shown in Table 2.

**Table 2: IoT Medical Service Features Device Information**

Function	Contents
Constant castle	There exists a channel (Internet, Bluetooth, etc.) that can communicate with real time computer
Convenience	Provide sense of identity and integration that users can use naturally and conveniently
Stability	Minimize fatigue and skin troubles caused by wearing or attaching for a long time, ensuring safety against power and electromagnetic waves
Sociability	Protection of privacy exposure by recording/recording and hacking

However, in the current hospital, there is a problem that when the equipment providing IoT medical service is not synchronized smoothly between devices, errors may occur when a hospital or a doctor interlocks the equipment to check the medical information of the patient.

In the proposed model, when IoT medical service is provided to the user, it is possible to induce synchronization between the IoT devices without error by using the attribute information attached to the IoT device attached to the user body, thereby improving the efficiency of the user’s management of the medical service . In particular, in the proposed model, a hospital or a physician intercepts the user’s medical information in the middle in the process of interlocking the IoT device to check the user’s medical information, abuses the user’s medical care information or prevents the error of the IoT device The access control of IoT device is constituted by the binary value of the matrix and the geographical information and the state information to provide a management service capable of providing IoT medical service to users in a hierarchical manner.



**Fig. 2: Overview Process of Proposed Model.**

Figure 2 shows the overall management process of the medical service in which the user receives the IoT medical service in the proposed model. In Fig. 2, the user who wears the IoT-based wearable device transmits the disease information of the user to the medical server through the wireless environment and judges the degree of the medical service by the medical staff and shows the overall operation structure in which the user provides the medical service.

The proposed model maximizes the efficiency and accuracy of the health care information of the users who are provided with IoT medical service through the following two methods for the medical staff to manage efficiently. First, when a user’s healthcare information is transmitted through different network equipment through IoT equipment, the proposed model divides the attribute information of IoT device into individual hierarchical



structure by forming the hierarchical structure of user's disease information, The disease information of the user extracted through the eigenvalues of the evaluation result is consistently verified. Second, the proposed model probabilistically classifies the similarity of user 's disease information extracted from IoT device for quick processing and management analysis of user' s disease information received through IoT equipment.

**Designing User Disease Management Model for IoT Medical Services**

**Recognition and layering process of IoT medical service equipment:** This section creates a group to recognize and dynamically layer the IoT medical devices associated with the user when the user visits the hospital. The IoT medical service equipment used in the proposed model is characterized in that it can obtain the optimal IoT medical service by analyzing the property and similarity degree related to the user's disease information in order to efficiently manage and operate the medical service provided by the user . The hospital examines the devices necessary for the IoT service required by the user and groups the highly similar devices and collects linkage information with the IoT device having the highest probability value representing the sub group. At this time, the IoT devices constituting the lower group are configured in a hierarchical structure using the probability values according to the attribute information of the IoT device.

In the proposed model, first of all, IoT devices related to users are configured as datasets for IoT devices with high priority. In this case, it is assumed that the data set of the IoT device filters an IoT device whose probability value is below a predetermined level, that is, an IoT device with a threshold ( $P < 0.3$ ), in order to increase the accuracy and speed. At the end of the filtering process, you can optimize the device for IoT healthcare services by reducing the size of the sampling dataset to select the subgroups.

**Authentication process of IoT device before verification of user's disease information:** In the proposed model, IoT device authentication process is required to prevent malicious patient 's illness information from being used to provide patient with effective IoT medical service. In the proposed model, it is assumed that the user registers the user information on the hospital server through the secure channel in order

to receive the IoT medical service. At this time, the user wears a device (an electronic bracelet or a neckband in the form of a smart band) to identify his / her medical information.

In a hospital system that manages IoT medical equipment, if it is determined that a user's illness information is illegally used by a third party, the system access is blocked by changing the key used by the user. If the blocked user information is returned, the administrator receives the authentication information again using the new device authentication protocol process.

In order to authenticate the IoT device in the proposed model, the following three processes (initialization process, delegation process, signature verification process, etc.) are performed.

**Initialization process:** The initialization process is a process in which the user visits the hospital in advance and registers the private key ( $p, q$ ) and the public key ( $N (= pq), e$ ) in the hospital server. Here,  $p (= 2q' + 1)$  and  $q (= 2p' + 1)$  are arbitrarily generated large prime numbers based on RSA.

$$\text{Select } p (= 2q' + 1), q (= 2p' + 1) \dots(1)$$

Then, the function  $\Phi (N)$  is derived through the process of Eq. (2) to (3) to generate positive integers that are mutually prime with  $N$ .

$$M^{k\Phi(N)+1} = M^{k(p-1)(q-1)} + 1 \equiv M \pmod N \dots(2)$$

$$ed = k \Phi(N) + 1 \dots(3)$$

Where, The function  $\Phi(N)$  means a function having a positive integer less than  $N$  and being mutually prime to  $N$ . Further, if the integer  $N$  used in the function satisfies  $0 < M < N$ , the integer  $M$  and the arbitrary integer  $k$  are selected. And,  $e$  and  $d$  mean the multiplicative inverse of  $\text{mod } \Phi(N)$  according to the modular arithmetic rule.

The private key ( $p, q$ ) and the public key ( $N (= pq), e$ ) registered by the user  $U_i$  in the hospital server use a secure hash function such as  $H_U : \{0,1\} \rightarrow Z_N$  and the medical staff  $P_i$  checks the user visiting the hospital via  $H_p : \{0, 1\}^* \times Z_N \rightarrow Z_p$ .

**Delegation Process:** The delegation process is the process of delegating individual consent to the medical staff in order to receive the IoT medical services provided

by the hospital. The user creates a power of attorney containing information related to the proxy signature, such as the authority to sign or expiration date, as shown in Eq. (4).

$$\text{Generate } m_i (1 \leq i \leq n, n \in \mathbb{Z}^*) \quad \dots(4)$$

The power of attorney generated in Eq. (4) is transmitted to the server, and T and  $(d_1, d_2)$  necessary for the signature of the user are generated and transmitted to the user again. At this time, the server generates Eq. (5) using the random number  $t \in \mathbb{Z}_N$  randomly selected by the server to generate the T value.

$$T = t^2 \text{ mod } N \quad \dots(5)$$

In addition, the server generates the result as shown in Eq. (6) by using the proxy and the result of Eq. (5) to generate  $(d_1, d_2)$ .

$$d_1 = \begin{cases} 0, & \frac{H(m_i, T) \% 2}{N} \\ 1, & \frac{H(m_i, T) \% 2}{N} \end{cases} \quad d_2 = \begin{cases} 0, & \frac{d_1, H(m_i, T) \% 2}{N} \\ 1, & \frac{d_1, H(m_i, T) \% 2}{N} \end{cases} \quad \dots(6)$$

The server sends the T and  $(d_1, d_2)$  required for the signature to the user, and the user carries out the signature process as shown in Eq. (7) and sends Eq. (8) to the medical staff.

$$\text{Sig} = (-1)^{d_2} \cdot e^{d_1} \cdot H(m_p, T) \text{ mod } N \quad \dots(7)$$

$$\text{Transfer } m_p, \text{ Sig}, T, d_1, d_2 \quad \dots(8)$$

**Signature verification process:** The signature verification process is a verification process in which, when a user visits a hospital, the surrogate signature information of the user is transmitted to the IoT medical service representative and the IoT medical service is provided using the signature of the user. The IoT healthcare service personnel confirms the information of the user visiting the hospital, and then transmits the user information to the server to confirm the user by comparing with the basic information of the user registered in advance. At this time, the IoT medical service representative confirms the proxy signature information (T and  $(d_1, d_2)$ ) of the user stored in the server and generates random number  $r_1$  and  $r_2$  as in Eq. (9) to (11).

$$r_1 = \text{sign} \cdot t \text{ mod } N \quad \dots(9)$$

$$r_2 = (-1)^{d_2} \cdot e^{d_1} \cdot H(m_p, T) \text{ mod } N \quad \dots(10)$$

$$\text{Transfer } m_p, T, d_1, d_2, r_1, r_2 \quad \dots(11)$$

The medical staff receives the user's information from the IoT medical service representative and verifies the proxy signature of the user through the process of Eq. (12) to (14) before confirming the presence / absence and condition of the user. If the verification does not match, the physician will re-request the IoT healthcare service representative for the user's proxy signature information.

$$R_1 = r_1 \text{ mod } N \text{ and } R_2 = r_2 \text{ mod } N \quad \dots(12)$$

$$\text{Sig} = (-1)^{d_2} \cdot e^{d_1} \cdot H(m_p, T) \text{ mod } N \quad \dots(13)$$

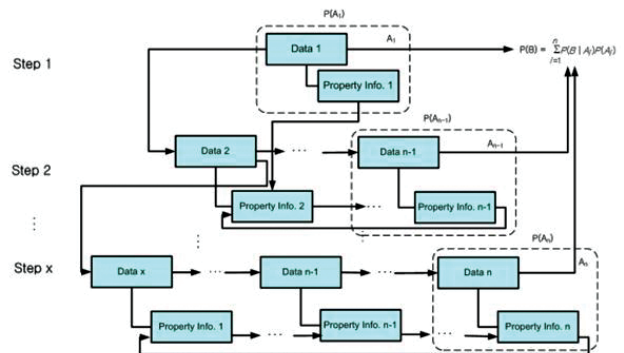
$$T' = R_1 \cdot \text{Sig} \text{ mod } N \text{ and } T'' = R_2 \cdot \text{Sig} \text{ mod } N \quad \dots(14)$$

**Diagnosis of user's disease by linking user's disease information:** The disease information of the users who received the IoT medical service classifies the correlation between the disease information as the Eq. (15) so that the medical staff can identify the disease.

$$MI = \begin{matrix} 0 & \dots & \alpha_{1,k} \\ \vdots & \ddots & \vdots \\ \alpha_{k_1} & \dots & 0 \end{matrix} \quad \dots(15)$$

Where,  $\alpha_{ij}$  denotes a correlation between attribute information of user disease information.  $\alpha_{ij}$  and  $\alpha_{ji}$  must satisfy the condition that i is 0 or more and j is less than 1 ( $0 \leq i, j \leq 1$ ). If  $\alpha_{ij}$  is 0, it means that there is no correlation between user disease information.

In the proposed model, the medical staff checks the similarity of the user medical information extracted from the IoT medical service device as shown in figure 3, and sequentially blocks the malicious approach shown in figure 4 that may occur from the third party.



**Fig. 3: Similarity Extraction Method of Proposed Model.**

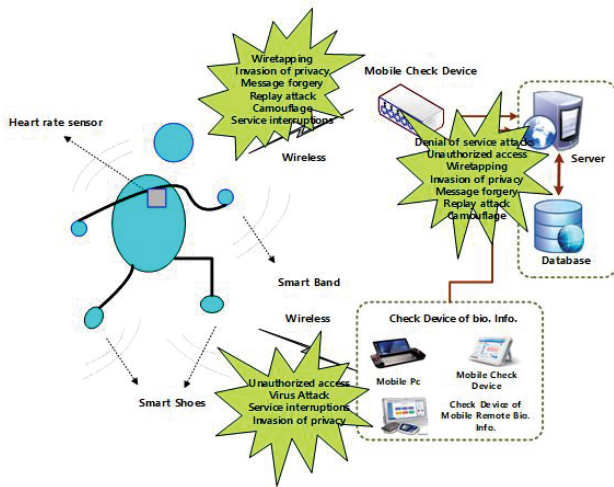


Fig. 4: Example of a malicious attack by a third party.

When the similarity test of the user’s disease information is completed, the proposed model classifies the disease information of the user into group management by assigning a probability value according to the type, function, and characteristics of the user’s disease information. Also, the priority of grouped disease information can be used to link disease information to each other, thus improving the efficiency of disease information management. The proposed model computes the similarity probability with ease in order to facilitate the segmentation of disease information and extracts disease information according to the similarity of disease information and hierarchically manages it.

**Performance Evaluation:** The performance evaluation of the proposed model is performed by evaluating the accuracy, efficiency, processing time, and overhead of the proposed model by dividing the performance of the proposed model into the case of supporting IoT medical service and the case of not supporting IoT medical service.

**Experiment preferences:** Table 3 shows the experimental environment for performance evaluation of the proposed model. The simulated network of the proposed model is designed to be composed of medical sensor, IoT device, gateway and medical service center which can support IoT medical service so that the proposed model operates.

Table 3: Parameter Setup

Parameter	Setting
Number of Medical Sensor Devices	$nu = \{1, 2, 5, 10\}$

Conted...

Number of medical Data	$nd = \{50, 100, 250, 500, 1000\}$
Number of Property	$p = \{1, 2, 3, 4, 5\}$
Threshold	$th = \{1, 3, 5\}$
Transmission of Medical Sensor Device	3m
Medical Data generation interval	0.01
Initial self data set time	300 s
Compressed data size(Bytes) through number of IoT devices	$nn = \{20, 30, 50, 60, 180\}$
Average Compress time(ms)	40
Average Decompression time(ms)	35

### PERFORMANCE ANALYSIS

**Accuracy:** Figure 5 compares the accuracy of the information processed by the IoT device of the hospital providing the IoT medical service by comparing the accuracy with the case of using the IoT medical service and the case of not using the IoT medical service. As shown in figure 5, the accuracy of medical information processing for users receiving medical services using IoT devices is more than 23.6% higher than that of users who do not use IoT devices. These results are the result of collecting information about the health status of the user and analyzing the health status at the same time in real time. Also, it is a result of the patient’s illness information collected through IoT medical equipment because the medical staff grasped the user’s disease according to various property information.

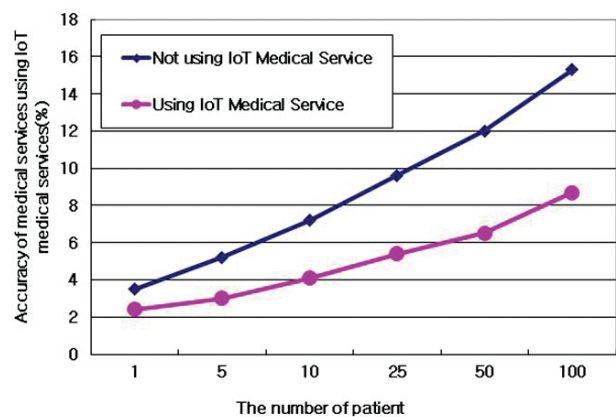
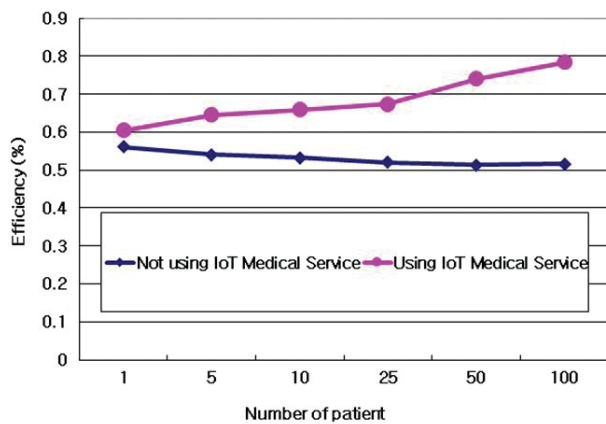


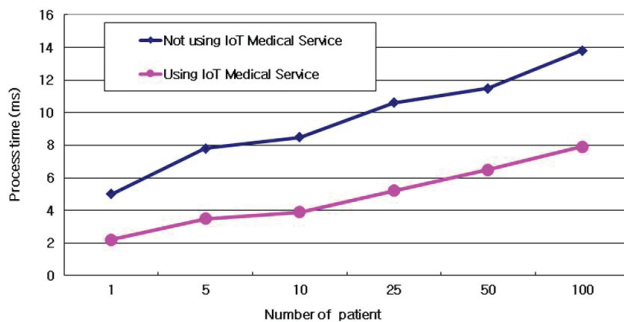
Fig. 5: Accuracy of medical services using IoT medical service vs. not using IoT medical service.

**Efficiency:** Figure 6 shows the result of evaluating the efficiency of the user’s medical service using the IoT device. As shown in Figure 6, users receiving IoT medical services using IoT devices have a maximum 31.8% improvement in efficiency of in-hospital medical services compared to users who do not use IoT devices. This result is a result of the fact that the time required for hospital work is shortened until the user visits the hospital to check for the disease and the medical staff pays the medical fee after the prescription. However, this result is based on the assumption that there is no error in the IoT medical equipment being used in the hospital, so if the IoT medical equipment error continues to occur, the efficiency of the operation may be lower than when the IoT device is not used.



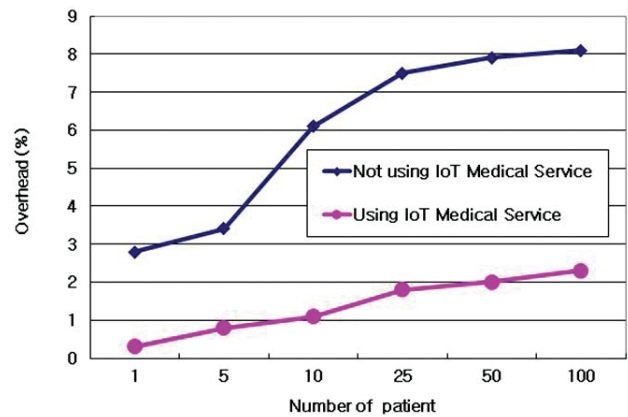
**Fig. 6: Efficiency of medical services using IoT medical service vs. not using IoT medical service**

**Processing time:** Figure 7 compares the time to visit the hospital to check for illness and the time it takes the user to be informed about the results of the test, compared to when IoT healthcare service was used or not. Experimental results show that the use of IoT healthcare service is 25.9% less than that of IoT healthcare service. These results are due not only to the differences in the medical equipment used by the patients receiving the hospital treatment, but also because the user’s disease information appears in a short time.



**Fig. 7: Process time of medical services using IoT medical service vs. not using IoT medical service.**

**Overhead:** Figure 8 compares the work overheads of healthcare providers with the number of users receiving IoT healthcare services. As shown in Figure 8, the more people who do not use IoT healthcare services, the higher the workload overhead is on average 27.5% than the IoT healthcare service. This result is due to the fact that there is a hospital work that the medical staff has to deal with in addition to the disease analysis of users who use IoT medical service. Especially, in the proposed model, the overhead of the medical staff is lower than when the IoT medical service is not used because the user does not check and analyze the disease.



**Fig. 8: Overhead of medical services using IoT medical service vs. not using IoT medical service.**

**CONCLUSION**

Recently, IoT medical services has been one of the fastest growing areas. In this paper, we propose a medical service management model based on IoT device for socially emerging elderly medical services. The proposed model is able to manage and diagnose diseases of patients who visited the hospital using IoT device. In the proposed model, the probabilistic value is given to the patient ‘s disease information attribute, and the purpose is to easily process the diagnosis of the medical staff based on the information collected from the IoT device. In particular, the proposed model improves accessibility to patient disease information by providing health information to the diseases collected through IoT devices and linking them with each other. In addition, the proposed model assures the accuracy of diagnosis of disease information because the information collected through the IoT device is grouped into a hierarchical structure according to the degree of similarity. As a result of the performance evaluation, the accuracy of medical information processing of users receiving

medical service using IoT device was found to be 23.6% higher than average, and the proposed model providing IoT medical service to users using IoT device was found to be an IoT device. The efficiency of the in - hospital medical service was improved by up to 31.8% than the unused users. Also, the processing time when using IoT medical service was 25.9% less than the service when IoT medical service was not used. The higher the number of users who did not use IoT health services, the higher the average work overhead was on average 27.5% than with IoT health care services. In future work, we plan to perform system performance evaluation based on the results of this study.

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**Source of Funding:** Tongmyong University

**Conflict of Interest:** NA

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# Effects of Visual and Spatial Working Memory Improvement Training Program on Elderly Driving Behavior

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## ABSTRACT

The aim of this study is to investigate the changes of multifaceted driving behavior features of the elderly through visual and spatial memory ability improvement training. A training program to improve visual and spatial memory ability of the elderly was conducted five times. Three groups – trained elderly group, non-trained elderly group, and adult group (i.e. comparison group) – were selected to compare the effect of the training. To measure multifaceted driving behaviors, three indicators were used: driving performance indicator, eye movement indicator, and physiological response indicator. Using the driving simulator, the parameters of the driving performance indicator were collected: approach velocity, transit time, the speed variation at the intersection, and the handling variation. The parameters of the eye movement indicator were collected using the eye maker: the ratio of visual scanning time: forward, left, and right visual fields. The parameters of physiological response indicator - the heart rate of electrocardiogram and the skin conductance level of skin electrical activity at the intersection- were collected and examined. As for the driving performance indicator, the result showed that the general adult drivers, the comparison group, pass through the intersection more rapidly than the elderly, who enter the intersections quickly and smoothly, and the changes by the training programs were not significant. As for the eye movement indicator, the elderly drivers participating in the training program showed a similar pattern to that of the general adult drivers, who were in the comparison group, in terms of the ratio of visual scanning time: forward, left, and right visual fields. As for the physiological response indicator, the overall arousal level of the elderly participating in the training program was significantly lower than that before the training program, and relatively lower than the elderly who did not participate in the training program. The implication of this study is to clarify the positive changes of the multifaceted driving behaviors by providing training for the elderly to improve their visual and spatial working memory ability.

**Keywords:** *elderly drivers, visual and spatial working memory ability, driving behavior, eye movement, physiological response.*

## INTRODUCTION

Driving is a vision-centric task. In particular, driving at the intersection, where several roads meet, is considered difficult in terms of task difficulty. However, difficulty is a subjective concept and a more objective concept is needed to measure the task difficulty. Instead of difficulty, complexity can be considered as an appropriate concept<sup>1</sup>. Complexity consists of a combination of two criteria: how much external information is required to be given to the driver when driving, and how often the steering wheel is manipulated. For example, driving in a suburban area or a highway corresponds to low information / low operation (LL) complexity because the driver requires low information processing demands and

requires less operation on the steering wheel. On the other hand, driving in urban areas requires a lot of rotations and corresponds to high information/high operation (HH) complexity because the driver needs high information processing demands and more operation on the steering wheel<sup>2</sup>. However, it is practically impossible for the driver to select only one of the driving environments, the high complexity or low complexity environment. It implies that the most important requirements for safe driving are the characteristics of the driver rather than the driving environment.

The question then is how to distinguish drivers with safe driving and those without. Generally, the elderly are more likely to be classified as drivers who are not

capable of safe driving because their aging causes poor cognitive and physical abilities. In view of this, the policy on reissuing driver's license through vision screening test has been implemented based on the visual-centered nature of driving. However, contrary to that view, there are several studies insisting that there is no relevance to the visual capabilities of the elderly, or that the view can only be accommodated in very limited areas<sup>3,4,5</sup>. In other words, simply classifying the elderly as drivers who are not capable of safe driving and preventing them from driving cannot be regarded as highly effective in achieving the goal of safe driving. Instead of visual capability, a study<sup>6</sup> suggested 'working memory' as a more appropriate criterion to classify the driving ability of elderly females and investigate the differences in their driving performance according to their working memory characteristics. As an index of driving performance, the capability to perform a safe left turn at an intersection in a high complexity driving environment was measured. On the other hand, a two-digit addition task was used to measure the working memory characteristics of elderly female drivers. The study<sup>6</sup> results for the elderly female drivers who performed better in the two-digit addition task corresponding to working memory showed safer driving performance than those who did not. That is, the subjects with high performance on the two-digit addition task corresponding to memory task attempted to turn left when the other vehicle and their own vehicle were kept at a longer distance. This result supports the interpretation that it is appropriate to utilize the level of working memory ability as a criterion for distinguishing the driving possibility. It also shows that the excellence of working memory is closely related to safe driving.

However, since working memory is a series of information processing systems that temporarily store information given from the outside, manipulate the information appropriately, and again manipulate the manipulated information, there is a high possibility of inducing change in the positive direction through training rather than relying on unchangeable factors. Still, the question on how to train the elderly drivers to improve their working memory ability for safe driving remains. As a response to this question, a study<sup>7</sup> can be applied in which the trained group, who participated in a visual information processing ability training that includes perceiving a visual object quickly and reacting accordingly, showed less risky driving behavior. Here, in terms of definition, visual information processing ability

training can be regarded as a procedure to improve working memory. It indicates that it is possible to induce safe driving through working memory ability training. In particular, it increases the possibility for the elderly drivers with poor working memory to be classified as drivers who can drive safely through working memory ability training. Based on this literature review and study findings, this study attempts to clarify the possibility of change of driving behaviors by providing the elderly drivers with visual and spatial task memory ability training on the subordinate items of working memory. On the other hand, multifaceted driving features are measured. In order to measure driving behaviors in a multidimensional manner, this study intends to examine the driving performance<sup>8</sup>, eye movement indicators<sup>8</sup> and physiological indicators<sup>9</sup> integrally.

## METHODOLOGY

**Participants:** 26 Elderly males aged 65 years and older with a driving experience of more than one year participated in the experiment. Their average rate of accidents in the past three years was 0.92 and their average age was 71.19 ( $\pm$  3.59) years. They were randomly assigned to two groups: training group or non-training group. Each group had 13 subjects respectively. However, two participants who did not agree with the training program were reassigned to the non-training group while one participant who was assigned to the training group quit. Therefore, 11 elderly were included in the training group and 14 elderly in the non-training group. The average age of the training group was 70.45 ( $\pm$  3.42) years, and the average age of the non-training group was 71.64 ( $\pm$  3.86) years. There was no statistically significant difference between the ages of the two groups [ $t(23) = -.80$ , n.s.]. As a comparison group for the elderly drivers, 22 adult males with more than one year of driving experience participated in the experiment. Their average rate of accidents in the past three years was 0.82, which is similar to that of the elderly drivers, and their average age was 27.73 ( $\pm$  2.69) years.

## APPARATUS

**Driving simulator:** The driving simulator, GDS-300S manufactured by Gridspace Co. (Korea), was configured to provide the forward, left, and right environmental information necessary for driving through three 32-inch LCD monitors [Figure 1]. In addition, the driving devices



(e.g. steering wheel, accelerator pedal, brake pedal) and display devices (e.g. turn signals, speedometer, RPM meter) of the vehicle were made identical to actual vehicles of the compact car click model of Hyundai Motor (Korea).



Figure 1. Driving simulator

**Eye marker:** EMR-8B, which is worn like a cap made by NAC Image Technology Inc. (Japan), was used for the measurement of eye movements. This is equipped with a forward-view lens at the center top of the cap and an eye mark detection unit at the left and right. The forward visual field lens receive the image presented in front of the experiment participant and transmits the image to the video recording device, and the eye mark detection unit detects the pupil movement in both eyes.

**Measuring device for physiological signal:** To measure the autonomic nervous system, Biopacamp manufactured

by Biopac System Inc. (USA) was the equipment used. AcqKnowledge (ver. 3.9.1) of MP100WS was used for data input and analysis. An electrocardiogram (ECG) was measured by using the CM5 induction method in which the reference electrode was attached to the right thorax symmetrically with the + electrode; the + electrode was attached to the left chest, and the electrode was attached to the top of the sternum<sup>10</sup>. Electrodermal activity (EDA) was measured by attaching an electrode under the driver's left foot pelvis to minimize movement during the driving<sup>11</sup>

**The training task to improve visual and spatial working memory ability:** The training task to improve visual and spatial working memory ability was presented in a 5 × 5 screen consisting of 25 cells in total [Figure 2]. In the course of short learning of visual information, a square is presented inside the cell and a rectangle with a randomly selected color is shown; the seven colors included are red, blue, yellow, green, purple, white, and black. In order to control the degree of the task difficulty, the squares presented in the cell were sequentially presented from 1 to 4. On the other hand, before starting the task, some clues such as color or location were provided to induce the characteristics of the given visual information to be changed. If the clue provided is a color, the color of the rectangle presented in the cell is remembered and responded. In the case of the given clue, the color of the rectangle in the cell is ignored. At the end of each trial, feedback information on the correct answer was provided.

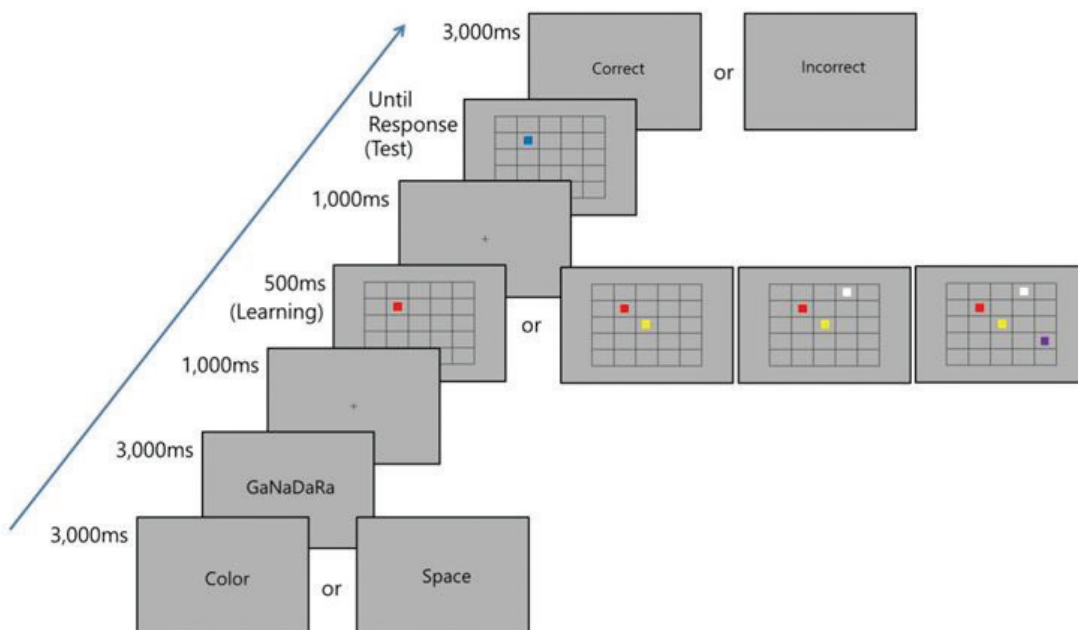


Figure 2: The training task improve to visual- and spatial working memory ability

## PROCEDURES

**Pre- and post-driving behavior measurement experiment:** Before conducting this experiment, the participants were put on the oculomotor measuring device, attached all the electrodes for autonomic nervous system measurement, and then practiced for 5 minutes to adapt to the driving simulator. In this experiment, the participants ran for about 10 minutes on a downtown two-lane road course, each of which included five left and right turn conditions. In the turning condition, the vehicle was driven according to the direction indicated on the screen before entering the intersection.

**Training program to improve visual and spatial working memory:** Among the participants, the trained elderly carried out the training program 5 times a day to improve the visual and spatial working memory ability. About 10 exercises were carried out before the program was implemented, and the sequence of training for improving visual and spatial working memory was counterbalanced according to the participant. After the color or position clues were presented in the training program, the participants were instructed to speak 'GaNaDaRa' repeatedly during the training program every time the phrase 'GaNaDaRa' was shown. This procedure is to prevent the visual information, color and location, from being stored in a verbal rather than a visual manner. After that, among the 25 cells, 4 squares of different colors were presented on the screen wirelessly for 500 milliseconds(ms). At this time, the experiment participants memorized the color according to the clue received at the start of the program or memorized the location where the square was shown. Then, a cross-shaped anchor point was presented at the center of the screen for 1,000 ms, and then a square with one color was presented at a specific location in one of the 25 cells. At this time, according to the clue provided at the start of the program, the experiment participants judge whether the color is the same as the one previously memorized or whether the location is the same as the one previously stored in the square location. If there is a match, participants press the '1' key on the numeric keypad, or the '2' key if there is no match. The training program consisted of 100 steps with each step having four levels of difficulty, and the next step included 50 steps with the same level of difficulty as the previous ones. The time required for the training program was about 30 minutes, and in the last 5 sessions, the task difficulty of level 4 was performed once again.

## RESULTS

**Driving performances:** In order to investigate the differences in driving performance between the trained elderly group, the non-trained elderly group, and the comparison group (adult group),  $2 \times 3$  Mixed ANOVA was conducted with training time (before and after) and turn direction (left and right) as independent variables and the driving performance indicator<sup>8</sup> (transit time, approach velocity, speed and steering variation) as dependent variables.

First, turn types were distinguished and the difference in intersection passing time according to group and time was investigated. As a result, only the main effects of the group were statistically significant regardless of the turn types (left turn:  $F_{(2,44)}=31.54$ ,  $MSe=3.89$ ,  $p<.001$ ; right turn:  $F_{(2,44)}=23.25$ ,  $MSe=7.52$ ,  $p<.001$ ). Comparatively, the comparison group (left turn:  $M=3.62$ ; right turn:  $M=1.92$ ) was found to cross the intersection faster than the trained elderly group (left turn:  $M=6.61$ ; right turn:  $M=5.69$ ) and the non-trained elderly group (Left turn:  $M=7.03$ ; right turn:  $M=5.85$ ).

Second, this study examined the difference in approach velocity to the intersection according to group and time. The result showed that the main effect of the group [ $F_{(2,44)}=10.34$ ,  $MSe=68.49$ ,  $p<.001$ ] and time point [ $F_{(1,44)}=5.17$ ,  $MSe=44.80$ ,  $p<.05$ ] was statistically significant only at the time of the left turn. In comparison, the approach velocity of the non-trained elderly group ( $M=21.84$ ) was slower than one of the comparison group ( $M=30.91$ ), but the ex ante ( $M=21.83$ ) was faster than the ex post ( $M=28.10$ ).

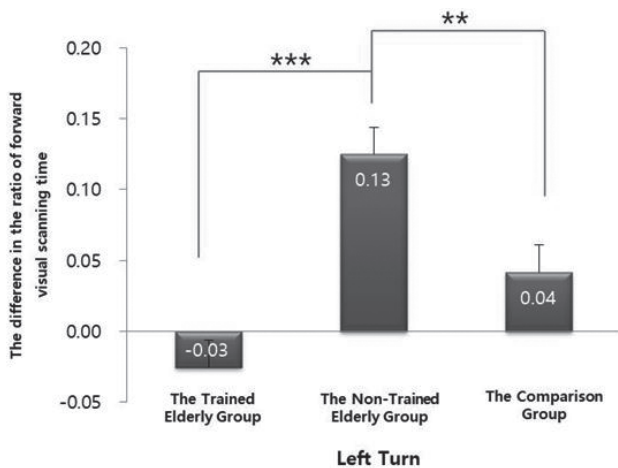
Third, the difference in speed variation at intersection passing was examined according to group and time. As for the result, all the effects of the group and time were not statistically significant regardless of the turn types.

Finally, this study examined the difference in the amount of handling variation when passing through intersections according to group and time. As a result, only the main effects of the group were statistically significant regardless of the turn types (left turn:  $F_{(2,44)}=8.66$ ,  $MSe=6.89$ ,  $p<.01$ ; right turn:  $F_{(2,44)}=42.05$ ,  $MSe=5.95$ ,  $p<.001$ ). Comparing the results of the ex ante and ex post, the handling variation of the comparison group (left turn:  $M=10.22$ ; right turn:  $M=11.32$ ) was smaller than the trained elderly group (left turn:  $M=11.85$ ; right turn:  $M=15.50$ ) and the non-trained elderly group (left turn:  $M=12.78$ ; right turn:  $M=16.23$ ).

**Eye movements:** In order to investigate the differences in eye movements between the groups,  $2 \times 3$  Mixed

ANOVA was conducted with group and time classified by turn types as independent variables and eyeball movement indicators<sup>8</sup>(the ratio of visual scanning time: forward, left, right) as dependent variables.

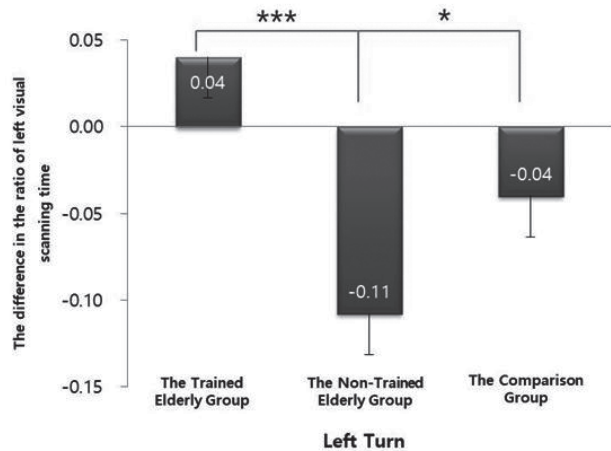
First, this study examined the difference in the ratio of forward visual scanning time according to group and time. The result showed that, at the left turn, the main effect [ $F_{(1,44)}=18.15, MSe=.003, p<.001$ ] and the interaction effects of groups and timing [ $F_{(2,44)}=13.48, MSe=.003, p<.001$ ] were statistically significant. While there was little change between the pre- and post-training time for the comparison group ( $d=0.04$ ) and the elderly group ( $d=-0.03$ ), the ratio of forward visual scanning time of the non-trained elderly group ( $d=0.13$ ) increased [Figure 3]. On the other hand, at the right turn, only the main effect of group and time was statistically significant [Group:  $F_{(2,44)}=6.02, MSe=.03, p<.01$ ; Point:  $F_{(1,44)}=12.22, MSe=.01, p<.01$ ]. That is, the comparison group ( $M=0.77$ ) gave longer attention to the forward than the non-trained elderly group ( $M=0.62$ ), and the ratio of forward visual scanning time was higher for all drivers at the post-training time ( $M=0.77$ ) than at the pre-training time ( $M=0.67$ ).



**Figure 3: The difference in the ratio of forward visual scanning time according to the group at the left turn**

Next, this study examined the difference in the ratio of the left visual scanning time according to the group and the time through division by turn types. The result showed that, at the left turn, the main effect of time [ $F_{(1,44)}=6.81, MSe=.004, p<.05$ ] and interaction effect between group and time was statistically significant [ $F_{(2,44)}=8.19, MSe=.004, p<.01$ ]. Similar to the ratio of forward visual scanning time, the comparison group ( $d=-0.04$ ) and the trained elderly group ( $d=-0.04$ ) showed little change between the pre- and post-training

time, whereas the ratio of left visual scanning time of the non-trained elderly group ( $d=-0.04$ ) decreased significantly [Figure 4]. On the other hand, at the right turn, only the main effect of the group was statistically significant [ $F_{(2,44)}=9.53, MSe=.003, p<.001$ ]. That is, the comparison group ( $M=0.09$ ) result showed that the left side was observed longer than the trained elderly group and non-trained elderly group ( $M=0.04; M=0.04$ ).



**Figure 4: The difference in the ratio of left visual scanning time according to the group at the left turn**

Finally, this study examined the difference in the ratio of right visual scanning time according to group and time through division by turn types. As a result, the main effect of the group was statistically significant at the left turn [ $F_{(2,44)}=4.88, MSe=.003, p<.05$ ]. That is, the comparison group ( $M=0.06$ ) showed a higher ratio of right visual scanning time than the trained elderly group and non-trained elderly group ( $M=0.03, M=0.03$ ). On the other hand, at the right turn, the main effect of group and time was statistically significant [Group:  $F_{(2,44)}=20.71, MSe=.02, p<.001$ ; Point:  $F_{(1,44)}=4.87, MSe=.01, p<.05$ ]. That is, the comparison group ( $M=0.08$ ) showed a lower ratio of right visual scanning time than the trained elderly group and non-trained elderly group ( $M=0.25; M=0.29$ ).

The ratio of right-side watch time was lower for all drivers at posterior point ( $M=0.19$ ) than at the preceding point ( $M=0.23$ ).

**Physiological responses:** In order to examine the autonomic nervous system changes between the groups as well as the driving performance and the eye movement, group, time and state condition (safety state: just before the turn state, the turn state) were classified as the independent variables. The  $2 \times 3 \times 2$  Mixed ANOVA was conducted with heart rate (HR), skin conductance level (SCL) as dependent variables.

First, this study investigated the differences in heart rate according to group, time, and state condition. It was found that the main effect of state condition was statistically significant at the left turn [ $F_{(1,44)}=56.56, MSe=5.48, p<.001$ ]. In other words, the heart rate of all drivers increased in the turn state compared with the safety state. On the other hand, at the right turn, the main effects of time and state condition were statistically significant [point:  $F_{(1,44)}=4.59, MSe=36.17, p<.05$ ; Condition:  $F_{(1,44)}=69.50, MSe=5.47, p<.001$ ], and the interaction effect between time and the state condition was statistically significant [ $F_{(1,44)}=5.83, MSe=.94, p<.05$ ]. In addition, the three-way interaction effect of group, time, and state condition was statistically significant [ $F_{(2,44)}=3.39, MSe=.94, p<.05$ ]. Therefore, the difference between group and time was examined using the difference of the heart rate from the turn state minus the safety state. As a result, the main effect of time was statistically significant [ $F_{(1,44)}=5.83, MSe=1.88, p<.05$ ] and the interaction effect between group and time was statistically significant [ $F_{(2,44)}=3.39, MSe=1.88, p<.05$ ]. In other words, there was no difference in the change of the heart rate between the pre- and post-training time, but the change of the heart rate was increased in the post-training.

Next, this study examined the difference in the skin conduction level according to group, time, and state condition by dividing by turn state. It was found that the main effects of group, time, and state condition were statistically significant at the left turn [Group:  $F_{(2,44)}=14.16, MSe=10.43, p<.001$ ; Point:  $F_{(1,44)}=17.51, MSe=8.28, p<.001$ ; Condition:  $F_{(1,44)}=11.82, MSe=.06, p<.01$ ], the interaction effect between group and time, and time and condition was statistically significant [ $F_{(2,44)}=5.15, MSe=8.28, p<.05$ ;  $F_{(1,44)}=6.86, MSe=.01, p<.05$ ]. In other words, the skin conductance level decreased at the post-training time compared to the prior, and the trained elderly group showed that the skin conductance level decreased to the level close to the comparison group at the post-training. On the other hand, the main effects of group, time, and condition were all statistically significant at the right turn [Group:  $F_{(2,44)}=13.17, MSe=10.85, p<.001$ ; Point:  $F_{(1,44)}=19.46, MSe=7.49, p<.001$ ; Condition:  $F_{(1,44)}=8.27, MSe=.09, p<.01$ ], the interaction effect between the group and time was statistically significant [ $F_{(2,44)}=5.72, MSe=7.49, p<.01$ ]. As in the case of the left turn, the skin conductance level decreased at the post-training compared to the pre-training, and the level of skin conductance was decreased at the post-training.

## DISCUSSION

The aim of this study is to investigate the changes in driving behaviors of elderly drivers by implementing short-term visual and spatial memory training programs. First of all, it was found that the general adult drivers, who are the driving force among the driving behavior indicators, pass the intersection quickly, enter the intersection at a high speed, and handle the driving smoothly compared with the trained elderly group and non-trained elderly group. These results show the fact that the implementation of the training program does not contribute greatly to the improvement of the driving performance of the elderly driver. On the other hand, there is a possibility that the elderly drivers could not apply the appropriate physical movements based on these treatments even though the actual driving situation was effectively treated through training for the reason that driving performance is a kind of behavior indicator. The possibility can be found in a study<sup>12</sup> in which it was concluded that drivers of varying ages, from young adults to the elderly, have improved their situational awareness ability to reflect on the judgment of the driving situation by increasing the amount of information in their workplaces. It means that the improvement of working memory ability through training has led to efficient processing of driving situation. This suggests that it is necessary to make a distinction between the process of judging the driving situation and the reaction according to the driving performance measurement.

Next, with regard to the driving behavior indicator, the ratio of left and right visual scanning time of the trained elderly group showed similar results to the comparison group at the left turn, whereas the non-trained elderly group showed difference from the comparison group at the left turn. These results can be interpreted as the result of transferring the exercise program to the eye movement that indirectly reflects the process of judging the driving situation. In other words, it suggests that effective information processing can be performed on the driving situation according to the improvement of the visual and spatial working memory capacity. This supports the findings of the study<sup>12</sup> and is consistent with the other study<sup>12</sup> that computer-based training courses can improve the memory and monitoring performance of driving-related information.

Finally, in the case of the autonomic nervous system response among the driving behavior indicators, the overall arousal level of the trained elderly group after the training program was higher than that of the comparison group, but it was relatively lower than that of the trained

elderly group. These results suggest that the overall level of arousal can be reduced by the implementation of the training program<sup>14</sup>.

## CONCLUSION

The aim of this study was to investigate the effects of driving training on visual and spatial memory ability of elderly drivers. The results of this study can be summarized as follows. First, driver's age was more of a factor affecting driving performance than the training. Never the less, the cognitive processing ability was improved through the driving training rather than the simple training of improving the visual and spatial working memory ability by the diffusion to the driving performance. However, the change in the driving performance close to the automatic processing was not reached.

Second, this study found that eye movement patterns of adult drivers who can drive more efficiently than the elderly drivers are similar. When turning at the intersection, a visual scanning that gives more attention to the direction of turn can contribute more to inducing safe driving.

Third, as for the physiological changes, it was confirmed that excessive level of awakening level was decreased by training. This is a result of suggesting the possibility that the elderly can drive more safely by alleviating the phenomenon of attention narrowing due to excessive awakening.

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# Usefulness of Twinkling Artifact for Urinary Stone Measurement

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## ABSTRACT

The purpose of this study was to investigate the usefulness of twinkling artifact (TA) ultrasonography in the evaluation of urinary stone measurement. We measured the different size of granite soil stones by various ultrasonic measuring methods. Then, the results were compared with the actual stone size for accuracy of the various measurement methods. TA is different from stone measurements depending on stone size ( $p < 0.001$ ). When the stone size was less than 6 mm, the measured diameter of the posterior shadow was most similar to the actual stone size. In the method of measuring the TA diameter in the color Doppler mode, an overestimation of about 1.5 mm was observed when the stone size was smaller than 6 mm, and an overestimation of 0.4 mm was observed at the size larger than 9 mm. TA showed the most accuracy on stones  $> 9$  mm than other ultrasonic measurement methods. TA may be used as a complementary method when the urinary stones size measurement is ambiguous in the B mode.

**Keywords:** *Ultrasonography, Urinary stone, Twinkling artifact, Color Doppler, B-mode*

## INTRODUCTION

Ultrasound has more different kinds of artifacts than other imaging methods. Ultrasound artifacts are caused by ultrasonic and inter-tissue characteristics, inspection techniques, inexperienced adjustment of equipment. Artifacts may interfere with accurate diagnosis and may aid in diagnosis, so it is important to understand the types and causes of artifacts to improve the accuracy of diagnosis. Twinkling artifacts are mainly manifested by strong reflectors such as kidney or gallbladder stones, or calcification<sup>1</sup>. TA is a phenomenon in which red and blue colors appear randomly in the color Doppler image behind certain highly reflective stationary objects, even though there is no vortex or similar motion within the tissue<sup>2</sup>. TA is excluded by the filter due to the narrow width of the Doppler shift scattered on the surface in the case of a smooth surface reflector. However, in the case of a rough reflector surface, the error of the measured signal becomes large, and the filter is out of the level, causing TA<sup>3</sup>.

Diagnostic methods of urinary stone include X-ray, computed tomography, and ultrasound. Ultrasonography is very useful in the medical diagnosis program due to its various advantages and ultrasonography is widely used in recent years to detect urinary stones. Urinary stones are made in the kidney and move along the ureter. When

they are small in size, they are naturally discharged from the body through the urine, but when the size is large, it can cause problems in various organs such as kidneys, ureters, bladder, and urethra. Because the renal sinus in which renal stones are found is hyperechoic by ultrasonography through renal sinus fat and mesenteric fat, it is difficult to accurately diagnose hyperechoic stones on general ultrasonography.

Several studies have been attempted to better understand the causes of the artifact and to assess its sensitivity for diagnosing renal calculi<sup>4,5</sup>. In Tchelepi et al., The incidence of TA was high in stones with rough surfaces<sup>6</sup>. In the study by Michael et al., the detection rate of stones in grayscale images was 56%, and the probability of detecting stones with posterior shadow was 67%. When color Doppler was used, TA was detected in 97%<sup>7</sup>, and in another study, the detection rate of urinary stones in twinkle color Doppler sign was 68%<sup>8</sup>. In Shim's study, the incidence of TA on color Doppler ultrasound was 100%<sup>9</sup>. Rass Winkel et al., also reported that TAs were present in 74% of the B-mode<sup>10</sup>. The conclusion of all studies is that TA is more useful than b mode alone for urinary stone detection.

In abdominal ultrasonography, When the renal stone detection is ambiguous in the B mode, we use TA and sometimes use it for measurement. Therefore, We

examined how TA relates to measuring the size of urinary stone. Whether conclusion this study investigated that is what usefulness in the urinary stones measurement by TA of ultrasonography which is useful marker for the diagnosis of urinary stones.

## MATERIALS AND METHOD

**Materials:** 8 decomposed granite soil stones of 2.46 ~ 13.5 mm in size were randomly selected and used. Each stone was averaged three times directly by three persons using a digital caliper with a minimum measurement resolution of 0.01 mm (Figure 1).



**Figure 1: Weathered granite stones of various size with rough surfaces**

**Ultrasonography:** The setting parameters of the ultrasonic equipment (A-35, Medison, Korea) used were the manufacturer's abdomen default setting. The depth was set to 16 cm, and a curved array type probe (Frequency, general harmonic) was used. A single focus was used to aim at the level of the stone. The color gain was set to 50 dB, the stage at which color noise disappears, the color scale was 20.6 cm/sec (PRF, 1.50 kHz), and the color mode frequency was general. The output power was set at 95%. All settings were kept the same until the end of the experiment.

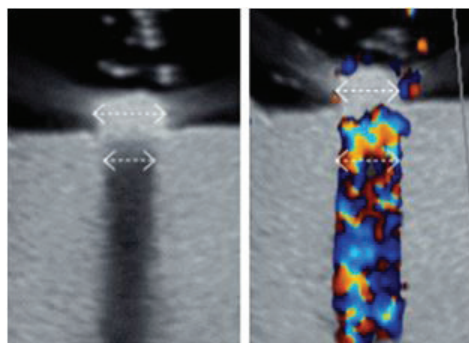
**Mounting experimental tools:** In a water tank (30\*20\*17 cm), water was poured so that the surface of acorn jelly would be 6 cm which is the approximate depth at which a kidney appears during a real abdominal scan. The stone was placed on the surface of the acorn jelly one by one using tweezers. In the ultrasound image, the position of the stone was directly adjusted so that the longest axis of the stone could appear. The probe was fixed so that the stone could be scanned vertically and the ultrasonic, probe, or stone settings were not moved until the end of the experiment (Figure 2).



**Figure 2: The material was adjusted on a fixed probe and an acorn in a water tank 2.4 Measurement method**

Measurements were made of the diameter of the stone and the posterior acoustic shadow diameter of the stone in the B mode image, the diameter of the stone and the diameter of the TA in ultrasound color Doppler mode. The measurement was done by three persons with ARDMS and at least 5 years of ultrasonographic clinical experience, and each stone was set and scanned and averaged 3 consecutive times without moving.

As a measurement standard of ultrasound images, the diameter of the B mode stone was measured at the boundary where the strong echogenicity of the stone was drawn, and the diameter of the posterior shadow was measured in the vicinity of the shadow forming a vertical line behind the stone. The diameter of the stone in the color Doppler mode was performed at the boundary where the strong echogenicity of the stone was formed after excluding the color shade as much as possible like in the B mode. In the same way as the posterior shadow measurement method, the diameter of the TA was measured at the boundary of the vicinity of the TA forming a vertical line behind the stone (Figure 3).



**Figure 3: Various ultrasonic measurement method of material. (a) stone diameter and posterior acoustic shadow diameter measurement in B-mode sonography. (b) stone diameter and TA diameter measurement in color Doppler mode sonography.**

**Statistical analysis:** The independent sample t-test was performed using the SPSS ver. 21 statistical program to verify the significance of the sonographic various measurement of stone size. We used a threshold of  $p < 0.05$  to reject the null hypothesis that TA had no effect on measurement of urinary stones.

## RESULTS

As a result of the independent t test, when the stone size was classified as less than 6mm and 9mm or more, the various ultrasonic measurement methods showed statistically significant results. A total of four stones smaller than 6 mm in size were found to have an average length of 4.12 mm. A total of four stones of more than 9 mm in size were found to have an average diameter of 11.94 mm ( $p < 0.001$ ). In case of stones with a 6mm diameter or less had an average diameter of 6.08 mm ( $\pm 1.06$  mm) in the B mode and an average of 4.12 mm ( $\pm 0.62$  mm) in the diameter of the posterior shadow. In color Doppler mode, the average diameter of the stones was 6.37 mm ( $\pm 1.01$  mm) and the TA average diameter was 5.66 mm ( $\pm 1.02$  mm). In case of stones with a diameter of greater than 9 mm were 13.02 mm ( $\pm 1.30$  mm) in the B-mode stone average diameter, and 9.59 mm ( $\pm 1.09$  mm) in the posterior shadow average diameter. The color Doppler mode stone average diameter was 12.56 mm ( $\pm 1.60$  mm) and the TA average diameter was 11.54 mm ( $\pm 1.78$  mm) ( $p \leq 0.001$ ), (Table 1), (Table 2).

When the measured values are compared with the actually measured values, 1.95 mm was over measured in the Bmode stone diameter in the stones smaller than 6 mm. Posterior shadow was the same as the actually measured value. It was 2.25 mm over measured in color Doppler mode stone diameter and 1.53 mm over measured in TA. For stones greater than 9 mm, it was 1.07 mm over-measured in B-mode stone diameters and posterior shadows were -2.45 mm under measured. For color mode stone diameters, 0.61 mm was over measured and TA was 0.4 mm over measured (Table 3).

## DISCUSSION

When the stone is present in the renal calyx, it is asymptomatic, but pain appears when the kidney passes through the funnel and ureter. Kidney tissue destruction due to hydrokidney and infectious disease due to stones may occur or hematuria may be accompanied. On

ultrasonographic examination, renal stones do not show a strong posterior acoustic shadow behind the stones because the renal sinus appears very bright. In particular, if the stone is small, it is difficult for accompany the shadow.

Many studies have shown that the occurrence of TA using color Doppler ultrasound is useful for the detection of stones. Turrin et al. noticed that the TA frequently useful to appears in the microlithiasis<sup>11</sup>. In 2009, Shabana et al. reported the results suggest that the twinkling artifact is a robust method for detecting the presence of renal calculi. The color signature is easier to detect than is acoustic shadowing<sup>12</sup>. According to Riddell's report, the sensitivity in ultrasonography of urinary stones with hydronephrosis was 90% for stones greater than 6 mm and 75% for those less than 6 mm<sup>13</sup>. In this study, the measurement results also were different according to the size of stone, and statistically significant were obtained when classified as less than 6mm and 9mm or more. Many studies have already been done on TA and TA is now recognized as the finding of ultrasonography for renal stones and its significance.

If the stone size is measured only in B mode, especially if the gain setting is high, the B mode image may appear blurry and overestimation may increase. As a result of this study, the over measurement of stone was reduced by inducing TA by using color Doppler. Measurement error was smaller than that of measuring stone directly.

The degree of occurrence of TA is affected by the angle of incidence of the stone and ultrasonic waves, the shape of the stone and the setting of the equipment parameters<sup>14, 15</sup>. The frequency in the color mode is basically set lower than the B mode. Since the frequency is low, a measurement error of the stone diameter may occur due to the decrease of resolution. In this study, the measurement error of CSD was increased more than that of BSD. This is the case when the diameter of the stone is smaller than 6mm. CSD measurements are limited due to the inaccurate outline of the stone due to disturbance by the color mapping of the stones. Thus, the results of this study showed differences from the measurements of BSD when the diameter of the stone is larger than 10mm.

As a limitation of this study, the stones used in the experiment are not stones from the human body, and while the measurement standard was met at the time of measurement, there is a possibility of error



for what is performed with the naked eye. Also, when the position of the stone is adjusted, since it is carried out by a subjective method, there is a possibility of error. However, significance can be found in the first research on the method of measurement of stones using twinkling, and it is thought that twinkling artifacts may be used as a complementary method when the stones size measurement is ambiguous in the B mode.

**Table 1: Stone size measured by various ultrasonic measurement method <mm>**

AD	BSD	BPD	CSD	CTD
2.46	14.47	10.80	13.93	13.73
3.69	6.67	3.45	6.40	6.30
4.83	6.73	4.90	6.80	6.73
5.50	6.40	4.27	7.30	4.63
9.50	11.37	8.33	10.40	9.70
11.98	12.77	10.13	12.30	12.13
12.78	13.46	9.10	13.60	10.60
13.50	14.47	10.80	13.93	13.73

\*AD:actual mean diameter by digital caliper, BSD: stone diameter in B-mode, BPD: posterior acoustic shadow diameter in B-mode, CSD: stone diameter in color Doppler mode, CTD: twinkling artifact diameter in color Doppler mode.

**Table 2: Independent t-test result between various ultrasonic measurement method <mm>**

Measurement method	Stone size	Mean diameter (standard deviation)	P	95% □□□□	
				□□	□□
AD	< 6	4.12(±1.34)	< 0.001	10.50	5.14
	> 9	11.94(±1.74)			
BSD	< 6	6.08 ±1.06	< 0.001	8.99	4.87
	> 9	13.02±1.30			
BPD	< 6	4.12±0.62	< 0.001	7.0	3.94
	> 9	9.59±1.09			
CSD	< 6	6.37±1.01	0.001	8.51	3.88
	> 9	12.56±1.60			
CTD	< 6	5.66±1.02	< 0.001	8.39	3.39
	> 9	11.54±1.78			

**Table3: Size deviation of stone mean diameter of 2 groups measured by various ultrasonic measurement method <mm>**

Stone size	AD(n)	BSD	BPD	CSD	CTD
<6	4.12(4)	+1.95	0	+2.25	+1.53
>9	11.94(4)	+1.07	-2.45	+0.61	+0.4

**CONCLUSION**

This paper proposed the usefulness of TA artifact of color-Doppler ultrasound for the measurement of

urinary stones. It showed that TA is different from stone measurements depending on stone size. When the stone size was less than 6 mm, the measured diameter of the posterior shadow was most similar to the actual stone

size. In the method of measuring the TA diameter in the color Doppler mode, an overestimation of about 1.5 mm was observed when the stone size was smaller than 6 mm, and an overestimation of 0.4 mm was observed at the size larger than 9 mm. TA showed the most accuracy on stones > 9 mm than other ultrasonic measurement methods. As a result of this study, if the stone measurement is ambiguous in B mode sonography, TA can be used as a complementary method.

**Ethical Clearance:** Taken from Kimsangyoung Internal Medicine Center, Korea

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**Conflict of Interest:** NA

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# Effects of the Shock Wave Therapy Based on Stretching Exercises on Muscle Tone and Neck Range of Motion of Upper Trapezius and Sternocleidomastoid in People with Forward Head Posture

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## ABSTRACT

This study examined how change the range of motion(ROM) of the neck and muscle tone of upper trapezius(UT) and Sternocleidomastoid(SCM) through the extracorporeal shock wave therapy(ESWT) and stretching exercise applied to subjects. Total 30 subjects who had forward head posture(FHP) in twenties healthy male and female each fifteen were applied with active stretching exercises (SE group) and additionally the extracorporeal shock wave therapy to 15 subjects for 7 weeks, total 14 times, twice a week (ESWT group). Before and after applying these experiments, in order to confirm the muscle tone of upper trapezius, sternocleidomastoid, and the neck ROM of the subjects with FHP were measured by a goniometer. It was noticeable that in the tone of upper trapezius, the angle of neck extension and left bending, there were significant differences statistically in both groups. In addition, in the measurements of right bending of these group, there was a significant difference compared to between pre-intervention and post-intervention. On the other hand, there were no significant differences from sternocleidomastoid and neck flexion compared to between pre and post intervention in those two groups. Even though there were no significant figures from the muscle tone of SCM and the angle of neck flexion, there were the other significant differences values. Moreover, it was ascertainable that without the extracorporeal shock wave therapy, the only conducting the stretching exercise to the subjects would work on the tone of upper trapezius, left and right neck bending and extension.

Applying the stretching exercise could work on upper trapezius and the angle of neck extension and side bendings in the people who have forward head posture.

**Keywords:** *forward head posture, extracorporeal shock wave therapy, stretching exercises, Myoton, sternocleidomastoid, upper trapezius*

## INTRODUCTION

Modern people move monotonously by using many devices that make them convenient instead of using their own bodies<sup>1</sup>. The shape of musculoskeletal system could be deeply affected by it<sup>2</sup>. It causes the forward head posture(FHP). Someone who has FHP is not only looked good but also not good for health. Especially, in now society, a number of people use computer, and most of people that use computer for a long time have FHP because when they are sitting on a chair, in general, they stay unconsciously stooped posture for instance, normally their heads start to come front gradually, and if it lasts, the people will have FHP. The people usually have kyphosis on their back and round shoulders<sup>3</sup>.

There are many studies that FHP is involved with several other symptoms, for example pain from neck, headache, round shoulders, temporomandibular disorder, which has been reported constantly<sup>4</sup>. FHP is well-known as a common type of abnormal posture<sup>5</sup>. In addition, FHP is the one of changes of general postures, which can see from patients with a disorder of the neck<sup>6</sup>, and, structurally, the FHP makes the center-line of the head move to the front and above so the weight of the head which is supported by the neck is increased. Due to this phenomenon, arising the change of the connection between the head and neck is caused by occurring relative compensation, for instance, continuous and abnormal contraction increment of lordosis on the connection

of the head and neck and the muscle of the lower part of the occipital bone, such as upper trapezius(UT) and sternocleidomastoid muscle(SCM)<sup>7</sup>.Moreover, weakening of the anterior cervical flexor muscles and shortening of the posterior cervical extensor muscles are involved with the FHP<sup>8</sup>.In order to treatment of the FHP, it is necessary to focus on the muscles around the neck<sup>9</sup>. The activestretching exercises(SE) that is focused on extension exercises also it is an exercise of a self-treatment is effective to self-correct<sup>10, 11</sup>.Recently, there are many conservative treatments, and one of the conservative treatments is theextracorporeal shock wave therapy(ESWT)<sup>12</sup>.

Furthermore, the ESWT can deliver the shock wave energy to the musculoskeletal system accurately so it has been used for patients who are not easy to be treated from orthopedic disorders and sports injuries as an alternative treatment<sup>13</sup>.Hence, there are relatively few researches about effects of theESWT on the FHP. Thus, the aim of this study examined how change the tone of SCM and UT and the range of motion(ROM) of the neck by stretching exercises with the ESWT to the subjects.

**MATERIALS AND METHOD**

For this study, subjects who participated in this study were total 30 people. They agreed participating in this study spontaneously, they have FHP and excepted the people with other disorders such as people who have mental disorders, tumor and herniated disc on their back and disorders that could be effect on the results of musculoskeletal system. The subjects were students of N university (Cheonan-si, Chungcheongnam-do, Republic of Korea).This research was performed in accordance with the Declaration of Helsinki.The values about the subjects is on the <table 1>.

**Table 1: Features of the subjects**

	ESWT	SE
Age(years)	20 ± 2.23	20 ± 2.02
Height(cm)	167 ± 9.42	168 ± 9.87
Weight(kg)	62 ± 11.70	66 ± 13.08

Values are expressed in mean ± SD

ESWT: extracorporeal shock wave therapy group, SE: only stretching exercise group

Before and after conducting the experiments, the measurement of the ROM and the tone of the two muscles which are upper trapezius and sternocleidomastoid were performed with a 6” goniometer (Sammons™ Preston. U.S.) and MyotonPRO (MyotonAS, Tallinn11415, Estonia) to the all subjects during neutral sitting posture.

After choosing subjects, 30 subjects were separated to the control group and the experimental group that have 15 people each.The experimental group(ESWT group) was applied with both thestretching exercises and the ESWT, and the control group(SE group) was conducted with only thestretching exercises.

Firstly, in orderto measure the ROM, made the subjects neck flexion, extension and right and left bending to the maximum without pain.After the measuring, let them relax to confirm the tone of UT and SCM. The device shows state of a muscle tension as frequency(Hz).

The ESWT was performed to the ESWT group by staying the prone position before applying the SE. After performing ESWT, the ESWT group exercised. Whereas, the SE group only did the stretching exercises which were shoulder horizontal adduction and abduction, shoulder elevation, depression, protraction, retraction, neck flexion, extension, neck side bending right and left and neck rotation right and left. The both groups exercised each movement maintained 10 seconds and rest 3 seconds, total 2 sets and 3 times per week a group by a group, if there were painful postures during exercising, let the people exercise until without the painand increased their range gradually, and these exercises were based on Memorial Sloan-Kettering Cancer center(MSKCC)and Nicholas Institute of sports Medicine and Athletic Trauma(NISMAT)<sup>14</sup>.

The ESWT was conducted with an Intellect® RPW Shockwave(Chattanooga, UK) to the experimental group by prone position, which settings were vibration transmitter of 17mm, 0.10 mJ/, 2000 times by low energy density and 5Hz on the UT and SCM twice a week for 6 weeks<sup>15</sup>.

A paired t-test was used for the measured data and used to compare differences between the stretching exercised group and the stretching exercised andESWTgroup. And an independent t-test was performed before and after the experimenting on it. In addition, setting the significant level was at =0.05 with SPSS ver. 18.0 for analyzing the values.

**RESULTS AND DISCUSSION**

The comparison of between the groups has no significant differences from the all parts. <Table 2>

**Table 2: Comparing the variations that are the tone and stiffness of the muscles and the ROM between the groups**

Variable Pre-post	ESWT		t value	p value	
	Pre-post	SE			
Flexion(°)	2.40±6.14	3.53±6.69	-0.48	0.63	
Extension(°)	10.67±11.12	9.67±7.94	0.28	0.78	
Lt. bend(°)	3.60±4.50	6.60±7.76	-1.29	0.21	
Rt. Bend(°)	4.60±8.89	8.00±9.43	-1.02	0.32	
UT	MT(Hz)	-1.59±1.77	-1.43±2.02	-0.23	0.82
	Stiffness(N/m)	-57.27±58.34	-53.53±58.66	-0.17	0.86
SCM	MT(Hz)	-0.47±2.71	0.41±2.19	-0.99	0.33
	Stiffness(N/m)	-23.33±97.01	13.67±72.28	-1.18	0.25

Values are expressed in mean ± standard errors

ESWT: extracorporeal shock wave therapy with stretching exercise group, SE: only stretching exercise group

UT : Upper trapezius, SCM : Sternocleidomastoid, MT: muscle tone

\*Significant difference between pre and post in each group(p < 0.05)

While there was no significant difference between the groups, compared to intragroup, there were significant differences. In the ESWT group, after conducting both the ESWT and SE, angles from the neck actions which are extension and left bending significantly increased. And the frequency and stiffness of UT decreased significantly but there were no significant differences in the other values such as angles of the flexion, right bending and the muscle tone and stiffness from the SCM. In the SE group, after performing the stretching exercises, the angles of extension, left and right bending rose significantly. Also, the muscle tone and stiffness of UT declined significantly, however, there was no significant difference on SCM.<Table 3>

**Table 3: Comparing the variations that are the tone and stiffness of the muscles and the ROM in subjects of each group**

Variable Pre		ESWT			SE		
		Post	P value	Pre	Post	P value	
Flexion(°)		28.27±5.38	30.67±6.20	0.15	27.00±8.74	30.53±3.85	0.06
Extension(°)		29.67±7.49	40.33±9.83	0.00*	30.13±8.10	39.80±7.83	0.00*
Lt. bend(°)		28.07±5.09	31.67±6.62	0.01*	26.40±3.94	33.00±7.79	0.01*
Rt. Bend(°)		30.73±9.23	35.33±6.49	0.06	28.07±7.01	36.07±7.54	0.01*
UT	MT(Hz)	17.69±1.43	16.10±1.75	0.00*	0.95±0.15	0.86±0.11	0.02*
	Stiffness (N/m)	316.40±42.61	259.13±54.56	0.00*	320.00±47.32	266.47±68.20	0.00*
SCM	MT(Hz)	20.46±2.06	19.99±2.15	0.51	20.07±1.25	20.49±1.34	0.48
	Stiffness (N/m)	408.40±78.08	385.07±70.65	0.37	386.80±42.58	400.47±44.67	0.48

Values are expressed in mean± standard errors

ESWT: extracorporeal shock wave therapywith stretching exercise group, SE: only stretching exercise group

UT : Upper trapezius, SCM : Sternocleidomastoid, MT: muscle tone

\*Significant difference between pre and post in each group(p < 0.05)

Based on a previous study that stretching exercises relative to neck extensors and flexors can improve ROM and FHP, the SE group performed the stretching exercises by MSKCC and NISMAT, consequently, there were significant effects on muscle tone and stiffness of UT and extension, Left and right bending of ROM except flexion<sup>16</sup>.

Stiffness is usually expressed as mechanical properties of muscles, and according to reduced stiffness values of overused UT, thus the stretching exercises were effective for status of muscles<sup>17</sup>.

Furthermore, as a result of these experiments on the basis of a previous research that ESWT can be effective on muscle tone and stiffness, extension, left bending, muscle tone and stiffness of UT of the ESWT group were with significant results<sup>18</sup>.

However, this research sought not significant from comparing between the ESWT and SE group in the values of flexion and SCM and right bending of the ESWT group.

There were some limitations to analyze results of this study. First of all, it is limited to generalize from the results to all people. Secondly, owing to observing only UT and SCM among muscles which can affect FHP, applying this study to all aspects of patients with FHP is difficult. Therefore, it is necessary to keep researching of interventions that can be effective on FHP in various aspects positively with supplementing these defects.

## CONCLUSION

This study was to observe variation of neck ROM, muscle tone and stiffness of UT and SCM by applying SE and ESWT to 30 subjects who have FHP. Even though between ESWT group and SE group had no significant difference, statistically, there were significant differences in ESWT group and SE group. Thus, extracorporeal shock wave therapy and stretching exercises with an intervention of FHP would be an effective method.

**Ethical Clearance:** Taken from Namseoul University,

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**Conflict of Interest:** NA

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# Effect of Gym Ball Exercise and Music Therapy on Menstrual Discomfort

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## ABSTRACT

This study investigated the effect of applying gym ball exercise and music therapy on the menstrual discomfort of 20 female university students in their 20s.

Subjects were divided into a gym ball exercise group (GBEG) and a music therapy group (MTG). Intervention sessions for each group started 3 weeks before the predicted menstrual date and ended on the last day of menstruation. Subjects attended 3 sessions a week for a total of 12 sessions. Measurement of menstrual discomfort was done using the menstrual distress questionnaire (MDQ). Pre- and post-intervention changes within groups was analyzed using a paired t-test and pre- and post-intervention changes between the two groups was done using the independent t-test.

The GBEG showed a significant decrease in all but 5 categories of the MDQ. The MTG showed a significant decrease in one category. The GBEG and the MTG had no significant differences between each other.

Gym ball exercises are easily accessible to female university students who experience menstrual discomfort and should be considered as an alternative intervention method to taking medication.

**Keywords:** *Gym ball exercise, Music therapy, Dysmenorrhea, Premenstrual syndrome, Menstrual distress questionnaire.*

## INTRODUCTION

The two most commonly experienced disorders during menstruation are premenstrual syndrome (PMS) and dysmenorrhea. Both are cause for adverse effects on function and quality of life for women<sup>1-3</sup>. Menstrual pain is a chronic or periodic pelvic pain that may also relate into nausea, vomiting, diarrhea, headache, fatigue, lower back pain, and dizziness - the prevalence may range from 20% to 90%<sup>4, 5</sup>. Furthermore, PMS is a common disorder for women during menstruation and hypersensitivity or similar psychological signs as well as physical signs such as headaches and lower back pain are frequently reported<sup>6</sup>.

Treatment for menstrual pain includes oral contraceptives, non-steroidal anti-inflammatory drugs, and sedatives. However, the negative side effects of some drugs such as indigestion, headaches, drowsiness, and dependency are cause for patient concern. Many studies have reported the desirability of exercise therapy

as an alternative to the aforementioned prescription of medication for the treatment of PMS and dysmenorrhea symptoms<sup>7-10</sup>.

Looking at previous studies, Tsai (2016) reported the improvement of PMS after a 12 week yoga program conducted on 64 female employees<sup>10</sup>. Azima et al. (2015) carried out a study on 102 female university students for 8 weeks performing isometric exercises and stated that the program was effective in reducing a few symptoms of dysmenorrhea<sup>11</sup>. Many similar studies exist regarding the improvement of menstrual disorders through exercise. Gym ball exercises are effective in stabilization of the trunk muscles<sup>12</sup>. It is also shown to comprehensively improve muscle strength, endurance, and flexibility as well as enhance reflexes, sense of balance, and proprioception<sup>13</sup>. Looking at the 6 week study conducted by Lee et al. (2003), it is noted that gym ball exercises effectively reduced pain in patients with lower back pain<sup>14</sup>. Despite the effectiveness of gym ball exercises the truth remains that there are not



many studies available regarding its use as a treatment for menstrual disorders.

Music therapy has many effects such as relaxing the mind and body, reducing stress, enhancing comfort, as well as increasing the threshold for pain<sup>15</sup>. Previous studies such as Gutgsell et al. (2013) reported that music therapy applied to palliative care patients reduced pain<sup>16</sup>. Li et al.(2017) stated a correlation between the application of music therapy and the relief in levels of pain and stress for burn patients<sup>17</sup>. As such, music therapy has been investigated in many studies regarding the improvement of pain but there is a lack of research specific to menstrual disorders. This study aims to mediate music therapy as an alternative treatment method for PMS and dysmenorrhea. Furthermore, this study aims to investigate the effect of gym ball exercises and music therapy on menstrual discomfort without use of medication.

## MATERIALS AND METHOD

**Design:** Gym ball exercise and music therapy are the independent variables. Menstrual discomfort is the dependant variable. The research design method used is the different subject design.

**Subject:** This study was conducted on female university students in their 20s currently attending ‘N’ University in Chungcheongnam-do. Selection criteria for the subjects are as follows<sup>18</sup>. The menstrual period has been regular for at least 3 months and has a cycle of 25-35 days. Using the visual analogue scale (VAS), subjects were selected when displaying measurement of menstrual pain above 4.0. Subjects have not been previously diagnosed with pelvic inflammatory disease, endometriosis, and have never given birth. During the study, subjects will refrain from using pain killers, heat therapy, or oral contraceptives. Subjects will have no previous experience with gym ball exercises and must have complete understanding of the study’s aims as well as express consent for participation. Before selecting the subjects, individuals were instructed to complete a questionnaire. Following completion, participating subjects were assigned to a gym ball exercise group (GBEG) and a music therapy group (MTG) using the simple randomization method. The GBEG and MTG each consisted of 10 subjects for a total subject pool of 20 individuals participating in the study. The aims, nature, and assigned tasks for the research were meticulously

explained to all subjects before obtaining voluntary consent for participation in the study.

**Measurement Apparatus:** For this study, the VAS was used to measure menstrual pain. 0 indicated the complete absence of pain while a score of 10 indicated the highest intensity of pain. Subjects marked the scores themselves. The MDQ edited by Kim(1995) was used to measure menstrual discomfort. Categories included physical pain, concentration, change in behavior, autonomic nervous system response, and fluid retention among 6 total categories. Each category consists of 35 items for a minimum of 35 points and a maximum of 210 points. A high score indicates intense PMS<sup>19</sup>.

**Method:** Materials for the study consist of pre-intervention measurement for VAS and menstrual discomfort. The initial measurement was based on the day of strongest menstrual pain. Post-intervention measurement took place on the last day of menstruation.

The exercise program for the GBEG took place at the practical rooms at ‘N’ University. Subjects were instructed to wear comfortable clothing and during the exercise, were allowed to listen to their preference of music. For this study, the gym ball exercise program was structured based on previously conducted research<sup>20, 21</sup>. The details of the program are as presented in Table 1. Before starting the study, subjects were trained thoroughly in order to ensure that the exercise program was done exactly, and continuous feedback was provided during the intervention period so that subjects maintained correct posture. The gym ball exercise commenced 3 weeks before the start of the predicted menstrual period and lasted until the last day of menstruation. Each session took place 3 times a week for a total of 12 sessions.

The MTG sessions took place in the electric therapy room at ‘N’ University. Subjects were instructed to listen and concentrate on their music of choice. Subjects were given individual areas closed off by curtains in order to create a peaceful and uninterrupted environment<sup>22</sup>. The music therapy commenced 3 weeks before the start of the predicted menstrual period and lasted until the last day of menstruation. The subjects attended 3 sessions a week, with each session lasting 35 minutes, for a total of 12 sessions of cognitive observation of music<sup>23</sup>. There were no subjects that left mid-study or that were asked to leave due to taking medication during the research period. The study was completed without any complications regarding external variables.

**Table 1: Gym Ball Exercise Program**

Order (Time)	Period	Type	Intensity
Warm-up (5 min)	4 weeks	Stretching	
Exercise		Up and down bounce	30 reps*1set
		Side to side pelvic tilt	30 reps*2set
		Pelvic circle	20 reps*2set
		Prone opposite arm leg lifts	20 reps*2set
		Ball crunch	10 reps*2set
		Ball straight leg bridge	10 reps*2set
		Ball leg lifts	10 reps*2set
Cool-down (5 min)		Stretching	

**Data Analysis:** The SPSS version 18.0 was used for data analysis in this study. The general characteristics of the subjects were calculated using descriptive statistics. Verification of homogeneity between the GBEG and MTG was done using the t-test. Pre-and post-intervention differences within the groups were analyzed using the paired t-test. The degree of change between the two groups pre-and post-intervention were analyzed using the independent t-test. The statistical significance was set as  $\alpha = .05$

## RESULTS AND DISCUSSION

### Results

**Subject General Characteristics:** The subjects of this study are female university students in their 20s attending 'N' University in Chungcheongnam-do. The total number of subjects was 20. The age, weight, menarche time span, length of menstruation and other general characteristics are as listed in Table 2.

**Table 2: General Characteristic of Subjects**

Category	GBEG (n=10)	MTG (n = 10)	p
	M ± SD	M ± SD	
Age (yr)	19.20 ± 1.55	19.00 ± 0.82	.722
Weight (kg)	52.60 ± 7.98	50.50 ± 5.68	.506
First menstruation (yr)	12.50 ± 2.01	12.50 ± 1.78	1.000
menstruation duration (day)	6.00 ± 1.16	5.30 ± 1.06	.175

\*p<.05

**Comparison of the Degree of Menstrual Discomfort within the GBEG and MTG:** The results of the comparison of menstrual discomfort within the GBEG and MTG are as shown in Table 3. In the GBEG, of the 6 categories, there was a statistically significant decrease in all except the autonomic nervous system (p<.05). In the MTG, there was a significant decrease in the change in behavior category (p<.05).

**Table 3: Internal Comparison within GBEG and MTG (MDQ) (score)**

Category	GBEG (n = 10)		p	MTG (n = 10)		p
	Before (M ± SD)	After (M ± SD)		Before (M ± SD)	After (M ± SD)	
Pain	18.40 ± 6.06	14.60 ± 5.17	.008*	16.40 ± 3.50	14.40 ± 3.17	.148
Lack of Concentration	20.20 ± 7.33	15.00 ± 3.92	.016*	21.20 ± 9.22	17.30 ± 5.19	.078
Behavior	21.60 ± 4.62	15.40 ± 3.98	.004*	19.50 ± 7.06	13.90 ± 5.11	.016*
Autonomic Reaction	8.70 ± 5.06	8.80 ± 3.26	.933	8.90 ± 4.10	7.30 ± 4.06	.256
Water Retention	11.80 ± 3.94	8.90 ± 3.14	.004*	9.60 ± 4.27	9.60 ± 4.14	1.000
Negative Emotion	24.60 ± 8.02	18.00 ± 4.97	.005*	23.80 ± 9.91	20.30 ± 11.00	.260

Menstrual distress questionnaire (MDQ)

Gym ball exercise group (GBEG), Music therapy group (MTG)

\*p<.05

**Comparison of the Degree of Menstrual Discomfort between the GBEG and the MTG:** As shown in Table 4, there was no significant difference in pre- and post-intervention menstrual discomfort between the GBEG and the MTG ( $p > .05$ ).

**Table 4: Comparison between GBEG and MTG(MDQ) (score)**

Category	GBEG (n = 10)	MTG (n = 10)	t	p
	post-pre (M ± SD)	post-pre (M ± SD)		
Pain	-3.80 ± 3.52	-2.00 ± 4.00	-1.07	.300
Lack of Concentration	-5.20 ± 5.59	-3.90 ± 6.19	-.49	.628
Behavior	-6.20 ± 5.05	-5.60 ± 6.02	-.24	.812
Autonomic Reaction	.10 ± 3.04	-1.60 ± 4.17	.97	.344
Water Retention	-2.90 ± 2.42	.00 ± 3.92	-1.99	.062
Negative Emotion	-6.60 ± 5.68	-3.50 ± 9.22	-.91	.377

Menstrual distress questionnaire (MDQ)

Gym ball exercise group (GBEG), Music therapy group (MTG)

\* $p < .05$

## DISCUSSION

For women, the periodic reproductive function is a natural part of life and as such, influences physical and mental capabilities<sup>24</sup>. Intense menstrual symptoms significantly affect school, work, interpersonal relationships, family, and social lives in a negative manner<sup>25</sup>. This study aimed to investigate the effect of gym ball exercise and music therapy on menstrual discomfort in women in their 20s.

Results of the study showed that the GBEG, which applied both the gym ball exercise and music therapy, experienced a significant decreases in all categories except the autonomic nervous system( $p < .05$ ). The correlation between stress and PMS has been reported which results from stress causing excitation of the sympathetic nervous system, resulting in the increased contraction of the uterine muscles and therefore pain<sup>26</sup>.

Endorphins aid in the increased threshold of pain and is released during exercise<sup>9</sup>. Bender et al. stated that the

endorphins released during exercise have an analgesic effect and the improved blood flow to the pelvis also contributes to the alleviation of menstrual discomfort<sup>27</sup>. In this study, the degree of pain was shown to have decreased significantly according to the MDQ. This is evidenced by the relief of stress through exercise which in turn reduced activity of the sympathetic nervous system. Furthermore, the symptoms of menstrual pain are eased due to the effects of an increase in endorphins.

On the other hand, limited abnormal movement of the lumbo-sacral vertebrae may increase fluids within the uterus causing contractions as well as increased menstrual pain<sup>28</sup>. In a study conducted by Kim et al. (2016), it was reported that women with menstrual pain had a statistically greater degree of pelvic misalignment than women without menstrual pain<sup>29</sup>. Walsh et al. (1999) stated that the menstrual pain of women disappeared once their spinal alignment returned to normal<sup>30</sup>. A compiled look at previous studies shows that gym ball exercises are effective in correcting pelvic and lumbo-sacral alignment, and as such, aids in circulation of fluids within the pelvis and decreases uterine contractions. Gym ball exercises affect both the endocrine and musculoskeletal systems which have a positive influence on menstrual discomfort, especially with decreasing pain. As the music therapy did not have a significant overall effect on menstrual pain,, this discussion will focus solely on the effects of the gym ball exercise.

Physical exercise increases endorphins and decreases adrenal cortisol which improves pain, nervousness, depression, and other similar endocrine system scriptural syndromes<sup>31</sup>. Previous studies have also reported that exercise is effective in reducing nerves<sup>32, 33</sup>. In this study, for the negative emotion category in the MDQ, the GBEG showed a decrease which supports the data presented in previous studies. Furthermore, the decrease in the concentration category also follows in line with previous studies that have noted that participation in exercise is the focal point of improving cognitive function. Muscle contractions that occur during exercise apply direct pressure to lymph nodes which effectively increases the pumping function and improves circulation of lymph<sup>34</sup>. Also, exercise increases the transport capacity of the blood vessels in the skeletal muscles<sup>35</sup>, and such increased circulation of blood as well as lymphatics in decreasing fluid retention.

Results of the study showed that in the MTG there was only a significant decrease in the change in behavior category of the MDQ. A systematic review conducted by Nilsson (2008) of 42 studies stated that there were many recommendations for use of music in clinical settings. According to the review, slow music at 60~80 beats per minute without vocals, a maximum of 60dB, patient selected from a preorganized set, with appropriate equipment, and at least 30 minutes of length was recommended<sup>36</sup>. On the other hand, in this study, patients were allowed complete freedom of choice in selecting the music without any informed decision and as such is seen as being responsible for a lack of effect in reduction of menstrual discomfort. In a study conducted by Guétinet al. (2005), patients hospitalized due to chronic back pain were gradually introduced to music therapy in order to provide relaxation as a form of treatment. While there was no statistically significant decrease in back pain, there was still an apparent decrease, and furthermore, a noted use as a complementary treatment for behavioral issues such as nervousness-depression was reported<sup>37</sup>. This study provided similar results with the MTG showing a significant decrease in the behavioral change category of the MDQ. Thaut (1990) stated that musical stimulation had a biological effect on human behavior through use of specialized brain function such as memory, intelligence, emotion, and other associated states<sup>38</sup>. Likewise, in this study, the appreciation of music was observed to have stimulated certain areas of the brain triggering a change in behavior.

This study was conducted on female university students in their 20s. As such, the results of this study are limited by age constraints and cannot be generalized across women of varying childbearing ages. Future studies are recommended to include more subjects with a wider age range. Furthermore, follow up studies would do well to investigate the effect of gym ball exercises on the strength and activity of muscles, as well as the muscle thickness in order to confirm the lumbosacral stabilizing effects. This would consolidate the effectiveness of gym ball exercises as an intervention appropriate for menstrual discomfort.

### CONCLUSION

This study investigated the effect of applying gym ball exercise and music therapy on the menstrual

discomfort of 20 female university students in their 20s. Study results showed that music therapy and gym ball exercise applied together within the GBEG statistically decreased all categories in the MDQ except one - the autonomic nervous system category. Music therapy applied alone in the MTG had a statistically decreased effect on only the change in behavior category. As such, in effectively improving menstrual discomfort, the GBEG which incorporated both gym ball exercises and music therapy was shown to be superior to the independent use of music therapy alone. Following the study, it would appear that the program used in the GBEG could be considered an easily applicable intervention for female university students who experience menstrual discomfort.

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# Relationship of Sleep Quality with Smartphone Addiction and Stress among Collegians

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## ABSTRACT

This study is to investigate the correlation between smartphone addiction, perceived stress and sleep quality and factors associated with sleep quality in collegians.

Participants in this study were 327 collegians. We collected data from July 10 to 14, 2017 using the self-report questionnaire. The survey scales comprised Pittsburgh Sleep Quality Index (PSQI), smartphone addiction and perceived stress. Data were analyzed using the SPSS (version 22.0) program. ANOVA, t-test, Pearson correlation coefficients, analysis and logistic regression analysis were conducted.

Participants ranged in age from 19-29 years (mean 22.47; SD 2.85). There were 137 males (41.9%) and 190 females (58.1%). In general characteristics, sleep quality was significant differences in gender ( $t=-3.01, p<.01$ ) and residence type ( $t=2.94, p<.01$ ). A risk group of smartphone addiction was 18.3% of participants, the mean of perceived stress was 27.51( $\pm 5.78$ ), and 48.3% of participants have a poor sleep quality. Sleep quality showed significant differences in smartphone addiction ( $t=-5.36, p<.001$ ), and perceived stress ( $t=-6.28, p<.001$ ). Sleep quality was positively related to smartphone addiction ( $r=.239, p<.001$ ), and perceived stress ( $r=2.85, p<.001$ ). Residence type (OR=3.092,  $p=.004$ ), perceived stress (OR=1.115,  $p<.001$ ), and smartphone addiction (OR=1.062,  $p=.002$ ) were identified as significant factors associated with sleep quality.

Students displaying high perceived stress and smartphone addiction should be attentively monitored for sleep quality and created an environment to improve a sleep quality of those who living in hall.

**Keywords:** Smartphone, Addiction, Perceived stress, Sleep quality, Collegian

## INTRODUCTION

Sleeping is crucial to maintain the best health condition through getting energy and keep an optimal condition of human function and recovery from physical, psychological fatigue.<sup>1,2</sup> If we fail to have enough time for adequate rest and sleeping, it induce diminishment of physical recovery and integrated capability, memory impairment, increasing of stress and is threatened not only physical health but also psychological health.<sup>3,4</sup> Sleep quality is determined by the amount of sleep, taking time until sleeping, degree of fatigue after getting up and feeling do not get rest.<sup>5</sup>

The average amount of sleep for their 20s including college student in Korea was 6 hours 35 minutes.<sup>6</sup> The average college student is sleep deprived and they go to sleep and wake up late. Sleep disorder including

insomnia and drowsiness during the daytime is reported 56.4% of a college student.<sup>7</sup>

Sleep quality of college student is influenced by anxiety, depression stress satisfaction with life, angry, fatigue and subjective feeling of health.<sup>5,8</sup> College student experiences physical, emotional change and also in various kinds of stress such as academic stress and job stress.<sup>7</sup> The more stress, the less sleep quality, which in turn causes more problems related to the sleep.<sup>9,10,11,12</sup> In research regarding sleep quality, stress is one of risk factors of important a lifestyle that arouse a sleep disorder<sup>10</sup> and is reported as predicting factor explaining depth of sleep and sleep quality.<sup>7,12,13</sup>

Recently, in factors related to sleep quality, smartphone addiction is said to be that worsened sleep

quality.<sup>14,15,16</sup> The more smartphone addiction, the less sleep time, which causes insufficient sleep.<sup>17</sup> Also, smartphone over-user tends to experience more stress and sleep disorder than less user. Overuse of ICT was bound up with the negative symptom of mental health including sleep quality.<sup>14</sup> Smartphone use rate of the twenties including college student is 99.7 %, it shows more use rate than other age groups.<sup>18</sup> According to the data of the National Information Society Agency<sup>19</sup>, from 14.2% in 2015 to 17.8% in 2016, the rate of at risk group for smartphone addiction increased. A high- risk group for smartphone addiction was 3.5% of teenage, 3.3% of the twenties and college students had the highest rate. Smartphone addiction of college students was closely related to stress.<sup>7,20</sup> They have high stress in their living environment and psychological aspects because they should be designing lives and careers.<sup>21,22</sup> It was reported that they are immersed in a smartphone to evade their stressful situation and it leads to smartphone addiction.<sup>23</sup>

Up to date, trends of research on sleep quality were limited to elderly, adult, adolescent and people with chronic illness.<sup>24</sup> The researches for college students with regards to smartphone addiction and stress in sleep quality studies are only a small part of study.<sup>7</sup>

The sleeping habits of a college student are important because of adopting a habit affecting social life and health after this.<sup>5,25</sup> So, this study is to determine the relation between the smartphone addiction, perceived stress, and the quality of sleep and to confirm factors connected with the quality of sleep, and to provide basic data for sleeping health of college students.

## MATERIALS AND METHOD

**Design and participants:** A cross-sectional descriptive survey was conducted to verify factors linked to the quality of sleep in Korean college students. The sample used for the study consisted 327 university students from one university in Jecheon. Questionnaires were distributed to 350 students, of which 327 questionnaires were returned (response rate of 93.4%). Data were collected from July 10 to 14, 2017.

### Research instruments

**Smartphone addiction:** National Information Society Agency (NISA)<sup>26</sup> developed the Smartphone Addiction Test. Smartphone addiction was measured by using it.

It is composed of 15 questions with a 4-point Likert scale, and total scores range from 15 to 60. A higher total score means a more addictive use of a smartphone. NISA showed the total score is categorized as 3 groups: a general group (total score  $\leq 39$ ), a potential risk group (total score 40 - 43) and a high-risk group (total score  $\geq 44$ ). The Cronbach's alpha reliability coefficient was .88.

**Perceived stress:** A perceived stress scale (PSS-14) developed by Cohen, et al<sup>27</sup> was used to measure the perceived stress. It consists of 14 items describing feelings and thoughts of stress during past month. It is comprised of a 5-point Likert scale and the possible scores range from 0 to 56. A higher total score means higher perceived stress. The Cronbach's alpha reliability coefficient was .74

**Sleep quality:** Pittsburgh Sleep Quality Index (PSQI) consisting of 19 self-rated items was used to measure the quality of sleep.<sup>28</sup> They are sorted by 7 elements, which consists of subjective the quality of sleep, sleep latency, sleep duration, habitual sleep efficacy, sleep disturbance, hypnotic medication and functional disorder of daytime. This element score ranges from 0 to 3 and the total possible scores range from 0 to 21, with higher scores meaning poorer sleep quality. Buysse, et al.<sup>28</sup> proposed total score 5 or more is categorized as a poor sleep quality group, while those who total score below 5 into a good sleep quality group. The Cronbach's alpha reliability coefficient was .85.

**Data analysis:** Data were analyzed by the SPSS version 22.0. Descriptive analysis was conducted to find out the level of sleep quality, smartphone addiction, and perceived stress. Differences in the sleep quality by the general characteristics were analyzed by ANOVA and t-test. The relationship between the smartphone addiction and perceived stress, sleep quality was calculated by Pearson correlation coefficients. Logistic regression analysis was performed to investigate factors related to sleep quality.

## RESULTS AND DISCUSSION

**Differences in the sleep quality by the general characteristics of the participants:** As mentioned in table 1, participants (N=327) ranged in age from 19-29 years (mean 22.47; SD 2.85). There were 137 males (41.9%) and 190 females (58.1%). Gender ( $t = -3.01, p < .01$ ) and residence type ( $t = 2.94, p < .01$ ) were



significant differences in sleep quality. In this study, the female students had significantly more bad sleep quality than the male students. This finding is consistent with the results of previous studies,<sup>1,3,13</sup> published that sleep quality of girls is much lower than boys. Kang, et al.<sup>1</sup> reported that women are 1.3 to 1.8 times more likely to sleep disturbance as opposed to men. This means women are much affected by the external environment and more sensitive than men. The present study demonstrated

students attend school from their home had a better sleep quality than those who live in dormitories. It is consistent with the result of Jung and Park<sup>7</sup> which reported that self-boarding college students have a higher sleep disturbance than those who live with family. This indicates that they have low sleep disturbance because students living with family are familiar with the environment and feel a greater sense of stability than those self-boarding students including dormitories.

**Table 1: Differences in the Sleep quality by the general characteristics of the participants (N = 327)**

Variables	Categories	n (%)	M(± SD)	t or F
Gender	Male	137(41.9)	4.92(± 2.73)	-3.01**
	Female	190(58.1)	5.91(± 3.02)	
Age (years)	≤ 20	54(16.5)	6.14(± 2.44)	1.84
	21-25	225(68.8)	5.31(± 2.93)	
	≥ 26	48(14.7)	5.64(± 3.41)	
Grade	1st	48(14.7)	5.50(± 2.60)	2.09
	2nd	67(20.5)	5.52(± 2.77)	
	3rd	122(37.3)	5.05(± 2.80)	
	4th	90(27.5)	6.07(± 3.33)	
Major	Humanities & social sciences	154(47.1)	5.74(3.11)	0.79
	Natural sciences	87(26.6)	5.34(2.84)	
	Health & medical sciences	74(22.6)	5.29(2.77)	
	Physical education & art	12( 3.7)	4.75(2.34)	
Residence type	Dormitory etc.	284(86.9)	5.68(± 2.83)	2.94**
	One's house	43(13.1)	4.27(± 3.34)	
Academic achievement	Good	183(56.0)	5.33(± 2.66)	1.51
	Moderate	111(33.9)	5.88(± 3.47)	
	Poor	33(10.1)	5.12(± 2.40)	
Economic status	Good	78(23.9)	5.30(± 2.70)	2.15
	Moderate	179(54.7)	5.32(± 2.89)	
	poor	70(21.4)	6.14(± 3.25)	

\*\* P<.01

**Smartphone addiction, perceived stress, and sleep quality:**

As shown in table 2, a general group, a potential risk group, and a high- risk group of the smartphone addiction were 81.7%, 10.7%, and 7.6% respectively. The mean of smartphone addiction was 33.64(±6.98). The proportion of a high- risk group in smartphone addiction ranged from 5.6% to 13% in research on the Korean collegian.<sup>16, 17</sup> These differences in the study are thought to be the result of participants' characteristics. The subjects of previous studies<sup>16, 17</sup> were composed of mostly female students who major in health science or did not include

every grade. The proportion of a high- risk group in smartphone addiction of college students was higher compared to 3.5% of adolescent, 2.5% of adult.<sup>29</sup> The most people using a smartphone are 20 to 30 years old, especially, college students. Therefore, it is required to monitor and its effect on smartphone addiction of college students. The average perceived stress was 27.51(±5.78). The mean scores of perceived stress in researches<sup>30, 31, 32</sup> on used PSS-14 instrument ranged from 17.1 to 26.5, and subjects of these studies were patients with chronic disease, adults, and older adults. Compared with these studies, mean score of

perceived stress in the present study is much higher. Lund, et al.<sup>12</sup> demonstrated that college students have commonly experienced stressful events and they may have not yet developed sufficient coping strategies for handling stressful events. In sleep quality level of participants, a good sleeper and poor sleeper were 51.7%, 48.3% respectively. The average sleep quality was 5.49 ( $\pm 2.94$ ). Research on the college students used PSQI found that proportion of a poor sleeper ranged from 55.8% to 60.0%<sup>12,33</sup> and mean of sleep

quality ranged from 6.23 to 6.88.<sup>33,34</sup> These were at a much lower sleep quality compared to findings of the current study. Sleep quality of college students was a higher rate compared to the result of previous studies which reported that 38.0 % to 44.7% of adult<sup>1,35</sup> 24.6% of middle school student<sup>36</sup> appeared to have a poor sleeper. It is consistent with the result of Chung, at al.,<sup>13</sup> which reported that many college students do not obtain adequate sleep.

**Table 2: Smartphone addiction, perceived stress and sleep quality (N = 327)**

Variables	Score	Group	n (%)	M ( $\pm$ SD)	Mini.	Maxi.
Smartphone addiction	$\leq 39$	General group	267(81.7)	33.64 ( $\pm$ 6.98)	15.0	53.0
	40 - 43	Potential risk group	35(10.7)			
	$\geq 44$	High- risk group	25( 7.6)			
Perceived stress				27.51 ( $\pm$ 5.78)	11.0	51.0
Sleep quality	$<5$	Good sleeper	169(51.7)	5.49 ( $\pm$ 2.94)	0.0	19.0
	$\geq 5$	Poor sleeper	158(48.3)			

**Smartphone addiction and perceived stress based on the sleep quality:** Such as shown in table 3, the quality of sleep appeared significant differences in smartphone addiction ( $t=-5.36$ ,  $p < .001$ ), and perceived stress ( $t=-6.28$ ,  $p < .001$ ). This means that who had lower sleep quality, would be more likely to be higher smartphone addiction and perceived stress. Choi<sup>16</sup> reported the higher levels of smartphone addiction, the lower sleep quality and high-risk group of smartphone addiction had a lower sleep quality than a general and potential group of smartphone addiction. Also, the findings from earlier studies<sup>12,37</sup> showed that the sleepers of poor quality reported greater levels of perceived stress than those who are good quality sleepers. However, it runs contrary to the result from Park, et al.<sup>17</sup> who found that the perceived stress level didn't have a significant difference in sleep time and sleep insufficient sleep.

**Table 3: Smartphone addiction and perceived stress based on the sleep quality (N = 327)**

Variables	Good sleeper (n = 169)	Poor sleeper (n = 158)	t
	M ( $\pm$ SD)	M ( $\pm$ SD)	
Smartphone addiction	31.71 ( $\pm$ 6.16)	35.71 ( $\pm$ 7.22)	-5.36***
Perceived stress	25.67 ( $\pm$ 5.58)	29.47 ( $\pm$ 5.34)	-6.28***

\*\*\*  $P < .001$

**Correlation between smartphone addiction, perceived stress and sleep quality:** As appeared in table 4, the quality of sleep was a significant correlation with smartphone addiction, and perceived stress. Smartphone addiction ( $r=.239$ ,  $p < .001$ ) and perceived stress ( $r=2.85$ ,  $p < .001$ ) correlated positively with sleep quality. Smartphone addiction had a significant correlation with perceived stress ( $r=.338$ ,  $p < .001$ ). These consequences correspond to other studies<sup>7,20</sup> that stressful people tend to use the smartphone more and are inclined to develop a smartphone addiction and Smartphone use severity<sup>15</sup>

was positively associated with subjective the quality of sleep, the sleep disturbance, and functional disorder of daytime element of PSQI. In various studies,<sup>15, 16, 17, 34</sup> smartphone addiction of college student showed a decreased sleep quality. Also, previous studies<sup>3, 7, 36</sup> showed increased levels of perceived stress in the poor sleepers. Thus, identifying students with having a high level of perceived stress and smartphone addiction and providing them with appropriate supportive services may help them to prevent a poor sleep quality.

**Table 4: Correlation between smartphone addiction, perceived stress and sleep quality (N = 327)**

	Smartphone addiction	Perceived stress
Perceived stress	.338***	
Sleep quality	.239***	.285***

\*\*\* P<.001

**Logistic regression analysis of factors associated with sleep quality:** As shown in table 5, logistic regression analysis was performed to identify factors related to the quality of sleep among college students. The dependent variable in logistic regression model was a good sleeper (0) and poor sleeper (1). The independent variables included gender, residence type, smartphone addiction and perceived stress. The goodness of fit was determined to be sufficient for the Hosmer-Lemeshow analysis (-2LL=390.585,  $\chi^2=9.199$ ,  $df=8$ ,  $p= .326$ ). There was 70.0% probability to correctly classify sleep quality and 23.2% of the variance of sleep quality (Nagelkerke’s  $R^2= .232$ ) was explained by this model, Results of the analysis indicated that the most powerful predictor related to sleep quality was residence type (odds ratio: 3.092,  $p=.004$ ). Other predictors associated with poor sleep included perceived stress (odds ratio: 1.115,  $p< .001$ ) and smartphone addiction (odds ratio: 1.062,  $p=.002$ ). These results have demonstrated those who do not live in one’s own house, having a higher perceived stress and smartphone addiction was more likely to have a poorer

quality of sleep. In our study, residence type seemed to be the most important factors in predicting sleep quality. When most college students entered the university, they leave their parents’ home and live in university dormitories or cook their own meals. To decrease a poor sleep quality of them, it is needed to create an environment in which sleep quality can improve. This finding is in line with prior studies<sup>7, 12, 13, 37</sup> that perceived stress were important factors for 13.5% - 34% of the variance in PSQI scores and college lifestyles could perpetuate stress-related sleeping difficulties<sup>12</sup> and emotional and academic stress negatively impacted sleep.<sup>12</sup> It is consistent with the result of Thomée, et al.<sup>14</sup> reported that prolonged use of media can negatively affect sleep and its use may be associated with a psycho-physiological stimulant. However, it runs contrary to report that smartphone overuse was not a significant factor of the quality of sleep<sup>15, 16</sup> and smartphone addiction did not have an impact on sleep quality<sup>16, 34</sup> and smartphone addiction has an indirect effect on sleep quality<sup>34</sup>. Repeated studies are necessary to evaluate the influence of smartphone addiction on sleep quality. This result implies that smartphone addiction and perceived stress were important factors to predict of sleep quality. Thus, it is necessary to detect students with a high perceived stress early and prepare practical programs to reduce effectively stress. In addition to, it needs to develop a program such as applications to perceive the habit of using a smartphone of one’s own and check the amount of smartphone use. They will be helpful to prevent a poor quality of sleep for college students.

**Table5: Logistic regression analysis of factors associated with sleep quality (N = 327)**

Variables	B	S.E.	Wald	df	p	Exp(B)	95%CI	
							Low	High
Gender	- .403	.253	2.545	1	.111	.668	.407	1.097
Residence type	1.129	.390	8.361	1	.004	3.092	1.439	6.646
Smartphone addiction	.060	.019	9.505	1	.002	1.062	1.022	1.103
Perceived stress	.109	.025	19.182	1	.000	1.115	1.062	1.171

Gender was coded as male (1) vs female (0). Residence type was coded dormitory etc. (1) vs one’s house (0). Sleep quality was coded good sleeper(0) vs poor sleeper(1).

**CONCLUSION**

This study is to arrange strategies to protect a poor sleep quality of collegian by finding out smartphone addiction, perceived stress and sleep quality and

identifying factors connected with the sleep quality. The quality of sleep may be related to smartphone addiction and perceived stress. Residence type, perceived stress, and smartphone addiction were identified as significant factors associated with sleep quality. College students

displaying high perceived stress and smartphone addiction should be attentively monitored for sleep quality. For those who are not living in their own home, it is needed to create an environment in which sleep quality can improve. College students who are continuously getting poor quality sleep are at risk for more serious problems. Health care professionals should take the lead in screening for sleep difficulties and in making a point of the importance of sleep quality in college students' good health.

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# Usefulness of Screening MRA for the Diagnosis of Cerebral Aneurysm

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## ABSTRACT

Brain MRA for the purpose of primarily diagnosing cerebral aneurysm has the advantage that it can observe blood vessels of the brain without using contrast media. Based on 2,680 people performing the brain MRA examination at health checkup. For MRA examination, SIGNA HDxt 3.0T of GE company is used, and FOV = 220 mm, TE = 2.60 ms, SL = 1.2 / no gab, TR = 24 ms, slice number is 208 pieces for all MRA images, using the TOF. We obtained images including willis-circled in the axial direction, the axial source image is reconstructed with MIP, and the axial plan is rotated by 5° in the vertical axis and the transverse axis then it got an MIP image. Statistic was used SPSS Statistics 20. A cerebral aneurysm of 107 out of 2,680 people examined for MRA in cerebrovascular examination was diagnosed and this result is similar to that when the nation incidence rate of Un-ruptured aneurysm is about 4% per population it shows numerical values. The most common aneurysms were paraclinoid, followed by p-com ICA. Among the diagnosed patients, 39 patients were judged to need immediate treatment, 14 of whom were treated at the hospital and the remaining patients were referred to other hospitals. There were 68 cases with suspected cerebral aneurysm. The source image was not confirmed, or the brain CTA result was normal or the mean of the treatment was not significant. The remaining patients are mostly tiny aneurysms and are usually recommended to follow-up brain CTA or MRA a year later. During examinations for cerebral aneurysm diagnosis, non-contrast brain MRA are thought to be the best screening method for patients without symptoms.

**Keywords:** cerebral aneurysm, brain CTA, brain MRA, TOF, MIP

## INTRODUCTION

A cerebral aneurysm is a dangerous disease often called “a time bomb in the brain”, it is a dreadful disease that can suffer serious neurological damage if it ruptures, and in the worst case it will die<sup>1-2</sup>. Therefore, proper treatment by early diagnosis can be the best treatment that can reduce mortality.

The MRA does not require NPO (nothing per oral) without using contrast media, can be repeatedly examined, there is no danger of radiation exposure, has high signal-to-noise ratio (SNR), high spatial resolution and resolving power, short TE values can be inspected in a short time. So it has superior advantages over other invasive tests to diagnose cerebral aneurysms<sup>3-4</sup>. I would like to investigate

the usefulness of cerebral aneurysm diagnosis through medical examination for medical examination.

An examinee who have symptoms of little symptoms, not symptoms of headaches (not so much as to come to the hospital).

## MATERIALS AND METHOD

We targeted a total of 2,680 examinees who got brain MRA examination at health checkup from February 1, 2012 to December 31, 2015 at M Hospital in Gyeonggi Province.

MRA is an angiography based on magnetic resonance imaging. It is widely used in the diagnosis of a vascular disease, aneurysm, arterio-venous malformation (AVM), etc.<sup>5-10</sup>

The MRAs are divided into two distinct ways of using contrast media and not in use. The method we use is Time of flight MRA (TOF MRA) which do not use contrast media.

TOF MRA have a shorter examination time due to the increased uptake of blood vessels due to the inflow effects of blood flow<sup>5-10</sup>.

**MRA Technique:** For MRA examination, SIGNA HDxt 3.0T of GE company is used, and FOV = 220 mm, TE = 2.60 ms, SL = 1.2/no gab, TR = 24 ms, Slice number is 208 pieces for all MRA images, NEX = 1 used. Using the TOF (Time of flight), we obtained images including willis-circled in the axial direction, the axial source image is reconstructed with MIP (Maximum intensity projection), and the axial plan is rotated by 5 ° in the vertical axis and the transverse axis then I got an MIP image.

The SIGNA HDxt 3.0T of GE company machine are as follows in Figure 1.



Figure 1: 3.0T MRI system (GESignaSystems)

The TOF MRA images are as follows in Figure 2.

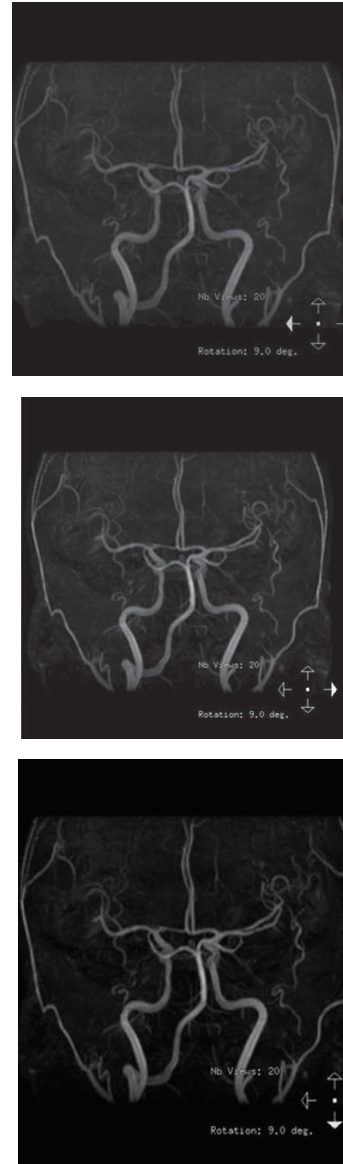
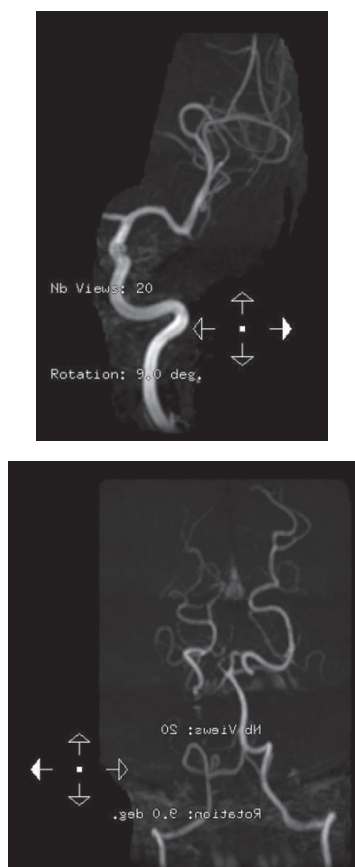


Figure 2: TOF MRA images

The resulting images were expressed segmentation by divisions of RT ICA, LT ICA, and VA in Figure 3.





**Figure 3: Segmentation by divisions of RT ICA, LT ICA, and VA**

**MRA Image reading:** Image reading was read by professor in charge of neurovascular part of radiology and classified as abnormal including suspected findings of readout cerebral aneurysm.

Image reading is only achieved with 3T MRA, primary reading was divided suspected findings and final diagnosis.

The patient in confirm of diagnosis recommended that the CTA or TFCA be subjected to additional inspections.

**Data analysis and statistical processing:** Statistical analysis methods which are more certain sex incidence in the aneurysm by dividing the genders using a descriptive statistical analysis using IBM SPSS ver. 20 divided into men and women is also the ages 20, 30, 40, 50, 60 divided into units, 70, at least 80 to investigate a specific age for ages that generate a lot.

In addition, the majority of places were divided into areas where the majority of places occurred, the frequency per site was calculated.

**RESULTS AND DISCUSSION**

A cerebral aneurysm of 107 out of 2,680 people an examiner for MRA in cerebrovascular examination was diagnosed and this result is similar to that when the nation incidence rate of Un-ruptured aneurysm is about 4% per population it shows numerical values.

**Total Examinees Analysis:** The results of sex distribution of examinees are as shown in Table 1.

**Table 1: Percentage of male and female total examinees n = 2680**

Sex	N %	
Male	1526	57
Female	1154	43

The results of age distribution of examinees are as shown in Table 2.

**Table 2: Results of age distribution of examinees n = 2680**

	Male	Female	Total
20~29	18	3	21
30~39	187	81	268
40~49	323	342	665
50~59	488	362	850
60~69	316	203	519
70~79	187	159	346
80~ more than	7	4	11

It was mainly intended for inspecting the examinees, so he had a lot of males. According to age groups that the age of 50 to 59 was the highest.

In addition, male and female men numbered 1526(27%) men and 1154(43%) women.

**MRA Reading Result:** TOF MRA primary reading results are normal 2439 people, suspicion 143 people, definite diagnosis 98 people as shown in Table 3.

**Table 3: Results of primary MRA n = 2680**

	N	Male	Female	Total
Normal	2439	1367	72	2439
Suspicion	143	74	69	143
Definite Diagnosis	98	50	48	98



Additional examination were recommended if further examination of 143 patients was required additional inspections recommend CTA or TFCA inspections.

As a result 9 people were additionally definite diagnosed as shown in Table 4.

**Table 4: Additional examination results n = 143**

	Normal	Aneurysm	Total
CTA	82	6	88
TFCA	7	5	12
None	-	-	43

So, there were 107 persons who were definite diagnosed. A cerebral aneurysm of 107 out of 2,680 people examined for MRA in cerebrovascular examination was diagnosed and this result is similar to that when the nation incidence rate of un-ruptured aneurysm is about 4% per population it shows numerical values as shown in Table 5.

**Table 5: Final diagnosis of cerebral aneurysm n = 107**

Age	N	Male	Female	Total
20~29	2	1	1	2
30~39	8	4	4	8
40~49	15	6	9	15
50~59	42	26	16	42
60~69	28	13	15	28
70~79	11	7	4	11
80~more than	1	1	0	1
Sum	107	58 (54.2%)	49 (45.8%)	107

As a result, The location of the cerebral aneurysm was the largest paraclinoid. After that, p-com ICA, supraclinoid, MCA, a-com ICA as shown in Table 6.

**Table 6: Diagnosed cerebral aneurysm location distribution n = 107**

	N	Male	Female
A-com ICA	9	5	4
MCA	13	9	4
Paraclinoid	34	19	15
Supraclinoid	11	5	6
Cavenous ICA	8	4	4
Ophthalmic	8	4	4
P-com ICA	20	9	11

Conted...

Basilar top	2	1	1
SCA	2	2	0
Total	107	58	49

The number of patients diagnosed with active treatment was 39, and 14 were treated in the M hospital.

The others 25 people went to the other hospital with a residential area, an acquaintance, etc as shown in Table 7.

**Table 7: Forms of treatment n = 107**

Immediate treatment	39
One-year follow-up observation	68

In addition, 68 people were diagnosed with cerebral arterial aneurysm, but most of the tiny aneurysms, it was recommended that one would normally examination CTA and MRA in a typical age of 1 year.

Also there were 65 cases of suspicious brain aneurysm, but it was confirmed that it was unlikely to be detected as a source image or as a result of the CTA or TFCA, which resulted in no further tracing.

## CONCLUSION

1/3 of patients with subarachnoid hemorrhage die on the spot, and one third is a terrible disease with a 50% chance of dying within one month, severe neurological deficits can occur in more than 1/3 of survivors, so early diagnosis and prevention is the only treatment that can be the best treatment.

Brain MRA can observe cerebral blood vessels without using contrast media and it has the advantage of not taking much time compared to other MRI scans. In addition, the accuracy of 3T MRA has been reported to be over 90% in many studies<sup>11-13</sup>. There is also no need to worry about exposure to radiation. MRA for cerebral aneurysm diagnosis is the best test for early detection of cerebral aneurysm if the price is reasonable and the elastic reservation program of MRI room is used appropriately.

According to the 2010 health insurance review assessment service, the frequency of occurrence of non-ruptured cerebral aneurysm is occurring in about 4 % of the total population and the probability of occurrence of subarachnoid hemorrhage (SAH) is reported to 10 persons per 100,000 people.

However, recently, most of the cerebral aneurysm size of the subarachnoid hemorrhage (SAH) sufferers is occurring in excess of 10 mm.

Brain MRA examination for diagnosing cerebral aneurysm diagnosis may reduce the risk of radiation exposure without radiation exposure and consent. Also, there is no need for NPO, especially reluctance to I.V or problems.

It is judged that if the cost of an MRI and the elastic operation of the MRI room is achieved, it is the best examination for early diagnosis of cerebral aneurysms.

**Ethical Clearance:** Taken from Seonam University

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# Interrelationship between Level of Serum Vitamin D and Allergic Diseases

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## ABSTRACT

Recently, many researcher have reported that vitamin D level was associated with cardiovascular disease, diabetes mellitus, rheumatoid arthritis, multiple sclerosis, and deadly cancers. This study was to identify the interrelationship between level of vitamin D and allergic diseases who visited a community hospital in Cheongju Ciity, Republic of Korea. We reviewed the medical records of 787 patients from 2013 to 2015, retrospectively. We gathered data of age, seasons, vitamin 1,25(OH)D level, vitamin 25(OH)D level, and related factors. Multilinear regression analysis was performed with only the variables showing significant differences in the univariate analysis. Results of this study showed a significant interrelationship between vitamin D level and related factors include age and seasons. There were no significant differences of vitamin D levels between healthy and patients with dermatitis, rhinitis, eating disorder, insomnia and hypothyroidism. Prevalence of vitamin D deficiency was high among Koreans. We recommend that sunlight exposure are needed based on age, seasons, and others.

**Keywords:** Vitamin D, Interrelationship, Deficiency, Allergic disease, Koreans

## INTRODUCTION

Vitamin D is a hormone with diverse functions<sup>1</sup>, especially as a hormone required for the growth and maintenance of the skeleton. A new light on vitamin D has been made since the expression of vitamin D receptor and 1 $\alpha$ -hydroxylase (1 $\alpha$ -hydroxylase) has been reported in various cells and tissues of the human body<sup>1,2</sup>. Recently, it was reported that vitamin D is playing an important role in immune regulation. Previous many studies have shown that vitamin D deficiency was associated with not only bone metabolism but also diabetes<sup>3,4</sup>, cancer<sup>5,6</sup>, cardiovascular disease<sup>7,8</sup>, autoimmune disease<sup>9,10</sup>, Infectious diseases<sup>11</sup>. These vitamin D circulate in the blood or are stored in tissues<sup>12</sup>.

More than 80% of the vitamin D present in the body is synthesized by converting 7-dehydrocholesterol of the skin into vitamin D<sub>3</sub> by exposure to ultraviolet B in sunlight<sup>2,9,13,14</sup>. The remaining 20% is supplemented through food, but the amount is very small. Vitamin D circulate into the blood and is stored in adipose tissue and is converted to 25-hydroxylated vitamin D (25 (OH)

D) in the liver. 25 (OH) D is converted to active vitamin D 1,25-hydroxy vitamin D (1,25 (OH) D) through the kidney or other cells. The half-life of 1,25 (OH) D is 5 to 8 hours, which can be even elevated or normal in the presence of vitamin D deficiency. Thus, 25 (OH) D is useful for measuring vitamin D status<sup>2,9,13</sup>.

In general, the criteria for vitamin D are severe deficiency of less than 10 ng / mL, deficiency of 10-20 ng / mL, relative insufficiency of 21-29 ng / mL, sufficient of 30 ng / mL or more<sup>1,15</sup>, however, no formal agreement has yet been reached. Recently, the function of vitamin D in immune regulation<sup>1,16,17</sup> has become known, and it has been argued that the criterion for deficiency and deficiency should be increased<sup>18</sup>.

Modern occupations have a lot of indoor activity, and there are fewer opportunities for exposure to ultraviolet rays due to the indoor environment and everyday life, and vitamin D synthesis is less than in the past. Recently, vitamin D deficiency had been reported in a various populations depending on age, race, culture, disease status, and residential area<sup>1</sup>. In Korea, deficiency

of vitamin D is one of the most prevalent<sup>13,19</sup>, and in the National Health and Nutrition Survey, sufficient (30ng/mL or more) is 13.2% for men and 6.7% for women<sup>20</sup>.

Recently, allergic diseases have increased rapidly worldwide. The reason for this is the claim that 'the westernized lifestyle reduces the exposure time of sunlight, resulting in deficiency of vitamin D, which leads to immune regulation disorder and increased expression of allergic diseases'. Therefore, studies on vitamin D and allergic diseases are actively under way. It also has been reported that vitamin D is related with atopic dermatitis<sup>21,22</sup>. However, no clear mechanism between atopic dermatitis and vitamin D has yet been established. Indeed, vitamin D deficiency has not been proven to be a causative agent of allergic diseases or an incidental phenomenon<sup>23</sup>.

Although there are studies on the association between allergic diseases and vitamin D in Korea, most of them are conducted in children who visit tertiary medical institutions. The aim of this study was to investigate the level of vitamin D in the blood of normal adults in primary care and to investigate the relationship between vitamin D levels and other diseases, especially allergic diseases.

## STUDY SUBJECTS AND METHODS

The purpose of this study was to assess the efficacy, risk and safety of vitamin D 1 or vitamin D 25 or OH 25 D (OH) D in a medical institution in a city from March 1, 2013 to February 29. The patient records were reviewed at the time of blood sampling of the subjects, and the main variables and test results of this study were recorded. To minimize the intervention of the researcher, the third party reviewed and entered the patient record, and the variables were constructed based on the diagnosis name and the evidence recorded at the time of the examination. Subjects were allergic rhinitis, allergic dermatitis, eating disorders, sleep disturbances, chronic fatigue. Also included were patients who were given consent for routine blood tests and added blood vitamin D tests. Patients were diagnosed and treated by a physician.

The specimens were collected in the hospital and submitted to the Seegene Medical Foundation for examination. Vitamin 25 (OH) D was measured by CLIA method using Unicell DXI 800 Bakman Cooler (USA) and Vitamin 25 (OH) D was measured by RIA method using Dream Gamma 10 CUUNTER (ShinjinMedix).

A total of 792 blood vitamin D levels were measured. A total of 787 subjects were selected, including 247 men and 540 women, except for those with overlapping

subjects and those with an out-lier blood vitamin D level. Of these, vitamin D 1,25 (OH) D was measured in 734 patients and vitamin D (OH) D was measured in 392 patients. Serum vitamin D levels were selected as dependent variables.

The independent variables included gender, age, date of test, clinical symptoms (allergic dermatitis, allergic rhinitis, eating disorders, sleep disorders, hypothyroidism). The age of the patients was divided into 10 years according to the date of the blood test. The test dates were classified 4 seasonal groups. Clinical symptoms were classified as 'present' when the test was performed and 'absent' when the test was not performed at the time of the test, and 'none' when symptoms were observed 1 month before or after the test. Allergic dermatitis was defined as a case of diagnosis of the infectious disease codes L209, L210, L211, L218, L219, L500, and allergic rhinitis was defined as cases diagnosed with the disease codes J301, J302, J303 and J304. Sleep disturbances were defined as cases diagnosed with the infectious disease codes F510, F512, F518, and F519, and hypothyroidism was defined as cases diagnosed with the infectious disease codes E031, E034, E038, and E039. Eating disorder was defined as the case of taking an appetite suppressant among diet therapists.

Differences in serum vitamin D levels by independent variables were tested by t-test and one-way ANOVA, followed by Duncan's method as post-hoc test. The statistical significance of the test results was defined as the level of  $p < 0.05$ . Multilinear regression analysis was performed with only the variables showing significant differences in the univariate analysis.

## RESULTS

**General characteristics of study subject:** A total of 787 subjects were studied, including 247 men (31.4%) and 540 women (68.6%). Overall, the most frequent was in the second and third decades (37.6%). The most common sexes were men under 20 years of age (30.1%) and women in the second to thirties (43.5%). There was a statistically significant difference ( $p = 0.335$ ) between the spring (March to May) and autumn (September to November). Among the diseases, 310 (39.4%) were infected with dermatitis, 259 (32.9%) with rhinitis, 169 (21.5%) with eating disorder, 69 (8.8%) with sleeping disorder and 25 (3.2%) with hypothyroidism. In males, 2.4% were found to be eating disorders, while in females, 30.2% had eating disorders ( $p < 0.001$ ). Sleep disturbances and hypothyroidism were rare in males and 12.2% and 4.6% in females, respectively ( $p < 0.001$ ,  $p = 0.001$ ) (Table 1). (Insert table 1)

**Table1: Distribution of general characteristics among this study subjects Unit: N(%)**

	Total		Men		Women		p-value*
	787	(100.0)	247	(31.4)	540	(68.6)	
<b>Age (years)</b>							
<20	237	(30.1)	124	(50.2)	113	(20.9)	<0.001
20~39	296	(37.6)	61	(24.7)	235	(43.5)	
≥40	254	(32.3)	62	(25.1)	192	(35.6)	
<b>Seasons</b>							
Spring	238	(30.2)	81	(32.8)	157	(29.1)	0.335
Summer	174	(22.1)	54	(21.9)	120	(22.2)	
Autumn	213	(27.1)	57	(23.1)	156	(28.9)	
Winter	162	(20.6)	55	(22.3)	107	(19.8)	
<b>Dermatitis</b>							
Yes	310	(39.4)	141	(57.1)	169	(31.3)	<0.001
No	477	(60.6)	106	(42.9)	371	(68.7)	
<b>Rhinitis</b>							
Yes	259	(32.9)	109	(44.1)	150	(27.8)	<0.001
No	528	(67.1)	138	(55.9)	390	(72.2)	
<b>Eating disorder</b>							
Yes	169	(21.5)	6	(2.4)	163	(30.2)	<0.001
No	618	(78.5)	241	(97.6)	377	(69.8)	
<b>Insomnia</b>							
Yes	69	(8.8)	3	(1.2)	66	(12.2)	<0.001
No	718	(91.2)	244	(98.8)	474	(87.8)	
<b>Hypothyroidism</b>							
Yes	25	(3.2)	0	(0.0)	25	(4.6)	0.001
No	762	(96.8)	247	(100.0)	515	(95.4)	
* p-values were calculated by x <sup>2</sup> -test							

Overall, only 12.5% of the total vitamin D levels were in sufficient condition, 24.0% in relative deficiency, 56.6% in deficiency and 6.9% in severe deficiency. Vitamin D in men was found to be sufficient in 17.8%, relatively insufficient in 32.7%, deficient in 44.9% and severe in 4.7%. The deficiency of vitamin D was more frequent in women than in men ( $p = 0.006$ ), with 10.5% in women, 20.7% in deficient state, 61.1% in deficient state, and 7.7% in severe deficiency. According to the diseases, 17.4% and 19.3% of allergic dermatitis and allergic rhinitis patients had sufficient vitamin D, 3.1%,

7.5% and 10.0% of sufficient condition for eating disorder, insomnia and hypothyroidism respectively appear. There was a statistically significant difference in the distribution of vitamin D deficiency among allergic dermatitis, allergic rhinitis, and eating disorders ( $p = 0.044$ ,  $p = 0.010$ ,  $p < 0.001$ ). However, insomnia and hypothyroidism did not show significant differences in the distribution of vitamin D deficiency ( $p = 0.624$ ,  $p = 0.936$ ). Vitamin D deficiency was most popular in each disease, followed by relative deficiency (Table 2).

**Table 2: Distribution of vitamin D deficiency by diseases**

	Total		Severe deficiency		Deficiency		Relative insufficiency		Sufficiency		p-value*
	392	(100.0)	27	(6.9)	222	(56.6)	94	(24.0)	49	(12.5)	
<b>Gender</b>											
Men	107	(27.3)	5	(4.7)	48	(44.9)	35	(32.7)	19	(17.8)	0.006
Women	285	(72.7)	22	(7.7)	174	(61.1)	59	(20.7)	30	(10.5)	

Conted...

Diseases											
Dermatitis	115	(29.3)	6	(5.2)	55	(47.8)	34	(29.6)	20	(17.4)	0.044
Rhinitis	135	(34.4)	9	(6.7)	64	(47.4)	36	(26.7)	26	(19.3)	0.010
Eating disorder	97	(24.7)	9	(9.3)	69	(71.1)	16	(16.5)	3	(3.1)	<0.001
Insomnia	40	(10.2)	3	(7.5)	26	(65.0)	8	(20.0)	3	(7.5)	0.624
Hypothyroidism	20	(5.1)	2	(10.0)	11	(55.0)	5	(25.0)	2	(10.0)	0.936

\* p-values were calculated by x<sup>2</sup>-test**Difference of Vitamin D by characteristic of study**

**subject:** There was no statistically significant difference ( $p = 0.243$ ) between vitamins 1,25 (OH) D in male and  $34.03 \pm 12.13$  ng / mL in female and  $32.94 \pm 11.52$  ng / mL in female. In the age group, vitamin D 1,25 (OH) D was higher than other age groups ( $37.58 \pm 11.95$  ng / mL), while those aged 40 and over were the lowest with  $30.94 \pm 11.69$  ng / mL ( $p < 0.001$ ). There were  $33.67 \pm 11.40$  ng / mL in March to May,  $33.54 \pm 12.07$  ng / mL in June and August,  $34.13 \pm 11.73$  ng / mL in September and November, and  $31.19 \pm 11.64$  ng / mL in February and February. However, there was no statistically significance ( $p = 0.112$ ). Vitamin 1,25 (OH) D was clinically significant in patients with allergic dermatitis and rhinitis ( $p = 0.006$ ). In addition, there was no significant difference between the two groups in the presence of diabetes mellitus, sleep disorders, and hypothyroidism (Table 3).

**Table 3: Vitamin 1,25(OH) D level of study subjects by general characteristic Unit: Mean $\pm$ SD(ng/ml)**

	Vitamin 1,25 (OH) D					p-value*
	N	(%)	Mean	$\pm$	SD	
<b>Gender</b>						0.243
Men	230	(31.3)	34.03	$\pm$	12.13	
Women	504	(68.7)	32.94	$\pm$	11.52	
<b>Age (years)</b>						<0.001**
<20	225	(30.7)	37.58	$\pm$	11.95	b
20~39	277	(37.7)	31.75	$\pm$	10.60	a
$\geq 40$	232	(31.6)	30.94	$\pm$	11.69	a
<b>Seasons</b>						0.112
Spring	218	(29.7)	33.67	$\pm$	11.40	
Summer	167	(22.8)	33.54	$\pm$	12.07	
Autumn	205	(27.9)	34.13	$\pm$	11.73	
Winter	144	(19.6)	31.19	$\pm$	11.64	

Conted...

<b>Dermatitis</b>						0.227
Yes	293	(39.9)	33.92	$\pm$	11.95	
No	441	(60.1)	32.86	$\pm$	11.56	
<b>Rhinitis</b>						0.006
Yes	239	(32.6)	34.99	$\pm$	12.48	
No	495	(67.4)	32.46	$\pm$	11.26	
<b>Eating disorder</b>						0.195
Yes	165	(22.5)	32.32	$\pm$	10.34	
No	569	(77.5)	33.56	$\pm$	12.08	
<b>Insomnia</b>						0.154
Yes	61	(8.3)	31.23	$\pm$	12.01	
No	673	(91.7)	33.47	$\pm$	11.68	
<b>Hypothyroidism</b>						0.079
Yes	20	(2.7)	28.74	$\pm$	7.11	
No	714	(97.3)	33.41	$\pm$	11.80	
Total	734	(100)	33.28	$\pm$	11.72	

Vitamin 25 (OH) D was  $22.10 \pm 9.70$  ng/mL in males and  $18.62 \pm 8.86$  ng/mL in females and was significantly higher in males than females and statistically significant ( $p < 0.001$ ). In the age group, the highest value was  $25.26 \pm 11.85$  ng/mL at 20 years of age and the lowest at  $16.18 \pm 5.54$  ng/mL between 20 and 39 years of age. There was statistically significant difference within the age group ( $p < 0.001$ ). There was a statistically significance ( $p < 0.001$ ) between 3 and 5 months in  $16.49 \pm 8.07$  ng/mL, and  $23.76 \pm 9.68$  ng/mL in 9 and November, respectively. According to clinical symptoms, vitamin D 25 (OH) D levels were higher than those without allergic dermatitis, but there was no statistically significance ( $p = 0.106$ ). On the other hand, vitamin D 25 (OH) D in the allergic rhinitis group was  $22.15 \pm 11.27$  ng/mL, which was higher than the group without rhinitis symptoms ( $p < 0.001$ ). There was a statistically significance ( $p < 0.001$ ) between vitamin E 25 (OH) D and vitamin E 25 (OH) D, which was lower than that of the group without eating disorder ( $16.36 \pm 5.70$  ng / mL). There was no statistically significance between the two groups in terms of sleeping disorder and hypothyroidism (Table 4).

**Table 4: Vitamin 25(OH) D level of study subjects by general characteristics Unit: Mean ± SD(ng/mL)**

	Vitamin 25(OH) D					p-value*
	N	(%)	Mean	±	SD	
<b>Gender</b>						
Men	107	(27.3)	22.10	±	9.70	0.001
Women	285	(72.7)	18.62	±	8.86	
<b>Age (years)</b>						
<20	102	(26.0)	25.26	±	11.85	c
20~39	152	(38.8)	16.18	±	5.54	a
≥40	138	(35.2)	19.09	±	8.25	b
<b>Seasons</b>						
Spring	142	(36.2)	16.49	±	8.07	a
Summer	80	(20.4)	19.67	±	7.67	b
Autumn	100	(25.5)	23.76	±	9.68	c
Winter	70	(17.9)	19.70	±	10.08	b
<b>Dermatitis</b>						
Yes	115	(29.3)	20.74	±	9.01	0.106
No	277	(70.7)	19.08	±	9.28	
<b>Rhinitis</b>						
Yes	135	(34.4)	22.15	±	11.27	<0.001
No	257	(65.6)	18.21	±	7.61	
<b>Eating disorder</b>						
Yes	97	(24.7)	16.36	±	5.70	<0.001
No	295	(75.3)	20.62	±	9.89	
<b>Insomnia</b>						
Yes	40	(10.2)	17.87	±	7.48	0.220
No	352	(89.8)	19.76	±	9.38	
<b>Hypothyroidism</b>						
Yes	20	(5.1)	17.70	±	8.21	0.352
No	372	(94.9)	19.67	±	9.27	
Total	392	(100)	19.57	±	9.22	

\*p-values were calculated by Student t-test, ANOVA  
 \*\*by Duncan's test; no significant difference between the group which have same word.

**Related factors with vitamin D level:** Regression analysis of vitamin D 1,25 (OH) D showed that vitamin D levels were 6.4 times higher than those aged <40 years, and statistically significance (p <0.001). There were no statistically significant differences in age, ages from 20 to 39, allergic rhinitis, and hypothyroidism (Table 5).

**Table 5: Independent factors for vitamin 1,25(OH) D leve**

Variables	B	SE of B	β	95% CI		p-value
<b>Age(years) (ref. ≥40)</b>						
<20	6.40	1.14	0.25	4.17	~ 8.63	<0.001
20~39	0.71	1.02	0.03	-1.29	~ 2.71	0.484
<b>Rhinitis (ref. No)</b>						
Yes	0.22	0.97	0.01	-1.69	~ 2.12	0.823
<b>Hypothyroidism (ref. No)</b>						
Yes	-2.53	2.62	-0.04	-7.67	~ 2.60	0.333
R square	0.062					
adjusted R square	0.056					

Regression analysis of vitamin D 25 (OH) D showed that levels of vitamin D were 5.04 times higher (p <0.001) than those aged over 40 years, but vitamin D levels were 2.65 times lower in 20s and 30s (P = 0.006). Vitamin D levels were 3.30 times lower in spring (March, April, and May) than in winter (December, January, and February) (p = 0.005). The highest level of vitamin D was 3.92 times in autumn (September, October, and November) (p = 0.002). There was no statistically significant difference in gender, summer season, allergic rhinitis, and eating disorders (Table 6).

**Table 6: Independent factors for vitamin 25(OH) D level**

Variables	B	SE of B	β	95%CI		p-value
<b>Gender (ref. Women)</b>						
Men	1.27	0.97	0.06	-0.64	~ 3.18	0.191
<b>Age(years) (ref. ≥40)</b>						
<20	5.04	1.13	0.24	2.82	~ 7.27	<0.001
20~39	-2.65	0.95	-0.14	-4.53	~ -0.77	0.006
<b>Seasons (ref. Winter)</b>						
Spring	-3.30	1.18	-0.17	-5.61	~ -0.98	0.005
Summer	1.02	1.33	0.04	-1.59	~ 3.63	0.442
Autumn	3.92	1.26	0.19	1.45	~ 6.39	0.002
<b>Rhinitis (ref. No)</b>						
Yes	1.25	0.97	0.06	-0.65	~ 3.16	0.196
<b>Eating disorder (ref. No)</b>						
Yes	-1.52	1.07	-0.07	-3.61	~ 0.58	0.155
R square	0.260					
adjusted R square	0.245					

## DISCUSSIONS

The purpose of this study was to investigate the level of vitamin D in the blood of patients who visited a medical institution for three years and to determine the factors effecting the level of vitamin D in the blood. Similar to the low reported vitamin D in women in Asia<sup>24</sup>, this study also showed that women had lower blood vitamin D levels than men. This is in agreement with the existing research results<sup>20,25</sup>. This tendency is thought to be due to the fact that women are relatively less active in external activities than men and are reluctant to be exposed to the sun. Also, the fact that men who are under 20 years of age and who have a lot of activity are included in the study will be the reason why vitamin D in the blood is low in women.

In this context, it is known that the elderly with little outdoor activities have low levels of vitamin D in their blood<sup>26</sup>. In this study, vitamin D was higher in the age group below 20 years than in those aged 40 years or older. Although we could not directly compare the variables related to outdoor activities, the interrelationship between vitamin D level and outdoor activities is likely to be high in patients with disease. In addition, similar to Canada<sup>27</sup>, the 20 to 39 year olds with the highest social activity showed the lowest vitamin D levels. This was because the social activities of 20-39 year olds are mostly indoor activities as a clerical worker, and this study seems to be due to the fact that many women are included in the 20-39 age group.

There was a difference in the level of vitamin D depending on the season. Vitamin D was lowest in spring (3, 4 and 5 months) and highest in autumn (September, October, and November). Because vitamin D is synthesized by exposing the keratinocytes of the skin to ultraviolet B<sup>13,14</sup>, blood levels of vitamin D are generally low in winter<sup>27,28</sup> and serum vitamin D levels are high in summer<sup>12</sup>. However, recent use of sunscreen agents has increased in recent summer, and there is more time to work indoors from the sun<sup>29</sup>. Vitamin D may be higher in autumn than in the hot summer months. As in autumn, vitamin D was expected to be high in spring, so vitamin D was the lowest in spring. This tendency is different from the previous study<sup>25</sup> in which the concentration of vitamin D in the blood is lowered in the order of fall-summer-spring-winter. Therefore, it is necessary to study the characteristics of the subjects in detail.

Vitamin D serve an important function in the immune system<sup>30,31</sup>, and many studies have been conducted recently on the expression of allergic diseases. It have been interrelated with the development of diabetes<sup>3,4</sup>, cancer<sup>5,6</sup>, cardiovascular disease<sup>7,8</sup>, autoimmune disease<sup>9,10</sup>, and infectious disease<sup>11</sup>. Clinical studies on atopic dermatitis and vitamin D have been related with the intensity of atopic dermatitis in children with vitamin D deficiency<sup>21</sup>, although the severity of vitamin D levels and disease severity was not related to the overall severity of atopic dermatitis, In atopic dermatitis patients with severe atopic dermatitis, vitamin D levels were lower than mild atopic dermatitis<sup>22</sup>. However, in this study, the level of serum vitamin D in each disease did not show any significant difference. This is probably due to the fact that the severity of illness among the subjects who visited the primary care facility was mild. Considering that vitamin D is not clearly proven as a causative factor in disease outbreaks, the differences from healthy groups may disappear as more patients with mild disease are included. In conclusion, serum vitamin D is expected to serve an important function only in certain stages of disease severity, and further studies on the severity of the disease should be conducted in the future.

The first limitation of this study was that the results of the study can not be easily generalized. A total of 787 subjects were included in the study, including patients who did not show any symptoms including those who visited for health checkups, patients with allergic diseases, and those with other diseases such as eating disorders or insomnia. However, the subjects of this study are outpatients who are localized to a specific area, and the control group can not represent the non-diseased group because it is the subject who does not have the disease or who visits the hospital for a specific purpose. Therefore, interpretation of results should be considered.

The second limitation was that the study did not include a variety of variables that could affect the level of vitamin D as well as the characteristics of the subjects, since this was a retrospective study using patient records. Since 80% of the vitamin D is synthesized by ultraviolet exposure, sun exposure is a very important parameter. However, this information is not normally available from patient records. Occupation is also one of the characteristics that indirectly grasps the degree of sunlight exposure, but it can not be utilized because it is partially described in the patient record.



In addition, the severity of the disease could not be categorized, especially blood tests for therapeutic and diagnostic purposes were mixed and blood test items other than vitamin D could not be used because the subjects did not agree. The vitamin D level and distribution were in agreement with those of previous studies. However, unlike previous studies in the short term, it was not only the patient. It is significant that the study included a large number of subjects including the general public. Future prospective studies including various variables such as future sun exposure and disease severity are needed.

The third limitation was that vitamin D levels were compared within patients who were not healthy controls without disease. Therefore, the difference in vitamin D levels due to actual disease may be some different from the results of this study, and a comparative study including healthy adults is needed in the future.

This study was conducted to identify the level of vitamin D based on patient records accumulated in a primary care facility in a region for three years and to investigate the relationship with specific diseases. Although there was a limit to the interpretation of the results, the overall vitamin D level and distribution were consistent with previous studies and it was significant that the general population and the patient group were included as study subjects.

As in previous studies, the importance of vitamin D has been emphasized in various diseases. The factors related to the level of vitamin D in the blood are presumed to be closely related to the daily life such as age, time, and exposure to sunlight. In this study, age and season were found to be interrelated to vitamin D levels in the blood, and the incidence of disease was less relevant. In the future, the level of vitamin D should be determined along with the lifestyle of the patients in each disease. In addition, a discussion of appropriate levels of vitamin D and recommendations for supplemental therapies should be prepared.

## CONCLUSIONS

Vitamin D is a multifunctional hormone that has recently been implicated in the development of immune regulation process, bone metabolism, diabetes, cancer, cardiovascular disease, autoimmune disease, and infectious diseases.

The purpose of this study was to investigate the level of vitamin D in patients visiting a primary care facility in a region and to investigate the relationship between allergic diseases and other diseases

The study data were reconstructed based on the patient records accumulated over the past three years. A total of 787 subjects were included in the study, including patients who did not show any symptoms including those who visited for health checkups, patients with allergic diseases, and those with other diseases such as eating disorders or insomnia. Serum vitamin D levels were associated to age and season, and there was no significant difference according to the prevalence status of disease.

This study was conducted in an exploratory study to find the factors associated with vitamin D levels, and results showed that age and season were related factors. However, as a result of using limited data at a primary medical institution in one area, it is necessary to carry out studies based on various data in the future.

**Ethical Clearance:** Taken from Konyang University

**Source of Funding:** Self

**Conflict of Interest:** NA

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# The Impact of Sexual Autonomy and Marital Communication on Contraceptive Behavior among Unmarried Couples

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## ABSTRACT

The purpose of this study was to investigate the correlation between the contraceptive behavior and sexual autonomy of unmarried young people. The research was carried out among unmarried young people in Korea. The participants of this study were university students in C Province of Korea, and the study was performed in 2016. One hundred seventy four answer sheets out of two hundred respondents were analyzed except for 26 incomplete ones. The independent variables are sexual autonomy, marital communication, and contraceptive behavior for dependent variable. SPSS WIN 22.0 for statistical analysis of the data was used in this study. The participants in this study are 67 males (38.5%) and 107 females (61.5%). Regarding the proportion of age, 19.5% of participants were under 20 years old, 70.1% of participants were between 21 and 25 years old. The experience rate of sexual intercourse the young couples was 97.1%. The overall mean of the couple's sexual autonomy was upper medium level ( $3.99 \pm 0.69$ ), marital communication was upper level ( $3.03 \pm 0.42$ ), and relationship satisfaction was upper medium ( $3.86 \pm 0.55$ ). The research participants showed a statistically significant difference in sexual autonomy ( $t=3.674$ ,  $p<.001$ ), and marital communication ( $t=3.128$ ,  $p=.002$ ). The participants using contraception showed higher sexual autonomy than the subjects not using contraception. Also, the participants using contraception showed higher marital communication ability than the subjects not using contraception. Sexual autonomy was significantly positively related with marital communication ( $r = .235$ ,  $p=.002$ ) and relationship satisfaction ( $r = .207$ ,  $p=.006$ ). Marital communication was significantly positively related with relationship satisfaction ( $r = .474$ ,  $p<.001$ ). According to results from logistic regression analysis, sexual autonomy (OR=2.472, CI=1.431~4.272), marital communication (OR=3.140, CI=1.182~8.341), contraceptive knowledge (OR=2.248, CI=1.134~4.455) were found to be factors significantly influenced unmarried couple's contraceptive behaviour. It is investigated that contraceptive behavior is associated with communication of young couples and sexual autonomy. Therefore, communication and sexual autonomy should be taken into account in contraception education program to increase safe sex life for unmarried couples.

**Keywords:** *sexual autonomy, marital communication, contraceptive behavior, unmarried couples, college students.*

## INTRODUCTION

Unmarried young couples have an opportunity to promote physical and emotional maturity with forming intimate relationship, learning the anticipated roles of the opposite sex, and ultimately socializing the role of marriage through heterosexuality<sup>1</sup>. In this period, unmarried males and females meet with people who can make close relationship through various meeting with the opposite sex and a trusting relationship with the person has a positive effect on satisfactory marriage life in future<sup>2</sup>.

In addition, the premarital sex rate of unmarried couples is rapidly increasing year by year. A study of 2006 reported that 34% of unmarried females had sexual experience<sup>3</sup>. On the other hand, 85.4% of unmarried males and 56.1% of unmarried females had sexual experience in the other study<sup>4</sup>.

Sexual health is related with a physical, mental, and social well-being state<sup>5</sup>, and it is important to care and respect the others in relation to sex. Therefore, gender identity, intimacy, and autonomy in adolescence are important factors that shape positive values of sex<sup>6</sup>.

Safe sex is important in the sex of unmarried males and females. It is to prevent problems such as sexually transmitted diseases, prenatal pregnancies, and negative outcomes such as unintended pregnancies and low birth weight babies<sup>2</sup>. According to the study on college students in Korea, the rate of having sexual intercourse without using contraceptive tools was 55.2% in the first sexual experience and it is necessary to reconsider the problems<sup>7</sup>. A study reported that college students' contraceptive attitudes towards contraception were more likely to use contraceptives. This suggests that attitudes towards contraception should be considered when developing contraception education program<sup>8</sup>. Prior study suggested that future research should aim to understand how communication with couples influences contraceptive use<sup>1</sup>.

Marital communication and sexual autonomy in couples' romantic intimacy are important correlates of couples' relationship satisfaction. However, few studies have examined the effect of marital communication and sexual autonomy on relationship satisfaction within the context of the interpersonal relationship processes. Sexual autonomy is the essential element of the theory of self-determinism, and it is the actual ability to control and regulate one's own desire or impulse<sup>9</sup>. Sexual autonomy is an important factor of protecting oneself and maintaining good health in situations of sexual contact<sup>10</sup>. As sexual autonomy can control and regulate sexual desire in sexual decision making, it can prevent sexual problems in advance and furthermore, it maintains healthy and safe sex<sup>9</sup>.

Existing studies on contraceptive behavior focus on the concept of planned behavior theory such as the knowledge, attitudes, discussion and intentions regarding family planning rather than on the actual impact of programs on contraceptive use<sup>4</sup>. In other words, although it provides a contraceptive intention and general picture of contraceptive behavior with attitude toward contraception, subjective norm and perceived behavior control, it can be seen that this theory has a limit to explain the complexity of contraceptive behavior. This is because contraceptive behavior is treated on a very personal level, unlike other health behaviors, so it is only partially supported by specific subjects or situations. Especially, though contraceptive act is existent reality, experience world is not known, so it is urgent to consider contraceptive act of unmarried

males and females in addition to rapidly changing sex culture<sup>11</sup>. This study investigated a correlation between contraceptive behavior and sexual autonomy of unmarried young people.

## MATERIALS AND METHOD

**Research Design:** This descriptive correlation study was designed to examine the relevance of unmarried couple's sexual autonomy and contraceptive behavior, and to identify the factors affecting on contraceptive behavior

**Participants:** The research was carried out among unmarried young people in Korea. The participants of this study were university students in C Province of Korea, and the study was performed in 2016. One hundred seventy four answer sheets out of two hundred respondents were analyzed except for 26 incomplete ones.

## MEASUREMENTS

**Sexual Autonomy:** The instrument of measuring sexual autonomy will be the tool developed by a researcher<sup>9</sup> or male and female college students. This tool had a sub-concept of control and correspondence and was composed of a total of 13 items measured by a five-point Likert scale (1 point = not at all, 5 points = very much). The possible score range is from 13 to 65 points. The higher the score, the higher the degree of sexual autonomy. The Cronbach  $\alpha$  value was .86 at the time of development of the tool, and the Cronbach  $\alpha$  value was .89 in the study.

**Marital Communication Inventory:** The Marital Communication Inventory (MCI) developed by Bienyenu<sup>12</sup> and partly modified by Park<sup>13</sup> was used. Park<sup>13</sup> modified MCI from the position of husband and wife to the viewpoint of men and women and she used it considering that it is the closest tool to measure the communication of heterosexual relationship although MCI has some problems in measuring marital communication. The MCI is composed of total 46 self-report items which uses the four-point Likert scale (1 point = never, 2 point = occasionally, 3 point = frequently, 4 point = always) and it means that the higher the score, the more successful communication. As a result of verifying the reliability of the communication scale, the Cronbach  $\alpha$  value was .91.

**Relationship Satisfaction:** The relationship satisfaction scale which was translated and modified by Kim<sup>14</sup> from Marital Satisfaction Inventory (MSI) of Frazier and Esterly<sup>15</sup> will be used in this study. The relationship satisfaction scale was selected as research tool of this program given that the closest measure of relationship satisfaction between the opposite sexes is the relationship satisfaction scale. The questionnaire consisted of 20 positive and 20 negative questions, and each item is related to opinions or feelings about the life of the other person, avoiding cognitive or memory-inducing questions. It is done by self-diagnosis and the format is a five-point Likert scale which is ranged from 'very satisfied' to 'very unsatisfied', so the score range is from a minimum of 40 points to a maximum of 200 points. The higher the score, the higher the degree of satisfaction with the relationship. As a result of verifying the reliability of satisfaction scale in relationships with the opposite sex, the Cronbach  $\alpha$  value was .94 and the internal consistency was high.

**Data Analysis:** SPSS Win 22.0 for statistical analysis of the data was used in this study, and descriptive statistics for the general characteristics, sexual autonomy and marital communication, and relationship satisfaction was conducted. T-test and one-way ANOVA was used for difference analysis of variables and the relation between variables was analyzed with Pearson correlation coefficients. Logistic regressions was used to find affecting factors of contraceptive behavior.

**Ethical Consideration:** The ethical aspects was considered prior to data collection by providing participants with the purpose, the method and utilization of research results of this study. It was also explained that no personal information will be revealed or used for other purposes, and their privacy will be protected. It took about 10 to 15 minutes to complete the survey questionnaire items, and a predetermined gift was provided for participants.

## RESULTS

**Demographic Characteristics:** The baseline characteristics of the participants are shown in Table 1. The participants in this study are 67 males (38.5%) and 107 females (61.5%). Regarding the proportion of age, 19.5% of participants were under 20 years old, 70.1% of participants were between 21 and 25 years old. The experience rate of sexual intercourse the young couples was 97.1%

**Table 1: General Characteristics (N = 174)**

Variables*	Categories	n(%)
Gender	Male	67 (38.5)
	Female	107 (61.5)
Age	≤20 years old	34 (19.5)
	21 ~25 years old	122 (70.1)
	≥26 years old	18 (10.4)
Education level	≤High school	122 (70.1)
	≤Community college	35 (20.1)
	≤College	10 (5.7)
	≤Graduate	5 (2.9)
	Etc.	2 (1.1)
Religion	Yes	57 (32.8)
	No	117 (67.2)
Residence condition	Living with parents	104 (59.8)
	Living alone	40 (23.0)
	Dormitory	27 (15.5)
	Etc.	3 (1.7)
Sexual intercourse	Yes	169 (97.1)
	No	5 (2.9)
Frequency of sexual intercourse (a month)	No	5 (2.9)
	1~10 times	146 (83.9)
	11~20 times	18 (10.3)
	21~30 times	(2.9)
Contraceptive behavior	Yes	125 (71.8)
	No	49 (28.2)

**Descriptive Statistics:** The means and standard deviations are shown in Table 2. The overall mean of the couple's sexual autonomy was upper medium level ( $3.99 \pm 0.69$ ), marital communication was upper level ( $3.03 \pm 0.42$ ), and relationship satisfaction was upper medium ( $3.86 \pm 0.55$ ).

**Table 2: Descriptive statistics (n = 174)**

Variables*	Range	Mean $\pm$ SD
Sexual Autonomy	1~5	$3.99 \pm 0.69$
Marital communication inventory	1~4	$3.03 \pm 0.42$
Relationship satisfaction	1~5	$3.86 \pm 0.55$

Sexual autonomy, Marital communication inventory, and Relationship satisfaction according to General characteristics

Table 3 shows sexual autonomy, marital communication inventory, relationship satisfaction according to general characteristics. The research participants showed a statistically significant difference in sexual autonomy ( $t=3.674$ ,  $p<.001$ ), and marital communication ( $t=3.128$ ,  $p=.002$ ). The participants using contraception showed higher sexual autonomy than the subjects not using contraception. Also, the participants using contraception showed higher marital communication ability than the subjects not using contraception.

**Table 3: Sexual autonomy, marital communication inventory, and relationship satisfaction according to General Characteristics**

Variables*	Categories	Sexual autonomy	F, t (p)	Marital communication	F, t (p)	Relationship satisfaction	F, t (p)
Gender	Male	3.91 (.71)	-1.226 (.222)	2.98 (.41)	-1.181 (.239)	3.90(.59)	.681 (.497)
	Female	4.05 (.67)		3.06 (.42)		3.84(.52)	
Age	≤20 years old	4.01 (.44)	.326 (.722)	3.06 (.42)	.355 (.702)	3.75(.51)	1.013 (.365)
	21 ~25 years old	3.97 (.73)		3.01 (.43)		3.89(.54)	
	≥26 years old	4.11 (.82)		3.09 (.38)		3.92(.64)	
Education level	≤High school	4.01 (.60)	2.396 (.052)	3.02 (.42)	1.228 (.301)	3.86 (.53)	.937 (.444)
	≤Community college	3.82 (.95)		3.06 (.42)		3.83 (.58)	
	≤College	4.52 (.51)		3.23 (.44)		4.05 (.62)	
	≤Graduate	3.69 (.19)		2.75 (.39)		3.61 (.60)	
	Etc.	4.15 (1.20)		2.88 (.60)		4.31 (.27)	
Religion	Yes	4.02 (.63)	.287 (.775)	3.05 (.41)	.433 (.665)	3.82 (.53)	-.785 (.433)
	No	3.98 (.72)		3.02 (.43)		3.89 (.56)	
Residence condition	Living with parents	3.99 (.63)	.063 (.979)	3.06 (.43)	.547 (.651)	3.86 (.55)	.019 (.997)
		4.03 (.60)				2.98 (.40)	
	Living alone	3.98 (.98)		2.97 (.43)		3.87 (.59)	
	Dormitory	3.90 (.77)		3.03 (.35)		3.93(.08)	
	Etc.	3.99 (.69)		3.03 (.42)		3.86 (.55)	
Sexual intercourse	Yes	3.99 (.69)	-.523 (.601)	3.03 (.42)	-.193 (.847)	3.88 (.55)	1.689 (.093)
	No	4.15 (.64)		3.07 (.35)		3.46 (.37)	
Contraceptive behavior	Yes	3.65 (.85)	-3.674 ( $<.001$ )	2.87 (.37)	-3.128 (.002)	3.78 (.48)	-1.315 (.190)
	No	4.13 (.56)		3.09 (.43)		3.90 (.57)	

**Correlation among Main Variables:** Table 4 shows correlations among main variable. Sexual autonomy was significantly positively related with marital communication ( $r = .235$ ,  $p=.002$ ) and relationship satisfaction ( $r = .207$ ,  $p=.006$ ). Marital communication was significantly positively related with relationship satisfaction ( $r = .474$ ,  $p<.001$ ).

**Table 4: Correlation among main variables**

Variable	Sexual autonomy	Marital communication	Relationship satisfaction
Sexual autonomy	1		
Marital communication	.235	1	
	(.002)		
Relationship satisfaction	.207	.474	1
	(.006)	( $<.001$ )	

**Factors Influencing on Contraceptive Behavior:** Results from logistic regression analysis are shown in table 5. Sexual autonomy (OR=2.472, CI=1.431~4.272), marital communication (OR=3.140, CI=1.182~8.341),

contraceptive knowledge(OR=2.248, CI=1.134~4.455) were found to be factors significantly influenced unmarried couple's contraceptive behaviour.

**Table 5: Factors influencing on contraceptive behavior (N = 174)**

Variables	B	S. E.	Exp(B)	p	95% CI
Age	.003	.089	1.003	.975	.843~1.193
Sexual autonomy	.905	.279	2.472	.001	1.143~4.272
Marital communication inventory	1.144	.498	3.140	.022	1.182~8.341
Relationship satisfaction	-.151	.383	.860	.693	.406~1.820
Contraceptive knowledge	.810	.349	2.248	.020	1.134~4.455
Residence condition	-.023	.238	.977	.921	.613~1.556
Constant	-8.129	2.913	.000	.005	

## DISCUSSION

This descriptive correlation study was designed to examine the relevance of unmarried couple's sexual autonomy and contraceptive behavior, and to identify the factors affecting on contraceptive behavior. It is investigated that contraceptive behavior is associated with communication of young couples and sexual autonomy. Contraceptive behavior is managed on a very personal level, unlike other health behaviors, so it is only partially supported by specific subjects or situations. Especially, it is urgent to consider contraceptive act of unmarried males and females in addition to rapidly changing sex culture<sup>11</sup>.

Since sexual intercourse is made by the interaction of two people rather than an individual, it is important to identify sexual behaviors, sexual attitudes, and sexual autonomy at the level of the couples. There are not many studies on couples in the existing research related to sex and since studies on contraception and sexual autonomy that can occur in sexual intercourse have not been conducted solely on subjects who have experienced sexual intercourse, analysis was made in response to a virtual situation without being based on actual situation in many cases. This study was able to identify more detailed and realistic results for sexual intercourse between couples, since data were gathered from unmarried men and women in their twenties who could be regarded as actually and potentially the most active sexual activity group<sup>1</sup>.

Sexual autonomy of unmarried couples in college students was 3.99 out of 5 points in this study which was

more than average. The previous study<sup>16</sup> also showed a similar result to 3.93 points. Sexual autonomy means that it can be controlled against external pressure and not burdened by external pressure in the context of sexual relations.

People with low sexual autonomy tend to have a variety of sexual problems such as unwanted pregnancy, artificial abortion, unwed mothers, and sexually transmitted diseases because they lack the ability to negotiate the conditions of sexual relations such as rejecting unwanted sex or using contraception tool.

According to the results of logistic regression analysis of contraceptive behaviour, sexual autonomy (OR=2.472, CI=1.431~4.272), marital communication (OR=3.140, CI=1.182~8.341), contraceptive knowledge(OR=2.248, CI=1.134~4.455) were found to be factors significantly influenced unmarried couple's contraceptive behaviour. In this study, contraceptive behaviors of unmarried couples were found to have a significant effect on sexual autonomy, communication, and knowledge of contraception. The degree of sexual autonomy of the continuous contraceptive group was higher than that of the non - continuous contraceptive group in the previous study<sup>17</sup>. The other study<sup>18</sup> also showed that people who can express themselves better and have higher sexual responsibility use contraception better. Therefore, sexual autonomy promotion programs need to be developed for contraception. The prior study have pointed that sexual activity has commonly been overlooked in both demographic and family planning research, a strong association existed between



autonomously decision making and the time since most recent sexual intercourse in the countries under study<sup>19</sup>. Thus women's sexual autonomy may be an important piece in protecting the sexual rights of women and helping them to achieve a safe sexual life<sup>19</sup>.

Communication between couples showed a significant influence on contraceptive behavior, because communication with partner is very important for preventive contraception in a mutual activity of sexual intercourse<sup>17</sup>. Adolescent couples who talked about contraception before sexual intercourse tend to use contraception more consistently than those who do not<sup>20</sup>. In brief, to achieve higher levels of contraceptive prevalence, efforts need to be done to encourage couples' communication and agreement, and to stimulate couple's participation in family planning<sup>21</sup>. We can predict that communication is related to the degree of continuous contraception or condom use and this is partially consistent with the previous study<sup>17</sup> which showed that sexual communication is more important for continuous contraception.

### CONCLUSION

The purpose of this study was to investigate the correlation between the contraceptive behavior and sexual autonomy of unmarried young people. The research was carried out among unmarried young people in Korea. The participants of this study were university students in C Province of Korea, and the study was performed in 2016. One hundred seventy four answer sheets out of two hundred respondents were analyzed except for 26 incomplete ones. The number of participants in this study was 67 males (38.5%) and 107 females (61.5%). Sexual autonomy was significantly positively related with marital communication ( $r = .235, p = .002$ ) and relationship satisfaction ( $r = .207, p = .006$ ). Marital communication was significantly positively related with relationship satisfaction ( $r = .474, p < .001$ ). According to results from logistic regression analysis, sexual autonomy (OR=2.472, CI=1.431~4.272), marital communication (OR=3.140, CI=1.182~8.341), contraceptive knowledge (OR=2.248, CI=1.134~4.455) were found to be factors significantly influenced unmarried couple's contraceptive behavior. It is investigated that contraceptive behavior is associated with communication of young couples and sexual autonomy. Therefore, communication and sexual autonomy should be taken into account in contraception education program to increase safe sex life for unmarried couples.

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**Conflict of Interest:** NA

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# Volatile Profile Comparison of Raw and Dried Rhizome of *Atractylodes japonica*

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## ABSTRACT

*Atractylodes japonica* is a source of herbal medicinal material “Sab-Joo” for herbal medicine “Baekchul” in Korea. Volatile aroma compounds may play some valuable therapeutic activities. Volatiles in raw and dried Sab-Joo (the rhizome of *A. japonica*) were analyzed by GC-MS after a dynamic headspace method. The mashed samples were stabilized at 40°C for 30min and volatile compounds were captured by 100  $\mu$ m polydimethylsiloxane coated SPME fiber just before DB-5MS column separation followed by mass spectrometric analysis (with electron impact mode). Among 58 detected peaks, the 15 major components were observed for their fate after drying of Sab-Joo.  $\beta$ -Elemene,  $\beta$ -maaliene, 2,3,4,5-tetramethyltricyclo[3.2.1.0<sup>2,7</sup>]oct-3-ene, curcumene, 1-(3,3-dimethyl-but-1-ynyl)-1,2-dimethyl-3-methylene-cyclopropane, guaia-10,11-diene, and furanodiene were diminished after drying.  $\alpha$ -Selinene and valencene were almost disappeared in dried Sab-Joo. Among the eight volatiles relatively increased after drying, five components, such as  $\beta$ -patchoulene, valencene,  $\alpha$ -selinene, 9,10-dehydro-Isolongifolene, and (-)-aristolene were more than doubled up (percent change over 100%).  $\beta$ -Patchoulene, valencene increased about four times after drying. The major volatiles over 5% (NPA%) in the dried sample were all sesquiterpenes having molecular formula C<sub>15</sub>H<sub>24</sub> (MW=204). The relative quantitative volatile profiles were quite different before and after drying Sab-Joo. Therefore the fate of the pharmaceutically/toxically important volatile components by the simple drying process should be carefully studied to maximize the efficacy and minimize the risk of the final product.

**Keywords:** *Atractylodes japonica*, Sab-Joo, Volatiles, SPME, GC-MS, Drying.

## INTRODUCTION

Due to its geographical conditions turning it into a traffic hub, Jecheon is famous as not only the major oriental medicinal products distribution point but also the cultivation of various herbal drug materials (HDMs) in South Korea<sup>1</sup>. Among the 117 HDMs in “common use for food and medicine”<sup>2</sup> in South Korea, the nine HDMs were produced in Jecheon area (over at least 900 square meters each in 2013), for the oriental medicine and/or the functional foods. *Atractylodes Rhizoma Alba* was the cultivated HDMs in the largest area of Jecheon (256588 square meters). The genus *Atractylodes* that is native to eastern Asia such as Korea, Japan, China etc, belong to Asteraceae (or Sunflower) family. One of *Atractylodes* “Sab-Joo” (Korean name of *Atractylodes*

*japonica* Koidaumi) is a plant material for preparing an aromatic herbal medicine Baekchul (*Atractylodes Rhizoma Alba*). But some people think Changchul (*Atractylodes Rhizoma*) is the dried rootstock part of Sab-Joo while Baekchul is the dried bulky root part at the end of Sab-Joo root. Moreover, Chinese researchers categorize *A. japonica* as “Gwan-Changchul”, a type of Changchul, which is not even listed in the Chinese pharmacopoeia<sup>3</sup>. However the rhizome of *A. lancea* D.C or *A. chinensis* Koidaumi is the official plant material for Changchul in the Korean Pharmacopoeia (Table 1). Their origins in pharmacopoeia are slightly different among South Korea, Japan, North Korea and China. Therefore the definition of Baekchul and Changchul is still confused a lot globally<sup>4</sup>.

**Table 1: The identity information of *Atractylodes* herbal medicinal materials in Korean Pharmacopoeia**

Herbal Medicinal Drug Material		Academic Name	Parts used
English	Korean		
Atractylodes Rhizome White	Baekchul	Atractylodes japonica Koidzumi	Rhizome orrhizome without periderm
		Atractylodes macrocephala Koidzumi	
Atractylodes Rhizome	Changchul	Atractylodes lancea De Candlle	Rhizome
		Atractylodes chinensis Koidzumi	

Most of herbal medicines are circulated as dried form. Therefore many chemical compounds may be dramatically concentrated or reduced according to their chemical and physical characteristics. Aroma compounds may have fate of diminishment due to its volatility after drying that is a typical process of herbal medicinal material. Volatile aroma compounds may play some valuable therapeutic activities such as anti-inflammatory<sup>5,6</sup>, anticonvulsant activity<sup>7</sup>, immunostimulating activity<sup>8</sup> and etc. The volatile compounds in the aromatic plants and essential oils could give high impact on the efficacy and/or quality of food, cosmetic, and pharmaceutical products suggests that the volatile analysis of herbal medicinal plants is quite precious in order to find valuable compounds from such sources.

The volatile flavor compounds of *A. macrocephala* and *A. lancea* were analyzed, while *A. japonica* is put in the title and considered same as *A. lancea* in South Korea<sup>9</sup>. In the research, the volatiles were acquired using simultaneous distillation extraction (SDE) method, the continuous extraction of the distilled water added sample by *n*-pentane and diethyl ether mixture (1:1 v/v). The liquid extract was chromatographed using a polar GC capillary column (FFAP), followed by electron impact mode mass spectrometric analysis. The authors call *A. macrocephala* as Baekchul and *A. lancea* as Changchul. They found some major compounds such as furanodiene,  $\alpha$ -cyperone, alloaromadendrene etc. in *A. macrocephala*

and *A. lancea*. And other Korean researchers compared the volatile components in essential oil from the different *Atractylodes* species. SDE was also used for the preparation of essential oil. However there is no any description of the solvent to dissolve essential oil. Even though authors mentioned that the volatile profiles were similar for *A. japonica* and *A. macrocephala* sampled in Korean herbal markets, among each sixteen volatiles found in each sample collected in Keumsan herbal market, only the four each compounds existed in each sample collected in Euisong herbal market<sup>10</sup>. The reasons for this discrepancies might come from the lack of analytical precision or sample consistency.

Simultaneous distillation (solvent) extraction is the traditional sample preparation method to get essential oil. But there are many chances of heat degradation (such as oxidation) for a couple of labile compounds during long distillation period (usually it takes a couple of hours). Not like the traditional volatile compounds analysis with the extracted essential oil, dynamic headspace (HS) method can be applied without chemical extraction step, with high sensitivity due to concentration effect of volatiles by solid adsorbent having high affinity to the target chemicals. One of DHM, solid-phase microextraction (SPME) have gained high popularity in many scientific fields such as environments, foods, drugs and etc., due to its simple and unique characters of this non-exhaustive method<sup>8</sup>. "When looking into the types of food in which SPME was used for analysis of flavor/volatile compounds, the biggest group was wine, followed by fruits/vegetables, dairy products, beverages, meat, spices and herbs, cereals/bakery, snacks, fats and oils, seafood/fish and honey"<sup>11</sup>. As a comparison of two sample preparation methods, SDE and SPME techniques, their effectiveness in the extraction of volatile compounds from various mustard paste samples were tested<sup>12</sup>. The results proved SDE lacked the sensitivity for the detection of some volatiles (such as 1,2-propanediol). SPME is adapting various stationary phase coated fused-silica fiber where anaDue to the spelytes in the sample are directly absorbed (or adsorbed) onto the fiber coating.<sup>13</sup> There are two kinds of SPME for HS sampling and liquid sampling. Direct immersion of the SPME probe in the liquid sample allows absorption or adsorption of not only target compounds but also various matrix compounds such as macromolecules inhibiting chromatographic analysis. Therefore most of SPME sample treatments are applied as HS-SPME

for selectively capturing volatile compounds from the complex matrices such as food, environments etc. Especially, due to the hindrance of food matrices such as sugars, fats, proteins, coloring agents etc., HS-SPME is the predominant SPME<sup>11</sup>.

In this study, the fate of volatile compounds in the rhizome of *A. japonica* (Sab-Joo) was investigated before and after drying process. The volatiles were analyzed by HS-SPME followed by GC-mass spectrometric (MS) analysis. Even though the most of the herbal medicinal materials are circulated as the dried form, the raw form of them could be used for the processed food material. Therefore, before and after drying, the relative profile of volatile components in some herbal medicinal material (such as *A. japonica* that is an aroma herbal medicinal material) can have a great influence on the medicinal efficacy and sensory quality of the final products.

## MATERIALS AND METHOD

**Materials and sample preparation:** Raw Sab-Joo was purchased in Jecheon medicinal herb market, Chungbuk province, South Korea. After purchasing, Sab-Joo was determined by an oriental medicine expert. Raw Sab-Joo was cut as small pieces and broken into shatters by multi-purpose cutter (KSP-35, Koreamedi Co., LTD, South Korea). The particle sizes were in 35-60 mesh. Dried Sab-Joo was prepared by drying in vacuum oven (JSVO-60T, JSR, South Korea) at 70°C for 24 hours. Raw and dried Sab-Joo samples were kept in a desiccator inside of refrigerator (4°C). Each 1 g of Sab-Joo raw and dried sample was put into a 20 mL size HS vial (Agilent Technologies, Santa Clara, CA, USA) and 5 mL of HPLC grade water (Burdick and Jackson, Muskegon, MI, USA) was added with magnetic stirring bar. To confirm any difference of volatile profiles between the raw Sab-Joo sample with/without additional water in HS vial, just the raw Sab-Joo without additional water was analyzed by the same manner. The 100 $\mu$  polydimethylsiloxane coated SPME fiber (Supelco, Bellefonte, PA, USA) was pre-conditioned at 250°C for 10 min in GC split/splitless injector, followed by positioning it in the HS region of the vial and sampled for 30 min at 40°C with stirring (with 500rpm). The *n*-paraffin mixture (C<sub>5</sub>-C<sub>30</sub>) for retention index (RI) calculation was acquired from Sigma-Aldrich (St. Louis, MO, USA).

**Moisture analysis:** The moisture content (%) of Sab-Joo was measured by the analytical balance (Entris323-1S, Sartorius Goettingen, Germany) after drying it in 70°C vacuum oven until getting constant weight. The sample was taken out from the vacuum oven every four hours, and the weight was measured after cooling down it in a desiccator. A paired sample was tested for 24 hours.

**Instrumental analysis:** Volatiles adsorbed in SPME fiber was delivered to GC injector by Splitless mode (purge delay time, 1 min and split vent flow 20 mL/min) at 250°C. The Pegasus IV GC $\times$ GC-TOF MS (time of flight mass spectrometer, Leco Corporation, St. Joseph, MI, USA) was used with HP-5MS (30m  $\times$  0.25mm I.D., 0.25 $\mu$ m *d<sub>p</sub>*). The oven temperature was programmed as, 40°C (2min)  $\rightarrow$  10°C/min  $\rightarrow$  65°C  $\rightarrow$  2°C/min  $\rightarrow$  110°C  $\rightarrow$  5°C/min  $\rightarrow$  160°C  $\rightarrow$  3°C/min  $\rightarrow$  190°C  $\rightarrow$  20°C/min  $\rightarrow$  280°C (2min). The mobile gas, helium (ultra-high purity, 99.999%) was set as 1 mL/min (constant flow mode). MS transfer line and the ion source temperatures were 260 and 250°C, respectively. The electron energy was set as -70 V (detector voltage was 1750 V). EI mass range was set as *m/z* 33~500. The ion source temperature was 220°C.

Qualitative peak identification was performed by the mass spectrum and RI comparison. Mass spectral library searching was processed by LECO® Software with Wiley Library. And RI of each peak was calculated by the formula for temperature programmed GC condition<sup>14</sup>. The *n*-paraffin mixture was analyzed every time of the sample analysis to guarantee the RI precision.

**Statistical analysis:** The statistical analyses such as relative standard deviation, etc. were carried out using the SPSS 15.0 software.

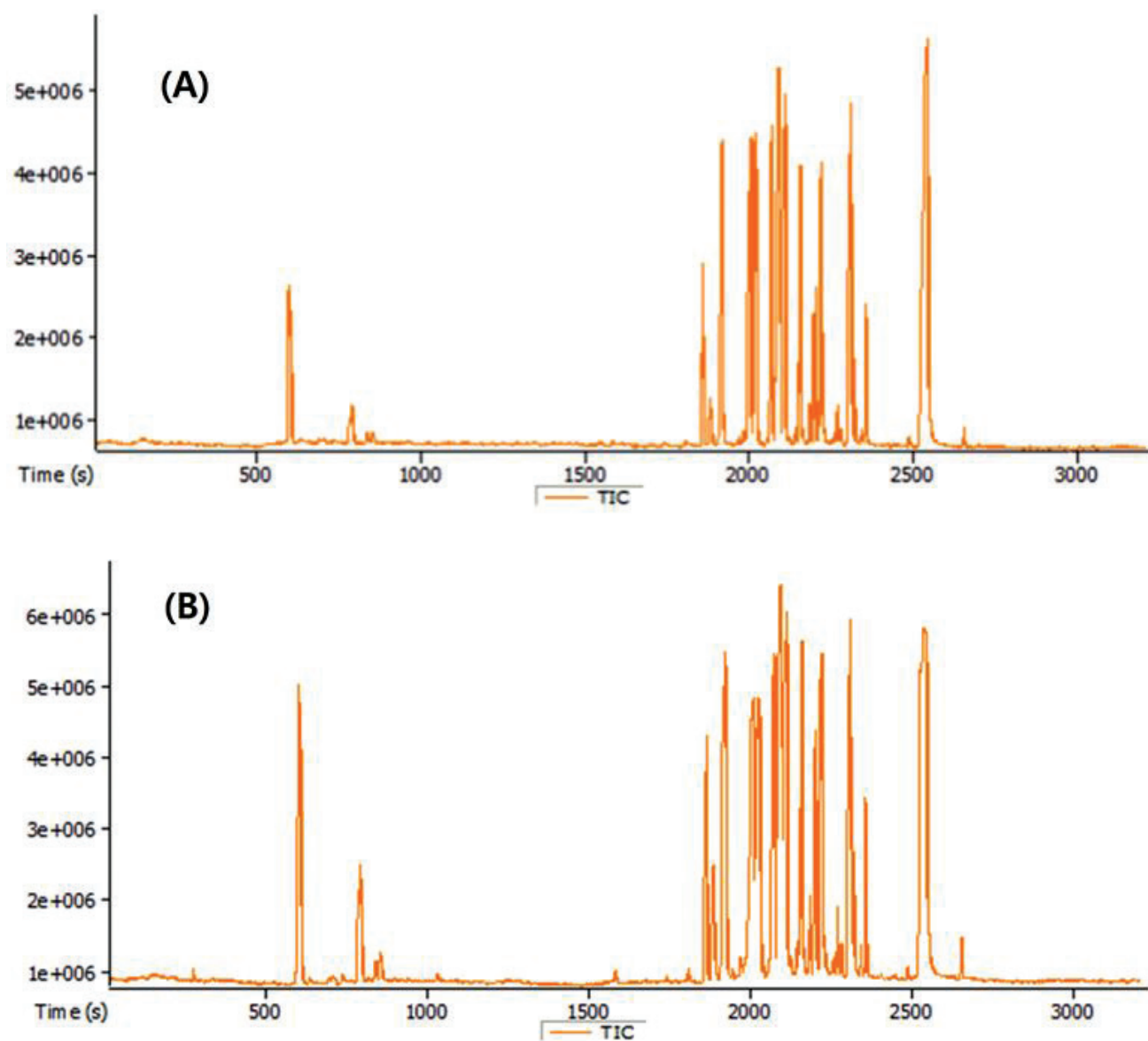
## RESULTS AND DISCUSSION

The moisture content of Sab-Joo was measured as 22.5% by duplicate analyses as shown in Table 2. After drying, the residual flavoring components could be concentrated 22.5% more if there is no chemical degradation and physical evaporation of the compound. Therefore a dried herbal plant material could have the different flavoring character than raw.

**Table 2: Raw and dried weight of *Atractylodes japonica* rhizome (Unit = gram)**

Sample	Drying time (hours) at 70°C vacuum oven							Moisture %	
	0	4	8	12	16	20	24	Each	Average
No. 1	7.4	6.7	6.1	5.9	5.9	5.9	5.9	20.3	22.5
No. 2	7.7	6.4	5.9	5.9	5.9	5.8	5.8	24.7	

The GC-MS ion chromatograms of the raw Sab-Joo volatiles (pretreated by two different HS-SPME methods) are displayed in Figure 1. The volatile peaks detected in both chromatograms are nearly identical. Existence of additional water for HS-SPME sampling did not likely affect the peak profiles. However, the HS volume in an HS vial determines the size of space filled with the sample vapor during equilibrium step. As a result, the headspace volume can be an important factor in determining the precision of the analysis, resulting it could be affected a lot by the HS equilibrium condition. Therefore HS-SPME sampling with a HS vial filled with a 1g solid sample plus 5mL of HPLC grade water (about 6mL of HS volume) was adapted in this research.



**Figure 1: The volatile compounds of raw *Atractylodes japonica* rhizome pre-treated by HS-SPME. (A) with 1g sample and 5 mL of HPLC grade water, (B) with 1g solid sample only.**

**Table 3: The volatile compounds of *Atractylodes japonica* rhizome pre-treated by HS-SPME**

Compounds	RT(min)	RI*	NPA%**	Ref***
$\beta$ -Elemene	35.2	1430	14.96	3
$\beta$ -Maaliene	32.0	1345	13.28	3, 9
1-(3,3-Dimethyl-but-1-ynyl)-1,2-dimethyl-3-methylene-cyclopropane	34.9	1421	10.63	
(-)- $\alpha$ -Neoclovene	33.4	1381	10.02	
Guaia-10,11-diene	34.5	1408	9.94	
$\beta$ -Caryophyllene	34.9	1419	9.53	3, 9 10
$\alpha$ -Selinene	37.0	1488	4.87	10
2,3,4,5-Tetramethyltricyclo [3.2.1.0 <sub>2,7</sub> ]oct-3-ene	33.7	1387	3.93	
(-)-Aristolene	31.0	1321	3.28	3
Valencene	38.5	1537	3.09	3, 10
Curcumene	36.7	1479	2.58	9
9,10-Dehydro-isolongifolene	39.3	1564	2.56	3
Furanodiene	42.4	1669	1.59	3, 9
$\beta$ -Patchoulene	33.7	1386	1.49	3
$\alpha$ -Himachalene	36.6	1476	1.06	9
Selina-3,7(11)-diene	37.8	1515	0.61	
1,8-Cyclopentadecadiyne	38.7	1543	0.55	
$\beta$ -Phellandrene	14.3	1028	0.46	3
(Z)-Ocimene	13.2	1008	0.45	
$\alpha$ -Humulene	36.0	1455	0.44	3, 9, 10
$\beta$ -Selinene	36.4	1470	0.39	3, 9, 10
1-Isopropyl-2-methoxy-4-methylbenzene	26.4	1236	0.38	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	38.6	1539	0.36	
4,6,6-Trimethyl-2-(3-methylbuta-1,3-dienyl)-3-oxatricyclo[5.1.0.0(2,4)] octane	44.2	1730	0.33	
$\beta$ -Sesquiphellandrene	38.0	1521	0.32	3, 9, 10
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	33.1	1372	0.26	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	32.8	1365	0.23	
$\gamma$ -Gurjunene	37.1	1492	0.22	
p-Cymene	14.0	1022	0.20	3, 9
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	39.0	1555	0.19	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	35.7	1447	0.18	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	31.4	1330	0.16	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	37.7	1510	0.13	
(-)-Caryophyllene oxide	41.5	1637	0.10	3, 9, 10
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	33.8	1390	0.09	
Bornyl acetate	29.0	1281	0.08	3
$\alpha$ -Terpinene	13.6	1015	0.07	3

Conted...

Clovene	32.6	1360	0.07	
$\gamma$ -4-Dimethyl-benzene butanal	36.3	1466	0.06	
Sabinene	11.6	971	0.06	
$\delta$ -terpinene	17.2	1081	0.06	
Isocomene	34.2	1400	0.06	3
(Z)-CIS- $\alpha$ -Bergamotene	37.5	1505	0.06	
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	40.9	1617	0.04	
3,7-Dimethyl-1,3,7-octatriene	35.9	1454	0.04	
$\gamma$ -Elemene	35.4	1436	0.04	3, 9
(1a4a4aa10aa)1,4,4a,5,6,9,10,10a-octahydro-11,11-dimethyl-1,4-methanocycloocta[d]pyridazine	37.3	1499	0.04	
Methyl thymyl ether	25.8	1226	0.03	
$\beta$ -Pinene	11.8	976	0.03	3
$\beta$ -Chamigrene	32.4	1355	0.03	
$\alpha$ -Phellandrene	13.2	1007	0.03	3
Myrcene	12.3	989	0.03	3
Sesquiterpene C <sub>15</sub> H <sub>24</sub> MW=240	34.0	1394	0.03	
$\alpha$ -Pinene	10.0	932	0.03	3
(E)- $\beta$ -Ocimene (trans- $\beta$ -Ocimene)	10.6	948	0.01	3
4,6,6-Trimethyl-2-(3-methylbuta-1,3-dienyl)-3-oxatricyclo[5.1.0.0(2,4)]octane	40.1	1591	0.01	
$\gamma$ -Terpinene	15.7	1054	0.01	3
trans-5,6-Epoxy-beta-ionone	2.7	<600	0.01	

\*RI means Retention Index.

\*\*NPA% means the normalized peak area percent.

\*\*\*Ref means the references of the compound that was detected in *Atractylodes japonica* in South Korea.

Total 58 ion peaks were detected in Sab-Joo (Table 3). Among them, 48 peaks were identified by comparing mass spectrum and RI while other 10 compounds were assumed as the sesquiterpene with molecular structure C<sub>15</sub>H<sub>24</sub> (MW=240). The fifteen compounds took the normalized peak area (NPA) percent over 1%.  $\beta$ -Elemene is the largest ion peak taking the NPA 14.96%. " $\beta$ -Elemene is the main constituent of *Rhizoma zedoariae* and *Pterodon emarginatus* as Chinese and Brazilian medicinal herbs, respectively. This compound has anti-inflammatory and antitumor properties and is able to pass the blood-brain barrier"<sup>15</sup>. It is one of the very popular sesquiterpene having the herbal, waxy and fresh odor, found in more than 300 floral plants belong to Araceae, Arecaceae, Cactaceae, Orchidaceae, Nyctaginaceae, etc<sup>16</sup>. It was also found in Sab-Joo treated by SDE using a Clevenger apparatus in South Korea<sup>3</sup>. The second largest peak (NPA 13.28%) designated as  $\beta$ -maaliene, its mass spectrum is very similar

to alloaromadendrene that is a structural isomer of it. Even though alloaromadendrene was identified in Sab-Joo by two different former researches<sup>3,4</sup>, its RI value in non-polar column (by temperature programming mode) is in the range of 1442~1477<sup>17</sup>. RI value of  $\beta$ -maaliene in this research is 1345 that is in the RI range 1369~1422 (analyzed by non-polar column with temperature programming mode) of  $\beta$ -maaliene in NIST Chemistry WebBook<sup>18</sup>. Moreover, the RI 1345 fall in just 0.8% difference bracket of RI 1356 that was assigned for  $\beta$ -maaliene identified in Sab-Joo formerly<sup>3</sup>.  $\beta$ -Maaliene was quantitated (as trace ~7.49%) in six Italian populations of *Ephedra nebrodensis* subspecies by HS-SPME and GC-FID/GC-MS analyses<sup>19</sup>. The fifth largest peak of RI 1408 was identified as guaia-1(10),11-diene. Guaia-1(10),11-diene, produced in leaves of *Polygonum minus*, was detected with RI 1456 (in DB-1 column) by SPME and hydrodistillation sample treatment<sup>20</sup>.  $\beta$ -Caryophyllene, the sixth largest peak taking 9.53% was eluted with RI 1419,



that is in the range of RI 1399~1455 acquired with non-polar column by temperature programming mode<sup>21</sup>. It was also detected in Sab-Joo three times in South Korea<sup>3,4,10</sup>.  $\beta$ -Caryophyllene is one of the very common flavoring compound in various plant parts. It was found as the major compound taking 52.9% of the essential oil (0.2% v/w on fresh weight basis) acquired from the aerial parts of *Orthodon dianthera* Maxim from Vietnam<sup>22</sup>. It was also found as 48.7% from a sweet basil oil<sup>23</sup>.  $\beta$ -Caryophyllene was detected as a major component in 25 research articles, as over than 10% of the plants derived part (most of them are essential oil) since the year 1985<sup>24</sup>. The organoleptic character of  $\beta$ -Caryophyllene is “sweet”, “woody”, “spicy”, “clove” and “dry”<sup>24</sup>. Among the other compounds with over NPA 1%, furanodiene was found in Sab-Joo

essential oil extracted by SDE in the two separate studies<sup>3,4</sup>. Furanodiene is a principle component in *Curcuma* species<sup>25</sup>. It was studied as an active compound restraining breast cancer cell growth<sup>26</sup>. RI 1670 of furanodiene in this study was close to RI 1640 acquired from HP-5MS (the same kind of column used in this research) in other research<sup>3</sup>. Other major compounds over NPA 1%,  $\alpha$ -selinene, (-)-aristolene, valencene, 9,10-dehydro-isolongifolene,  $\beta$ -patchoulene and  $\alpha$ -himachalene were also detected in Sab-Joo<sup>3,4,10</sup>. Among 48 identified compounds,  $\beta$ -caryophyllene,  $\alpha$ -humulene,  $\beta$ -selinene,  $\beta$ -sesquiphellandrene, and (-)-caryophyllene oxide were the common volatiles detected in Sab-Joo analyzed by three different Korean researches. Totally 27 compounds, including above four compounds, were also identified in Sab-Joo by at least one Korean research<sup>3,4,10</sup>.

**Table 4: Normalized volatile compounds of *Atractylodes japonica* rhizome before/after drying**

Compounds			NPA%*		Percent Change**
Name	Formula	MW	Raw	Dried	
$\beta$ -Elemene	C <sub>15</sub> H <sub>24</sub>	204	16.12	0.01	-100
$\beta$ -Maaliene	C <sub>15</sub> H <sub>24</sub>	204	14.31	0.02	-100
1-(3,3-Dimethyl-but-1-ynyl)-1,2-dimethyl-3-methylene-cyclopropane	C <sub>12</sub> H <sub>18</sub>	162	11.45	3.12	-73
(-)- $\alpha$ -Neoclovene	C <sub>15</sub> H <sub>24</sub>	204	10.80	11.91	10
Guaia-10,11-diene	C <sub>15</sub> H <sub>24</sub>	204	10.71	8.15	-24
$\beta$ -Caryophyllene	C <sub>15</sub> H <sub>24</sub>	204	10.26	15.82	54
$\alpha$ -Selinene	C <sub>15</sub> H <sub>24</sub>	204	5.25	17.83	240
2,3,4,5-Tetramethyltricyclo[3.2.1.0 <sup>2,7</sup> ]oct-3-ene	C <sub>12</sub> H <sub>18</sub>	162	4.24	0.11	-98
(-)-Aristolene	C <sub>15</sub> H <sub>24</sub>	204	3.53	7.62	116
Valencene	C <sub>15</sub> H <sub>24</sub>	204	3.33	16.25	388
Curcumene	C <sub>15</sub> H <sub>22</sub>	202	2.78	0.44	-84
9,10-Dehydro-isolongifolene	C <sub>15</sub> H <sub>22</sub>	202	2.76	7.35	167
Furanodiene	C <sub>15</sub> H <sub>20</sub> O	216	1.72	1.33	-23
$\beta$ -Patchoulene	C <sub>15</sub> H <sub>24</sub>	204	1.60	8.65	440
$\alpha$ -Himachalene	C <sub>15</sub> H <sub>24</sub>	204	1.15	1.41	23

\* Normalized peak area percent was calculated within fifteen major compounds.

\*\*Percent Change was calculated by (Dried NPA%-Raw NPA%)/Raw NPA%.

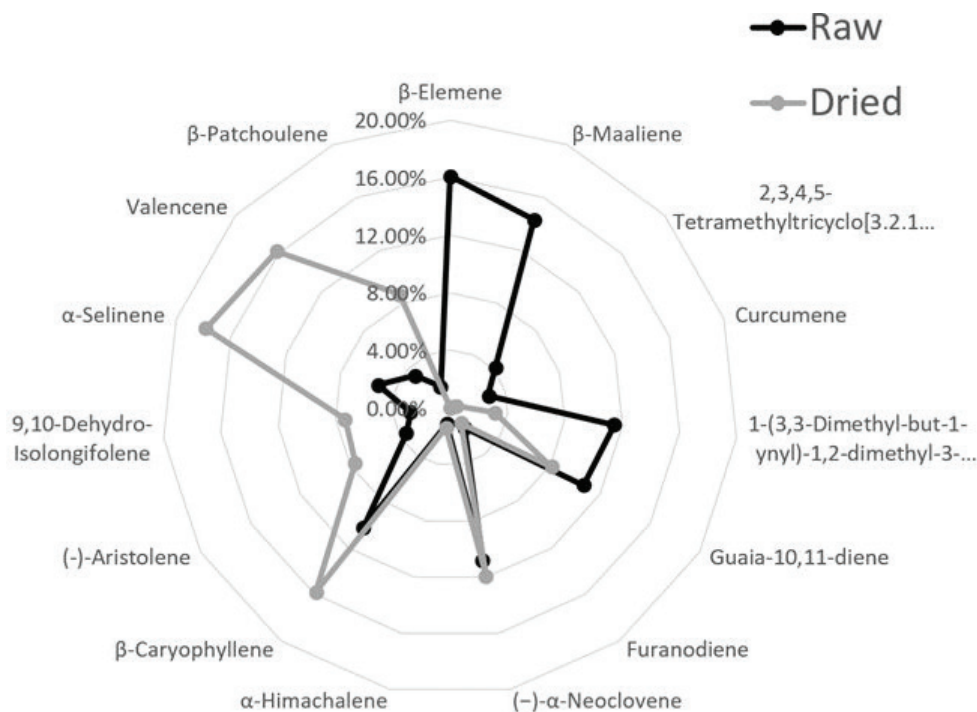
Fifteen major volatile compounds (over NPA 1%) were monitored for their fate after drying process (Table 4). NPA% of each peak was re-calculated with the fifteen compounds only.  $\alpha$ -Selinene and valencene were the relatively large components as NPA 17.83% and 16.25% in dried Sab-Joo, respectively, while  $\beta$ -elemene and  $\beta$ -maaliene (those were highest NPA% volatiles as 16.12% and 14.31% in raw Sab-Joo, respectively) were almost totally disappeared. The major volatiles over

NPA 5% in the dried sample were all sesquiterpenes having molecular formula C<sub>15</sub>H<sub>24</sub> (MW=204).  $\beta$ -Elemene,  $\beta$ -maaliene, 2,3,4,5-tetramethyltricyclo[3.2.1.0<sup>2,7</sup>]oct-3-ene, curcumene, 1-(3,3-dimethyl-but-1-ynyl)-1,2-dimethyl-3-methylene-cyclopropane, guaia-10,11-diene, and furanodiene were diminished after drying. Among the eight volatiles relatively increased after drying, five components, such as  $\beta$ -patchoulene, valencene,  $\alpha$ -selinene, 9,10-dehydro-Isolongifolene, and (-)-aristolene were

more than doubled up(percent change over 100%).  $\beta$ -Patchoulene(a sesquiterpene of percent change after drying, 440%) was reported in Patchouli oil as rich as 4.2%. "Patchouli oil(from *Pogostemon cablin*) is a basic ingredient of high value perfumes because of its oriental notes and strong fixative properties"<sup>27</sup>. Valencene was the second largest component, with its NPA% tripled up after drying of Sab-Joo sample. A sesquiterpene, valencene (possessing orange, wood and citrus-like flavoring character) is an important aroma ingredient, albeit a low-amount produced in citrus essential oil<sup>28</sup>. Valencene, used to be extracted from the peel of Valencia orange is frequently utilized in fragrance and flavoring industry and also used in the production of nootkatone, the main flavoring component of grapefruit flavor and aroma<sup>29</sup>. Large amount of valencene was determined as the main compound(31.80%) of the naturally field grown *Salvia cryptantha* that is an aromatic herb belonging to Lamiaceae<sup>30</sup>. NPA% of (-)-aristolene was also increased 167%. It was reported as a component of *Nardostachys chinensis* or *N. grandiflora*(analyzed by

SPME-GC-MS)<sup>31</sup>. *N. jatamansi*(synonym of *N. chinensis* or *N. grandiflora*) is a source material of an essential oil "spikenard" of intensely aromatic amber-colored type. This essential oil was utilized as a part of the Ayurvedic herbal tradition of India in ancient times<sup>32,33</sup>. The rhizome of *N. chinensis* or *N. jatamansi* are used as the material of an oriental medicine "Gam-Song-Hyang"<sup>34</sup>. The sesquiterpenes, such as  $\beta$ -caryophyllene,  $\alpha$ -himachalene, and (-)- $\alpha$ -neoclovene were the compounds with a little increment(as 54~10% percent change) of their NPA%.

The fifteen major volatile profiles of raw and dried Sab-Joo are displayed as the spider maps in Figure 2. As the shape of the two profiles is differentiated distinctively, the organoleptic characters provoked by two different status of matrices might be different with each other. Any pharmaceutical or functional efficacy could be different by means of those each characteristic volatile components' profiles of the raw form and dried form of Sab-Joo.



**Figure 2: Spider map of the volatile profiles of raw and dried *Atractylodes japonica* rhizome(based on normalized GC-MS TIC peak area within the major 15 compounds).**

## CONCLUSION

The volatile profiles of raw and dried Sab-Joo were proved as distinctively different with each other. Among the 15 major peaks(having higher than NPA 1%), the 7 volatiles were diminished from -23% to almost -100%( $\beta$ -elemene and  $\beta$ -maaliene), while the other 8

sesquiterpenes ( $C_{15}H_{24}$ ; MW=204) were increased from 10% to 440% ( $\beta$ -patchoulene).The relative quantitative volatile profiles were quite different before and after drying of Sab-Joo. Those phenomena may change the general knowledge about the simple processing "drying" of the herbal medicinal materials used to be circulated as the dried form traditionally. Therefore the fate of the

pharmaceutically worthwhile volatile component by the even simple drying process should be carefully studied to maximize the efficacy of the final product. Moreover, the accumulation of any toxically potent volatile components during drying process must be carefully observed to minimize the risk of any functional foods or drugs made with the herbal medicinal materials.

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**Source of Funding:** Self

**Conflict of Interest:** NA

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# The Effects of Psychological Capital and Organizational Communication on Turnover Intention: Mediating Effect of Stress

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## ABSTRACT

The purpose of this study was to determine the mediating effect of job stress on influence of organizational communication and psychological capital on turnover intention. Subjects were surveyed with convenience sampling method at more than 25 workplaces, and 344 workers were used for analysis. SPSS Win 21.0 was used for descriptive statistics, reliability analysis and correlation analysis, and AMOS 23.0 was used for structural equation analysis. First, correlation analysis revealed that organizational communication and psychological capital revealed statistically positive correlation with in all sub-variables. However, organizational communication and psychological capital negatively correlated with stress and turnover intention. Second, job stress revealed mediating effect between organizational communication and turnover intention. Third, job stress revealed mediating effects between psychological capital and turnover intentions. Based on results of this study, we suggested a plan to reduce turnover intention.

**Keywords:** Turnover intention, Organizational communication, Psychological capital, Job stress, Worker

## INTRODUCTION

Turnover is defined as termination of financial support or intangible benefits, or transfer of a member to another entity, as a member of a voluntary or other party is not willing to conduct social activities any longer <sup>1</sup>. Turnover is largely divided into voluntary turnover and involuntary turnover. Voluntary turnover refers to turnover determined by oneself even if no other person requests it, and involuntary turnover refers to an unwanted turnover <sup>2</sup>. Conversely, turnover intention refers to attitude of members of the organization to leave the organization, specifically to abandon membership in the organization and to leave their current job<sup>3</sup>.

This turnover leads to problems such as production loss and economic cost in the organizational aspect, and personal problems such as stress, loss of income and turnover cost <sup>4</sup>. To prevent turnover, various predictive factors have been studied for reasons such as prevention.

In recent years, job stress is emerging as a significant variable with turnover.

Job stress is defined as stress perceived in the process of doing business and stress perceived by psychological and physiological symptoms<sup>5</sup>. This results in psychological symptoms such as depression and anxiety, physical symptoms such as headache and hypertension, as well as a decrease in work motivation and lower productivity in terms of organizational effectiveness <sup>6</sup>. Therefore, when workers are exposed to these stresses, they are linked to dissatisfaction and negative emotions <sup>7</sup>, that have significant negative impact on job performance and commitment, thereby increasing turnover intention<sup>8</sup>. Job stress affects negatively job satisfaction and life satisfaction, found to increase turnover intention<sup>9</sup>.

On the organizational side, communication among members impacts job stress. From the perspective of an organism, when external stimulus is aggressive, the defensive system is activated. When a human being exceeds this limit, he or she lapses into helplessness <sup>10</sup>. By adjusting their values lower and using defensive measures such as rationalization and repression, they fail to adapt and that may lead to stress <sup>10</sup>. In addition,

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communication between members has a positive impact on organizational and job effectiveness such as job satisfaction and organizational commitment<sup>11</sup>. Therefore, communication among members has significant negative impact on individual job stress and turnover intention, but has positive impact on business effectiveness.

Psychological capital, conversely, is defined as enhancing performance by using enterprising thoughts and behaviors, using positive psychological strength for a given environment<sup>12</sup>, that influences stress in most previous studies. The higher the psychological capital, the lower the depression, the higher psychological well-being<sup>13</sup>, and the higher the positive self-concept level, the lower the stress<sup>14</sup>.

Based on these findings, job stress serves as a mediator in the relationship between organizational communication and turnover intention, and between psychological capital and turnover intention. However, most studies to date have addressed organizational and individual variables, and few studies have examined job stress as a mediator.

The purpose of this study was to determine the mediating effect of job stress on influencing organizational communication and psychological capital on turnover intention. Results of this study will provide baseline data for increasingly frequent turnover and job stress.

## METHODS

**Research model:** Bases on results of the study that organizational communication positively impacts stress<sup>10</sup> and turnover intention<sup>11</sup> and that psychological capital has a positive impact on stress and turnover intention<sup>12</sup>, and stress is highly significant relative to turnover intention<sup>8</sup>, we developed the research model in <Figure 1>.

**Participants:** The subject of this study was purposely selected from more than 25 workplaces in two provinces (Chungnam, Chungbuk), and one metropolitan city (Daejeon) from the entire country. From October, 2016-November, 2014, A questionnaire was distributed and promptly collected from subjects.

Average age of subjects was 36.26 ( $\pm$ 8.07). Sex was 297 men (86.3%) and 42 women (12.2%). According to

level of education, 238 students (71.3%) graduated from a four-year university, followed by 42 two-year college graduates (12.6%), 46 high school graduates (13.8%) and eight graduate school graduates (2.4%). The number of working years ranged from five-10 with 71 persons (20.6%), followed by 69 persons (20.5%) between one-three years, 59 persons (17.5%) between three-five years. Salary was the highest at 301-3.5 million won with 74 (21.8%), followed by 63 (18.6%) with 201-2.5 million won and 62 (18.3%) with 251-3 million won. Last, ranking of respondents were more than half, with 168 (50.1%) of personnel, 77 (23.0%) of deputies, 42 (12.5%) of directors, 31 (9.3%) of deputy managers, and 13 (3.9%) of managers.

## RESEARCH TOOLS

**Psychological Capital:** Psychological capital was measured using 24 items from Luthans et al.<sup>15</sup>, psychological capital questionnaire (PCQ) translated by Lee and Choi<sup>16</sup>. The scale consists of four sub-domains: hope, optimism, self-efficacy, and resilience. Each item has a Likert scale ranging from “not at all” to “very agree” with a score of 1-5. The higher the score, the higher the psychological capital. In this study, reliability of Cronbach’s  $\alpha$  for this scale was .909 for the whole. For each subscale, hope was 0.713, optimism was 0.687, self-efficacy was 0.822, and resilience was 0.670.

**Organizational Communication:** Organizational communication was measured using<sup>10</sup> items used by Hwang<sup>17</sup>. This scale consists of three items of business communication, three items of creative communication, and four items of emotional communication. Each item is based on a Likert scale from 1 point to 5 points. The higher the score, the higher the organizational communication. In this study, Cronbach’s  $\alpha$  of the scale was 0.912 for the whole scale, and for each subscale was 0.759 for business communication, 0.827 for creative communication, and 0.815 for emotional communication.

**Job Stress:** Job stress was measured using 13 items developed by Parker and Decotiis<sup>6</sup> and translated by Cho<sup>18</sup>. Each item has a 5-point Likert scale ranging from “not at all” to “very strongly”, that means job stress increases as the score increases. In this study, reliability of Cronbach’s  $\alpha$  was 0.897.

**Turnover Intention:** Turnover intentions were measured using six items developed by Cho<sup>18</sup>. Each item is a 5-point Likert scale ranging from “not at all” to “very strongly”, that means the higher the score, the higher turnover intention. In this study, reliability of Cronbach’s  $\alpha$  was 0.882

**Data analysis:** SPSS Win 21.0 was used for descriptive statistics, reliability analysis and correlation analysis, and AMOS 23.0 for structural equation analysis.

**RESULTS AND DISCUSSION**

Results of correlation analysis between main variables are presented in <Table 1>. Business, creative and emotional communication, and subordinate variables of psychological capital, hope, optimism, self-efficacy and resilience revealed statistically significant correlation. However, variables revealed negative correlation with job stress and turnover intention. Among them, business communication and creative communication revealed

highest correlation coefficient ( $r=.742, p<.01$ ), followed by self-efficacy and resilience ( $r=.733, p<.01$ ), and creative communication and emotional communication ( $r=.717, p<.01$ ). Overall correlation coefficient ranged from 0.742 to -0.347, indicating no multicollinearity. Conversely, mean value of variables were 2.76 or more. Among them, optimistic, subgroup of psychological capital, was highest at  $3.62\pm.53$ , and job stress was lowest at  $2.76\pm.63$ .

This result implies organizational communication and psychological capital have significant impact on stress and turnover intention, and there is a need to increase organizational communication and psychological capital to lower stress and turnover intention. Results are consistent with recent research that organizational communication and psychological capital have positive impact on stress and turnover intention 7, 8, 11. Ultimately, to lower turnover intention, both organizational communication and psychological capital should be considered.

**Table 1: Correlation and descriptive statistics between main variables**

Variables		1	2	3	4	5	6	7	8	9
Organizational Communication	1. Business Communication	1								
	2. Creative Communication	.742**	1							
	3. Emotional Communication	.658**	.717**	1						
Psychological Capital	4. Hope	.295**	.318**	.358**	1					
	5. Optimism	.227**	.216**	.307**	.675**	1				
	6. Self-Efficacy	.260**	.307**	.370**	.707**	.730**	1			
	7. Resilience	.241**	.312**	.312**	.641**	.679**	.733**	1		
8. Stress		-.205**	-.189**	-.182**	-.244**	-.235**	-.210**	-.185**	1	
9. Turnover Intention		-.347**	-.321**	-.351**	-.228**	-.144**	-.227**	-.154**	.494**	1
Mean		2.96	2.95	3.00	3.36	3.62	3.45	3.55	2.76	2.92
SD		.74	.83	.77	.51	.53	.57	.52	.63	.79
* P<.05, ** p<.01										

We conducted a confirmatory factor analysis using the maximum likelihood method to verify the whole measurement model. As a result of analysis, fit indices were  $\chi^2 = 33.968, df = 23, \chi^2/df = 1.477, TLI = .990, CFI = .994$  and  $RMSEA = .036$ . Overall, leading indices were appropriate. In addition, standardized coefficients of

each variable were higher than .50, so the criteria were met and coefficients were significant. Variance extraction index (AVE) of latent variables ranged from .802-.893 were higher than .50 and construct reliability (CR) ranged from .924-.971. was more than .7. Therefore, convergence validity of variables was verified

As a result of path model analysis, overall fitness of the research model was  $\chi^2 = 33.968$ ,  $df = 23$ ,  $\chi^2/df = 1.477$ ,  $IFI = .994$ ,  $TLI = .990$ ,  $CFI = .994$  and  $RMSEA = .036$ . Therefore, the research model was accepted without modification, and verification results of the path coefficient are shown in Fig. 2 and Table 2. Results of verification for each path are as follow.

Organizational communication had significant impact on stress ( $\beta = -.120$ ,  $p < .05$ ) and turnover intention ( $\beta = -.321$ ,  $p < .001$ ). However, psychological capital had significant impact on stress ( $\beta = -.226$ ,  $p < .001$ ), but did not significantly impact turnover intention ( $\beta = .006$ ,  $p = .906$ ). Finally, stress had significant impact on turnover intention ( $\beta = .405$ ,  $p < .001$ ).

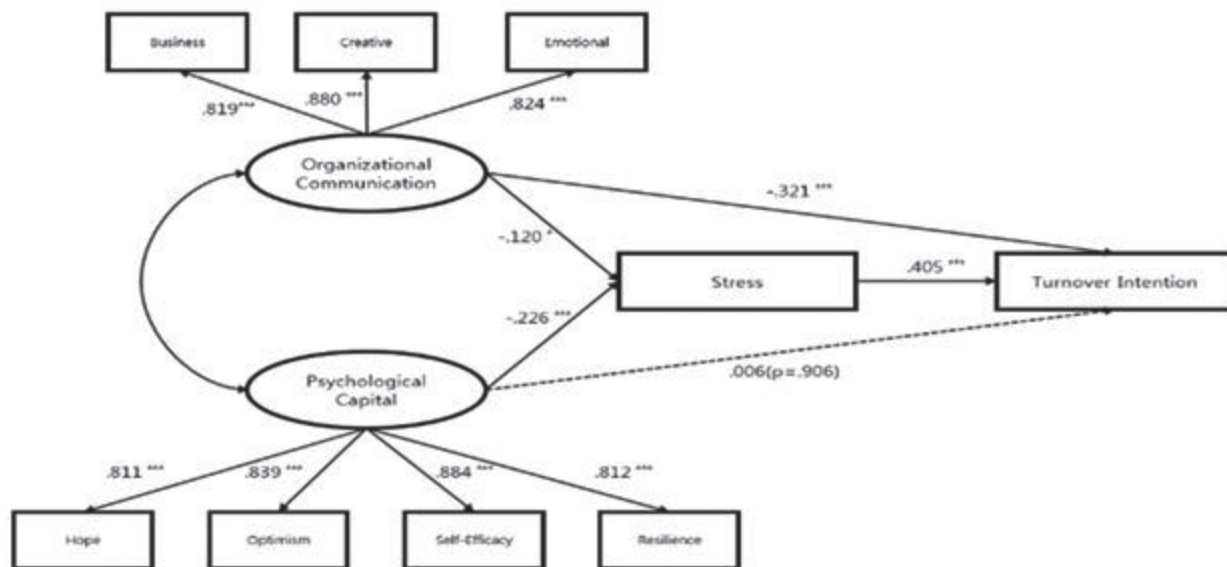


Figure 2: Results of Research Model Path Analysis

\*  $P < .05$ , \*\*\*  $p < .001$

Table 2: Results of Path Analysis

Path	B	$\beta$	S.E	C.R
Organizational Communication → Stress	-.103	-.120	.051	-2.013*
Organizational Communication → Turnover Intention	-.345	-.321	.057	6.070***
Psychological Capital → Stress	-.340	-.226	.089	3.812***
Psychological Capital → Turnover Intention	.012	.006	.099	.118
Stress → Turnover Intention	.508	.405	.057	8.923***

Table 3 reveals direct, indirect, and total impact of organizational communication and psychological capital on stress and turnover intention. As shown in Table 3, organizational communication has indirect impact on turnover intention through stress, psychological capital on turnover intention through stress.

Table 3: Analysis Results of Direct, Indirect, and Total Impact

Path	Direct effect	Indirect effect	Total effect
Organizational Communication → Stress	-.120		-.120
Organizational Communication → Turnover Intention	-.321	-.048	-.369
Psychological Capital → Stress	-.226		-.226
Psychological Capital → Turnover Intention		-.173	-.173
Stress → Turnover Intention	.405		.405



Table 4 reveals results of bootstrapping to verify if indirect impact was significant. As a result of verification, mediating impact was significant.

**Table 4: Bootstrap test of multiple mediating impact**

Path	Estimate	p	95% Interval
Organizational Communication → Stress → Turnover Intention	-.048	.082	(-.099 ~ .008)
Psychological Capital → Stress → Turnover Intention	-.173	.004	(-.161 ~ -.039)

Based on results of this study, discussion is the following. First, between organizational communication and turnover intention, job stress revealed mediating impact. Organizational communication has indirect impact on turnover intention after impacting job stress, and has direct impact on turnover intention. Results are consistent with most previous studies <sup>7, 8, 11</sup>. However, bootstrapping test results revealed that mediating impact was insignificant. This may be an unusual result for this study subject with a third variable intervening. Therefore, the role of mediation impact should be determined according to various factors such as occupation and environment. According to previous research, results were inconsistent according to study subjects.

Second, job stress in the relationship between psychological capital and turnover intention revealed mediation impact. Psychological capital impacts turnover intention after impacting job stress. Therefore, job stress is a critical variable. Results are supported by findings of Parker et al. <sup>6</sup> and Choi <sup>5</sup>. It suggests that countermeasures such as welfare benefits and appropriate reimbursement to lower job stress are needed to lower turnover intention of workers with low psychological capital.

**CONCLUSION**

The purpose of this study was to investigate structural relationship among job stress, turnover intention, organizational communication and psychological capital of workers. Results revealed that job stress mediates between organizational communication and turnover intention, and between psychological capital and turnover intention. Results implied impact of job

stress on turnover intention is significant. Based on these results, we discussed how to reduce turnover intention in the previous section.

Based on limitations of this study, suggestions for future research are as follows. First, this study is focused on workers in the Chungcheong area, so there is a limit to generalization. Therefore, in future research, nationwide sampling should be conducted and it is necessary to diversify occupations. Second, as a result of path analysis, psychological capital is more related to job stress than turnover intention, compared to organizational communication. Results suggest psychological capital is more related to job stress than organizational communication, and further study is needed. Despite limitations, this study is the first to reveal the role of job stress in the relationship between organizational communication and turnover intention. Results of this study suggest that it is crucial to provide basic data for increasing job satisfaction and organizational commitment and reduce turnover of workers and to suggest theoretical plans.

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**Conflict of Interest:** NA

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# Nurse's Images Perceived by Girl's High School Students

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## ABSTRACT

This study was aimed to identify how high school students who are interesting in nursing as their future career recognized nurses. This study applied the Q methodology to understand nurses' image perceived by high school students in order to identify future nurses' perception for their job. This study was conducted from May 27 to October 14, 2016, and 30 girls, selected by convenience sampling method, scored 29 Q statements using forced normal distribution. Data was analyzed through the QUANL PC program such as eigenvalues, variance, correlation, z-score and so on. There are three different factors with three types showing eigenvalue more than 1. Factor I with twelve participants showed that they agreed with giving the feeling of thrust, well behaved and a worthwhile job positively, the eigenvalue 7.1458. Factor II with twelve participants showed that they positively agreed with a comfortable person, a value and worthwhile job as well as playing a role as a mother, the eigenvalue 2.5628. Factor III with eight participants showed that they positively agreed with a doctor's assistance, well behaved and a comfortable person, the eigenvalue 2.5366. The correlation among three types was not relatively similar. However three types showed some consensus items. They recognized positively a value and worthwhile job, earnest and honest as a nurse, while negatively scientific knowledge, leadership and authority. The result of this study can provide basic data for preparing a nursing educational strategy with personalized the image of nurses for future generation who will become a nurse.

**Keywords:** Nurse's image, high school student, girl, future career, Q methodology

## INTRODUCTION

Due to the appearance of AlphaGo's, the prediction for the future disappearing jobs by Oxford University and economic recession, there has been a lot of interest in nursing care among Korean young generation as their future career<sup>1</sup>. Also South Korea is the fastest aging society in the world so we need a lot of medical staff in order to take care of the elderly effectively and qualitatively with controlling medical cost.

As mentioned above, the interest and demand for nursing have been increased, while the tasks and roles of nurses in the public are still vague and appear to be secondary to the physician and play ancillary roles in the field of medical areas negatively<sup>2</sup>. In addition, looking at the trends of Korean researches on the image of nurses, there are some studies on the nurse's image perceived by nursing college students and on drama<sup>3,4</sup>. Therefore, this study will analyze the image of nurses thought by high school girls who are interested in nursing as their major at a university in the near future.

## MATERIALS AND METHOD

This study was conducted using the Q methodology to see how high school girls as each individual have images for nurses. This study was conducted using the Q methodology to see how high school girls as each individual have images for nurses. The subjects of this study were 30 high school girls in Y district, G province using the convenience extraction method. Also the Q methodology was based on small sample doctrine, with an emphasis on finding individual differences insignificance. Through the literature review and previous researches, the selected 29 Q statements were printed on a card of 8x8cm size, and the subjects were classified as the most affirmative items on the distribution chart and the most negative items on the 7 point scale. Data were analyzed using the QUANL program. The program converts the scores assigned to each Q statement into z-scores. If the z-score is (+), it can be interpreted that the individual is positive for the Q statement. If the z-score is (-), it can be interpreted that

the individual is negative for the Q statement. In order to select ideal numbers of factor and increase explanation power for variance, the eigenvalues greater than 1.0 were selected as the best type<sup>5</sup>

## RESULTS AND DISCUSSION

The results of this study using the QUANL PC program were as follows. The results of the study accounted for about 41% of the total variance and three types were analyzed from three factors. The eigenvalues representing the magnitude of the variance of each type were extracted as three, 7.1458, 2.5628 and 2.5366, respectively in table 1.

**Table 1: Eigenvalues and Variance percentage**

	Factor I	Factor II	Factor III
Eigenvalues	7.1458	2.5628	2.5366
Variance percentage	0.2382	0.0854	0.0842
Cumulative frequency	0.2382	0.3237	0.4079

In table 2, the correlation coefficient showing the degree of similarity between each type, similarity of each type is not seen.

**Table 2: Correlation**

	Factor I	Factor II	Factor III
Factor I	1.000		
Factor II	0.393	1.000	
Factor III	0.421	0.405	1.000

In terms of general characteristics, a total of thirty respondents were fifteen in the first year of high school and fifteen in the second grade as shown in table 3. 40% (12) answered that there is no religion, followed by Christianity (30%), Roman Catholic (23.3%) and Buddhism (6.7%). More students (66.7%) answered that they had no nurses in their family members. Media such as TV or drama and hospitalization or visiting somebody in a hospital were influenced on the image of nurses the most. The most reason why they were interested in nursing was to help somebody.

**Table 3: The general characteristics (n = 30)**

Items	Numbers	%	
Grades	1 <sup>st</sup>	15	50%
	2 <sup>nd</sup>	15	50%
	3 <sup>rd</sup>	0	0%
Religion	Christian	9	30%
	Buddhism	2	6.7%
	Roman Catholic	7	23.3%
	No religion	12	40%
	Others	0	0%
Nurses In family members	Yes	10	33.3%
	No	20	66.7%
The most Influence on The image of nurses	TV or drama	12	40%
	Books	1	3.3%
	Hospitalization or visiting somebody in a hospital	12	40%
	Nurses in a member of family or relatives	4	13.3%
	Others	1	3.3%
Distinction between nurses and nursing aids	Yes	14	46.7%
	No	16	53.3%
The reason of Interesting in nursing	Having aptitude	7	23.3%
	For employment	7	23.3%
	By recommendation	1	3.3%
	Able to serve	9	30%
	Others	6	20%
Experiences of hospitalization	Yes	14	46.7%
	No	16	53.3%

In terms of Factor I, there were eleven participants in the category out of total sum of thirty. Agreed statements and disagreed ones are shown in table 4. High school female students who were associated with Factor I positively recognized nurses' image as the feeling of trust, being well behaved and a valuable and worthwhile job, while they negatively disagreed with nurses' autonomy. Therefore this group is called as the type of 'focusing on good value'.

**Table 4: Descending Array of Z-scores of Factor I (greater than ± 1) (n = 11)**

	Statement	Z-score
Positive	Q2. The nurse I think gives the feeling of trust.	1.44
	Q28. The nurse I think is well behaved.	1.33
	Q10. The nurse I think is a valuable and worthwhile job.	1.32
	Q22. The nurse I think is faithful; sincere; earnest.	1.20
	Q7. The nurse I think takes care of or helps others.	1.18
	Q25. The nurse I think is considerate to others.	1.10
	Q1. The nurse I think is devoted.	1.01
	Negative	Q17. The nurse I think practices their own nursing care unto themselves.
Q12. The nurse I think joins in determining new hospital policies and standards.		-1.34
Q6. The nurse I think plays a role as a mother.		-1.42
Q19. The nurse I think is a counselor.		-1.52
Q20. The nurse I think misuses their power(authority).		-1.99

In terms of Factor II, there were eleven participants in the category out of total sum of thirty. Agreed statements and disagreed ones are shown in table 5. Eleven high school girls affirmatively accepted nurses' image as comfort, a valuable and worthwhile job and playing a role as a mother but they unfavorably recognized nurse's intelligent level. Factor II group is called as 'the type of focusing on occupational rewards'.

**Table 5: Descending Array of Z-scores of Factor II (greater than ± 1) (n = 11)**

	Statement	Z-score
Positive	Q29. The nurse I think is a comfortable person who wants to depend on.	1.57
	Q10. The nurse I think is a valuable and worthwhile job.	1.44
	Q6. The nurse I think plays a role as a mother.	1.41
	Q22. The nurse I think is faithful; sincere; earnest.	1.21
	Q11. The nurse I think is cooperative and good at relationship with others.	1.18

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Negative	Q17. The nurse I think practices their own nursing care unto themselves.	-1.07
	Q26. The nurse I think is highly intelligent.	-1.28
	Q5. The nurse I think is an educator.	-1.60
	Q4. The nurse I think is unkind.	-2.18
	Q20. The nurse I think misuses their power(authority).	-2.20

In terms of Factor III, there were eight participants in the category out of total sum of thirty. Agreed statements and disagreed ones are shown in table 6. They positively recognized the nurse was doctor's assistant, well behaved and a comfortable person while negatively accepted nurses' image such as personality, leadership and so on. As a result, this Factor III is called as 'the type of focusing on focusing on complex aspects'.

**Table 6: Descending Array of Z-scores of Factor III (greater than ± 1) (n = 8)**

	Statement	Z-score
Positive	Q23. The nurse I think is a doctor's assistant.	2.27
	Q28. The nurse I think is well behaved.	1.55
	Q29. The nurse I think is a comfortable person who wants to depend on.	1.37
	Q10. The nurse I think is a valuable and worthwhile job.	1.15
	Q7. The nurse I think takes care of or helps others.	1.12
Negative	Q27. The nurse I think is a mature personality with philanthropism.	-1.14
	Q21. The nurse I think has leadership.	-1.14
	Q6. The nurse I think plays a role as a mother.	-1.16
	Q5. The nurse I think is an educator.	-1.59
	Q17. The nurse I think practices their own nursing care unto themselves.	-1.69
	Q20. The nurse I think misuses their power(authority).	-1.79

Among three types, there were some consensus items. Three Factors recognized positively the nurse as a valuable and worthwhile job and earnest while negatively as authority, social position as well as knowledge in table 7.

**Table 7: Consensus item**

	Statement	Z-score
Positive	Q10. The nurse I think is a valuable and worthwhile job.	1.30
	Q22. The nurse I think is faithful; sincere; earnest.	1.10
	Q9. The nurse I think understands and supports the patient's position.	0.51
	Q3. The nurse I think is honest.	0.38
	Q15. The nurse I think solves health problems.	0.25
	Q16. The nurse I think is an expert.	0.21
Negative	Q13. The nurse I think gets recognition socially.	-0.14
	Q14. The nurse I think has scientific knowledge.	-0.26
	Q21. The nurse I think has leadership.	-0.71
	Q17. The nurse I think practices their own nursing care unto themselves	-1.32
	Q20. The nurse I think misuses their power(authority).	-2.00

### CONCLUSION

In conclusion, thirty high school girls were interested in a nurse as their future career so they desired to know what the nurse was and how they could become a nurse. They thought that a nurse was a valuable and worthwhile job positively while they negatively recognized that a nurse practiced their own nursing care unto themselves in common. Three groups or factors clearly showed the inter-individual distinction with their own thought, feeling and subjectivity. Because of the fasted aging process, our society has to need a lot of medical services so that we

should know how future labor population look at nurses as their promising career in the foreseeable future in order to educate them well without misunderstanding nursing duties, tasks, responsibility, etc.

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# Relationship between Post-Traumatic Growth and Ego-resilience of Nurses in the Emergency Department

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## ABSTRACT

This research aimed to identify the post-traumatic growth according to the degree of ego-resilience of the nurses in the emergency department. In a descriptive study, 131 emergency department nurses were participated. The nurses answered self-questionnaires assessing ego-resilience and post-traumatic growth. we compared between upper and lower groups of ego-resilience among nurses. Chi-square test and t-test were used to analysis the effectiveness of ego-resilience. The general characteristic of both groups had no significant difference between both groups except the preferred department ( $t=5.449$ ,  $p=.019$ ). However, upper groups had high level of ego-resilience than lower groups ( $t=7.459$ ,  $p<.001$ ). Also, there were significantly difference in post-traumatic growth between both groups. Consequently, ego-resilience has a great influence on the nursing practice of emergency department. Ego-resilience also helped to improve post-traumatic growth among emergency department nurses. It can be utilized as one of the administrative strategies to reduce the turnover intention of the nurses.

**Keywords:** *Ego resilience, Post-traumatic growth, Emergency department, Nurse, Post-traumatic stress*

## INTRODUCTION

**Background:** Emergency department nurses provide primary care for patients who have been seriously injured by traffic accidents, burns, or sexual abuses. Also, they are often psychologically shocked by caring suicide or homicide people due to hanging, drowning, transmission, drug intoxication, or arterial amputation etc<sup>1</sup>.

Since the nurses in emergency department are exposed to physical violence and verbal abuses directly, they are more likely to experience post-traumatic stress due to direct or indirect traumatic events.

Because of emergency department nurses are always in traumatic and tense situations, the nurses have higher job stress than general ward nurses<sup>2</sup>. If these stress are not resolved, they are mentally and psychologically exhausted and it causes failure, guilt, and regret about the job. It also decreases job satisfaction and job performance, which in turn causes more job stress in a vicious cycle<sup>3</sup>.

According to the result of previous research, emergency department nurses, who experience the more traumatic events report the high level of post-traumatic stress<sup>4</sup>, and these stress directly affect to their turnover

intention<sup>5</sup>. The other result shows that emergency department nurses with lots of post-traumatic stress are highly depressed, and this depression also affects to turnover intention<sup>6</sup>.

Post-traumatic growth resistances to extreme stress and returns to a previous level of functioning before a trauma. Furthermore, it helps to move qualitatively beyond previous level of adaptation<sup>7</sup>.

Post-traumatic growth begins with the characteristic and lifestyle of individuals before traumatic events<sup>8</sup>. One of individual characteristics that directly affect to post-traumatic growth is ego-resilience, which is the ability to maintain a relatively stable and healthy level of psychological and physical functioning while exposure to trauma<sup>9,10</sup>.

Ego-resilience is the ability to respond flexibly and adapt successfully based on self-control in changing circumstances or stressful environments<sup>11</sup>. Therefore, it helps the nurses overcome difficulties and stress that face in the work. Despite the severe job stress, ego-resilience also influences positively to promote a certain level of function and adaptation and to relieve stress<sup>12</sup>. In addition, it is a variable that significantly affect

to post-traumatic growth of among adults 20s-50s<sup>7</sup>, and there is a significant positive correlation between ego-resilience and post-traumatic growth in college students<sup>13</sup>. Moreover, the higher the ego-resilience of nurses in the emergency department has the high level of the job satisfaction<sup>14</sup>, and a higher the disaster nursing core competency<sup>15</sup>.

Therefore, this study attempts to evaluate the post-traumatic growth according to the degree of ego-resilience of the nurses in the emergency department and provides basic data to improve the post-traumatic growth of emergency department nurses.

### OBJECTIVES

The purpose of this study is to attempt to evaluate the post-traumatic growth according to the degree of ego-resilience of the nurses in the emergency department and provides basic data to improve the post-traumatic growth of emergency department nurses.

### METHODS

**Design:** This study is a descriptive study to investigate the post-traumatic growth according to the degree of ego-resilience of the emergency department nurses.

**Sample and Procedure:** A total of 131 nurses who worked in emergency department; participants were recruited from three university hospitals located in S and D city. All participants autonomously provided a written indication of consent to participate. Ego resilience of participants was measured; data from 69 participants (highest 25% represents upper group and lowest 25% represents lower group in ego-resilience scale; 35 and 34 nurses, respectively) was used.

Data collection was completed after detailed explanations of the present study's context and objectives were provided to the relevant nursing department in hospitals, who were subsequently asked to cooperate. Participants were informed that they could withdraw from the study at any time without penalty. Explained that even if the participants withdraw from the study, the gift will not be collected and the survey will take about 15 minutes.

**Table 1: Difference in general characteristics according to resilience levels**

Variables	Categories	Upper25% (n = 35)	Lower25% (n = 34)	t/ $\chi^2$	p
		n (%) or M $\pm$ SD	n (%) or M $\pm$ SD		
Age (year)		28.74 $\pm$ 6.60	28.00 $\pm$ 4.28	-0.554	.582
Clinical career of emergency department (month)		40.20 $\pm$ 3.50	40.94 $\pm$ 3.56	-0.087	.931

### MEASUREMENTS

**Ego-resilience:** Ego-resilience was measured by using the self-reported ego-resilience, which Park<sup>11</sup>modified from the ego-resilience developed by Klohn<sup>12</sup>. It compromises the self-esteem, effectiveness of interpersonal relation, optimistic attitude, and control of mindfulness. In this scale, there are 4 positive statements and 25 negative statements. It consists 28 questions scored 1 point for negative answer and 5 points for positive answers. The higher scores indicate high ego-resilience. The Cronbach's  $\alpha = .88$  in Park's study<sup>11</sup>, and .93 in this study.

**Post-traumatic growth:** Post-traumatic growth was measured by using the Korean version of the post-traumatic growth inventory that Song et al.<sup>16</sup>corrected and adapted from the one developed by Tedeschi & Calhoun<sup>17</sup>. It consists 16 questions rated from 0 to 5 points, and higher scores signify positive changes after trauma. The Cronbach's alpha were .90 by Song et al. and .91<sup>18</sup>in this study.

**Statistical analysis:** Data were analyzed using the IBM SPSS Statistics 19.0. The general characteristics according to the degree of ego-resilience of the subjects were analyzed by chi-squared test and t-test. The post traumatic growth according to the degree of ego resilience of the subjects was analyzed by t-test.

### RESULTS

**General characteristics and ego-resilience of participants:** Table 1 showed that general characteristic different between upper and lower groups. There was no significant difference in age and clinical career of emergency department nurses between upper and lower groups except the preferred department ( $t=5.449$ ,  $p=.019$ ). The levels of ego-resilience significantly varied between the upper and lower groups (27 (77.14%) and 17 (50.0%), respectively;  $t=20.85$ ,  $p<.001$ ).



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preferred department	Yes	27 (77.14)	17 (50.00)	5.499	.019*
	No	8 (22.86)	17 (50.00)		
Resilience		96.71±4.90	67.50±6.63	20.85	<.001**
M = mean, SD = standard deviation, * <i>p</i> <.05, ** <i>p</i> <.001					

**Post-traumatic growth according to ego resilience:** Table 2 compares the post-traumatic growth between the upper and lower groups. Mean of post-traumatic growth was significantly difference between the upper and lower groups (49.86 and 33.62, respectively, *t*=7.459, *p*<.001).

**Table 2: Difference in posttraumatic growth according to resilience levels**

Variables	Upper 25% (n = 35)	Lower 25% (n = 34)	t	p
	M ± SD	M ± SD		
Posttraumatic growth	49.86 ± 9.43	33.62 ± 8.53	7.459	<.001*
M = mean, SD = standard deviation, * <i>p</i> < .001				

**DISCUSSION**

In this study, the nurses with high ego-resilience showed higher post-traumatic growth than those with low ego-resilience (*t*=7.549, *p*<.001). This finding was consistent with the previous findings, which showed people with high ego-resilient reported the high level of the post-traumatic growth among 20s to 50s (*r*=0.44, *p*<.01) and college students with high ego-resilience showed the high level of the post-traumatic growth (*r* = 0.45, *p* <.01)<sup>13</sup>.

Therefore, ego-resilience is a positive coping resource in crisis situations, and this is a personal trait that plays a major role in post-traumatic growth. Especially, emergency department nurses have at least a moderate level of traumatic event experience, and more than one-fifth of these nurses are found in the high-risk group of post-traumatic stress<sup>6</sup>.

One of the major causes of post-traumatic stress in emergency department nurses is the unpredictable urgent situation in their workplace. So, it is necessary to develop various educational programs that can enhance ego-resilience so that they can respond and adapt flexibly to the unpredictable environment.

As a result of analyzing the predictive variables of turnover intention of nurses in emergency department,

those who experienced more than 10 times the amount of traumatic events during work had a high level of turnover intention<sup>5</sup>. In addition, the high level of post-traumatic experience strongly predicted post-traumatic stress among nurses. Furthermore, about 20% of these nurses considered about turnover from their job.

Therefore, it is necessary to assess and analyze the level of post-traumatic experience and ego-resilience of emergency department nurses periodically. In this respect, the administrative strategies that can be systemically applied should be developed. To develop these strategies, the further research is needed.

Additionally, the ego-resilience of the nurses who wanted to work in the emergency department was higher than those who did not (*t*=5.499, *p*=.019). The results of the present study were similar with previous finding that nurses with a low level of employment and job satisfaction intended to leave the position than those who had a high level of employment and job satisfaction(*t*=2.50, *p*=.013, *F*=8.12, *p*<.001)<sup>15</sup>. In addition, the participants who were satisfied about their job adapted to their work environment and conditions better. it also affects to ego-resilience.

Furthermore, ego-resilience of charge nurses was significantly higher than general nurses. As the position of a nurse ascend, various dispute resolution experiences can be seen to increase and have a positive impact on ego-resilience<sup>18</sup>.

The high level of ego-resilience group reported that only 8% were suffering from post-traumatic stress disorder. However, 25% of the lower level of ego-resilience group had post-traumatic stress disorder. Moreover, those with higher ego-resilience had noticeably lower post-traumatic stress and better job performance. A high level of ego-resilience also helped to maintain meaningful interpersonal relationships and the overall level of daily living activity<sup>20</sup>. According to this study, ego-resilience has a great influence on the nursing practice.

The present results are in line with previous study which demonstrated a positive relationship between ego-resilience and job performance among nurses<sup>21</sup>. It also helped to reduce the negative psychological factors such as turnover intention, stress, or depression that occurred to nurses from the workplace<sup>22,23,24</sup>.

## CONCLUSION

Consequently, the nurses who wanted to work in the emergency department had a high level of ego-resilience and a low level of post-traumatic stress.

Therefore, it is necessary to determine the post-traumatic stress of emergency department nurses according to hospital volume, and to find out the variable that will lead to post-traumatic growth instead of post-traumatic stress. This variable will impact the nurses who are at risk of being exposed or exposed to post-traumatic stress existential change in the form of post-traumatic growth.

It is also important for hospital administrators to have countermeasures and systematic strategies to actively promote post-traumatic growth of emergency department nurses.

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# Changes of Higher-order Aberrations According to the Increase of Refractive Errors

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## ABSTRACT

To identify the relationship between spherical refractive errors and HOAs and the relationship between cylindrical refractive errors and HOAs, the HOAs within 6mm zone were measured. The refractive errors and HOAs were measured by KR-9000PW (Topcon Corp., Japan), a wavefront aberrometer using Hartmann-Shack method, and the aberrations within the 6mm range of pupil diameter were measured. The Zernike coefficients from 3rd to 4th expressions were analyzed. All HOAs such as trefoil aberration, coma aberration, tetrafoil aberration, 2nd astigmatism, and spherical aberration that were analyzed showed a significant correlation with cylindrical refractive error. On the other hand, only spherical aberration had a correlation with the spherical refractive error in the comparison between HOAs and spherical refractive error, and the remaining aberrations had no significant correlation. In the comparison with Zernike coefficients, Z40, Z42, and Z44 had a significant correlation with the Spherical refractive error and cylindrical refractive error, while Z31 had a significant correlation only with the spherical refractive error. The other coefficients had no significant correlation with both spherical refractive error and cylindrical refractive error. Since HOAs have very small values compared to refractive error and the values change greatly in each measurement, it is considered necessary to measure HOAs more precisely to identify the correlations among each other.

**Keyword:** cylindrical refractive error, HOAs, spherical refractive error, wavefront aberrometer, Zernike coefficients.

## INTRODUCTION

Monochromatic aberrations, which become the main optical cause to see objects clearly, can be classified into lower-order aberrations and higher-order aberrations (HOAs). They can be corrected by glasses or contact lens because they are lower-order aberrations that mean simple refractive errors such as defocus and astigmatism, and HOAs cannot be corrected. The HOAs of eyes are less compared to lower-order aberrations, but have been the subject of attention with regard to the qualitative part of image formed on the retina [6], [7], [10].

HOAs require to be measured precisely because it has small values. Even if the same object is measured by the same aberrometer, it has been reported that values vary depending on conditions such as tear membrane or the arrangement of visual axis at the time of measurement [9], [13]. The precision of aberrometers that have been developed and commercialized in the market has been verified through experiments such as artificial eyeholes, there are still various reports of clinical results [4], [5], [11], [12], [14], [15].

With the development of wavefront aberrometer, there have been overseas researches conducted on the correlation between the refractive error and HOAs. While most researches report that HOAs increase as the refractive error increases, studies show differences regarding statistical significant correlations [1], [2], [8].

[2] Argued that severe myopia increases spherical aberration, but [3] said that the increase of spherical equivalent refractive error (SE) does not result in the significant change of spherical aberration and coma aberration. In contrast, [8] claimed in their study that spherical aberration and coma aberration have a significant correlation with SE, and that cylindrical refractive error has correlations with total HOA, 4th aberration, coma aberration, etc.

This study sought to examine not only the correlation of the refractive errors of eyes with individual HOAs but also the correlation with each of Zernike coefficients and refractive errors.

**METHOD**

The study subjects were 198 university students who had never undergone any kind of refractive surgery and had recently not worn contact lens for a certain period of time (6 weeks for hard lens and 2 weeks for soft lens). Their age ranged from 20 to 29 years old and the mean age was 23. The refractive errors and HOAs were measured by KR-9000PW (Topcon Corp., Japan), a wavefront aberrometer using Hartmann-Shack method, and the aberrations within the 6mm range of pupil diameter were measured. The Zernike coefficients from 3rd to 4th expressions were analyzed. Finally, the study analyzed the correlation between RMS value of each coefficient and refractive error as well as the correlation between refractive errors and each of aberrations, including trefoil, coma, tetrafoil, 2nd astigmatism, and spherical aberration. To measure the refractive errors of eyes used in the comparison, the spherical refractive error and cylindrical refractive error were used.

**RESULTS**

The mean spherical refractive error of 198 subjects (396 eyes) was -2.34D and the mean cylindrical refractive error was -1.00D. The mean RMS of total HOA was 0.397  $\mu\text{m}$  and the aberrations of 3rd expression and the 4th expression were 0.303  $\mu\text{m}$  and 0.199  $\mu\text{m}$  respectively. The mean RMS of trefoil aberration was measured to be 0.194  $\mu\text{m}$ , coma aberration was 0.217  $\mu\text{m}$ , tetrafoil aberration was 0.086  $\mu\text{m}$ , 2nd astigmatism was 0.083  $\mu\text{m}$ , and spherical aberration was 0.106  $\mu\text{m}$  in Table 1.

**Table 1: Mean RMS ( $\mu\text{m}$ ) of ocular higher-order aberrations for 6mm pupil zone**

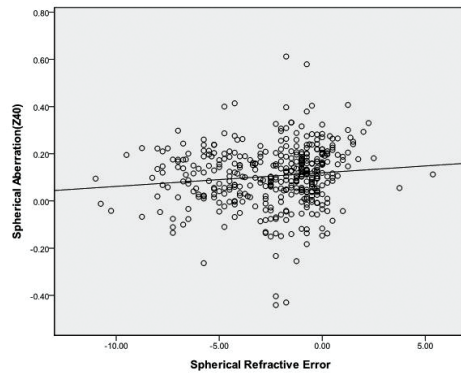
Aberration	Mean ( $\pm$ SD)	Range
Total HOA	0.397 ( $\pm$ 0.192)	0.120~1.995
Third	0.303 ( $\pm$ 0.163)	0.035~1.336
Fourth	0.199 ( $\pm$ 0.113)	0.022~0.867
Trefoil	0.194 ( $\pm$ 0.110)	0.013~0.646
Coma	0.217 ( $\pm$ 0.145)	0.002~1.179
Tetrafoil	0.086 ( $\pm$ 0.078)	0.004~0.545
2nd Astigmatism	0.083 ( $\pm$ 0.066)	0.002~0.550
Spherical	0.106 ( $\pm$ 0.129)	0.003~0.610

Pearson correlation analysis was carried out to figure out the correlation between spherical refractive error and the RMS of HOAs. Only the spherical aberration had a significant correlation with the spherical refractive error ( $r=0.115$ ,  $p<0.05$ ) and the other aberrations had no

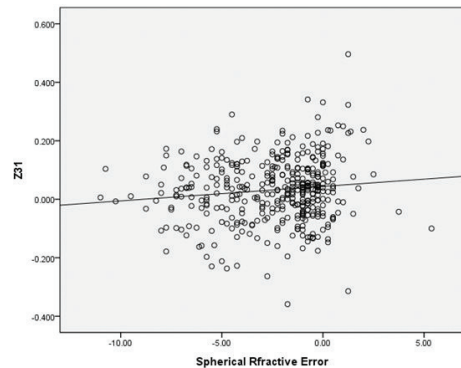
significant correlations with the spherical refractive error. In the comparison between each of Zernike coefficients and spherical refractive error, Z31, Z40, Z42, and Z44 had a correlation with the spherical refractive error with correlation but the other Zernike coefficients appeared to have no significant correlations with the spherical refractive error details are displayed in Fig. 1 to 4.

According to the comparison between cylindrical refractive error with higher-order aberration, all aberrations such as trefoil, coma, tetrafoil, 2nd astigmatism, and spherical aberration showed a significant correlation with cylindrical refractive error. However, among Zernike coefficients, only Z40, Z42, and Z44 had a correlation with the cylindrical refractive error but the other coefficient had no significant correlation are given in Fig. 5 to 11.

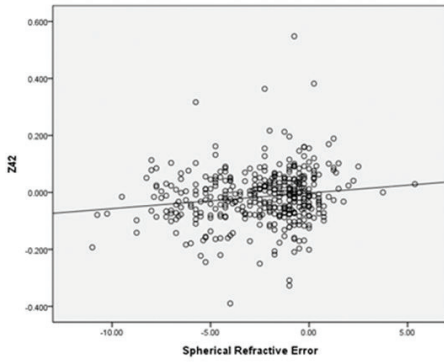
In the comparison of SE and higher-order aberration, only the spherical aberration had a significant correlation as in spherical refractive error and other aberrations did not have significant correlations with SE. In the comparison of SE and Zernike coefficients, Z31, Z40, and Z42 had significant correlations are explained in Fig. 12 to 14.



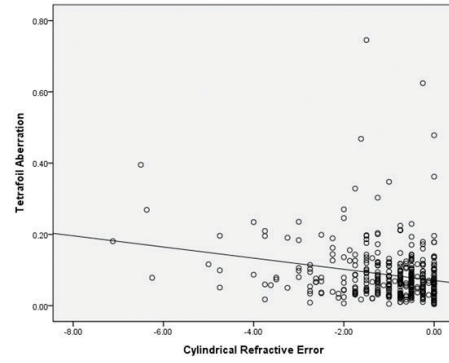
**Fig. 1: Correlation between spherical refractive error(SRE) and spherical aberration Z40 ( $r=0.115$ ,  $p=0.02$ ).**



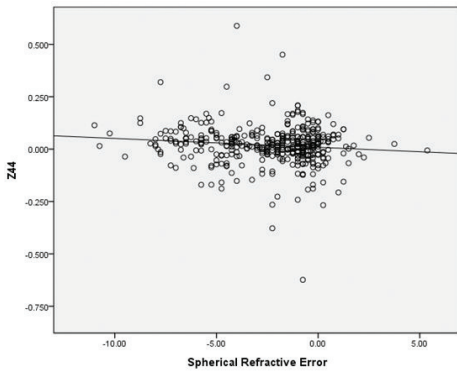
**Fig. 2: Correlation between SRE and Z31 ( $r=0.117$ ,  $p=0.02$ ).**



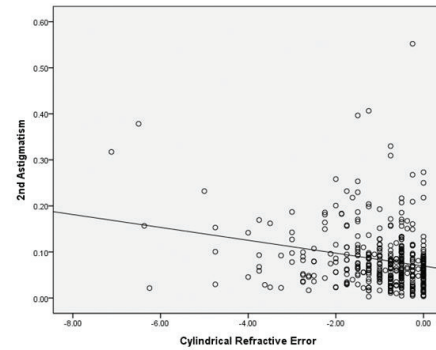
**Fig. 3: Correlation between SRE and Z42 ( $r=0.149$ ,  $p=0.00$ ).**



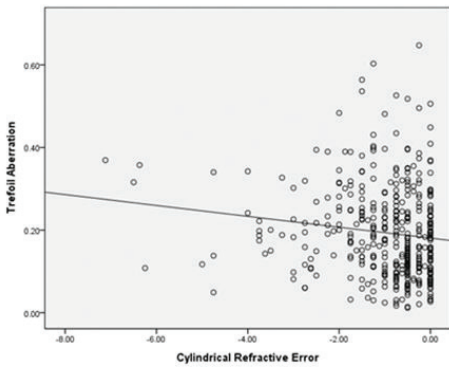
**Fig. 7: Correlation between cylindrical refractive error and tetrafoil aberration ( $r=-0.221$ ,  $p=0.00$ ).**



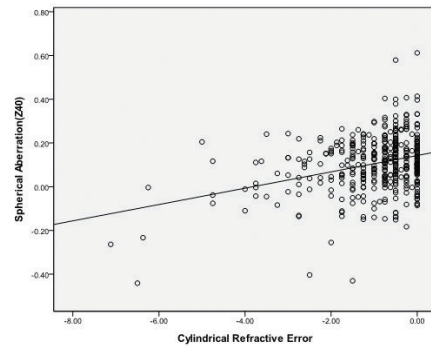
**Fig. 4: Correlation between SRE and Z44 ( $r=-0.114$ ,  $p=0.00$ ).**



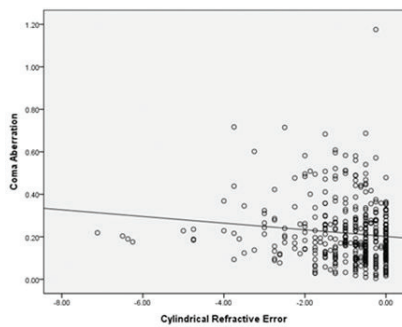
**Fig. 8: Correlation between cylindrical refractive error and 2nd astigmatism ( $r=-0.233$ ,  $p=0.00$ ).**



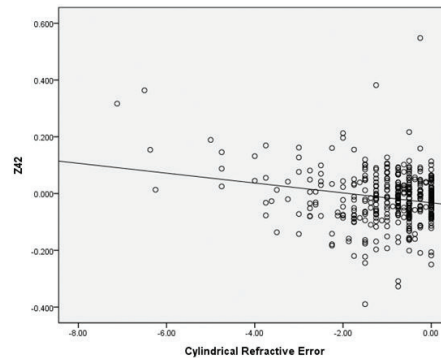
**Fig. 5: Correlation between cylindrical refractive error and trefoil aberration ( $r=-0.131$ ,  $p=0.01$ ).**



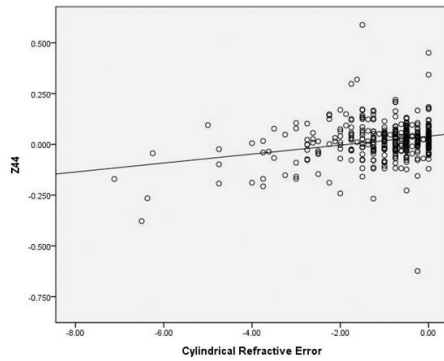
**Fig. 9: Correlation between cylindrical refractive error and spherical aberration Z40 ( $r=0.319$ ,  $p=0.00$ ).**



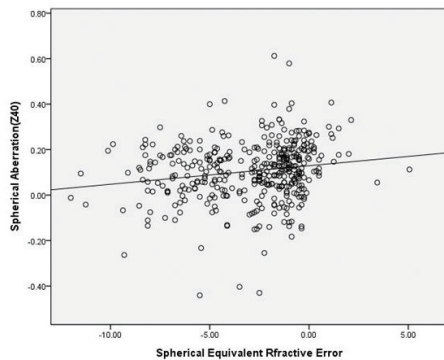
**Fig. 6: Correlation between cylindrical refractive error and coma aberration ( $r=-0.118$ ,  $p=0.02$ ).**



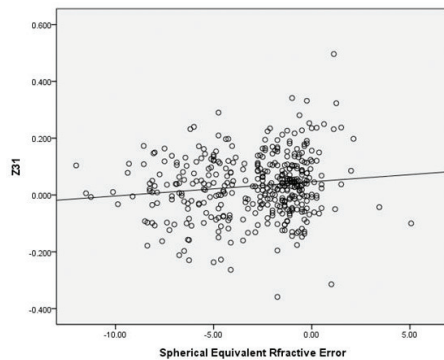
**Fig. 10: Correlation between cylindrical refractive error and Z42 ( $r=-0.202$ ,  $p=0.00$ ).**



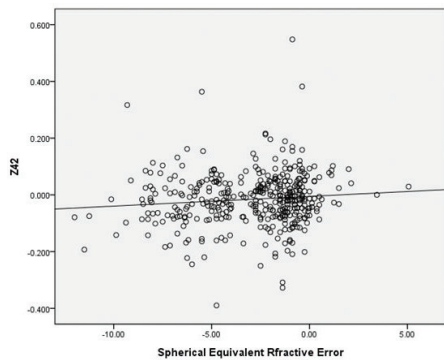
**Fig. 11: Correlation between cylindrical refractive error and Z44 ( $r=0.256$ ,  $p=0.00$ ).**



**Fig. 12: Correlation between SE and spherical aberration Z40 ( $r=0.172$ ,  $p=0.00$ ).**



**Fig. 13: Correlation between SE and Z31 ( $r=0.126$ ,  $p=0.01$ ).**



**Fig. 14: Correlation between SE and Z42 ( $r=0.099$ ,  $p=0.04$ ).**

## CONCLUSION

Cylindrical refractive error had significant correlations with all HOAs such as trefoil aberration, coma aberration, tetrafoil aberration, 2nd astigmatism, and spherical aberration. On the other hand, spherical refractive error and SE had no significant correlations with all HOAs except spherical aberration.

In the comparison of Zernike coefficients, spherical refractive error had significant correlations with Z31, Z40, Z42, and Z44, and cylindrical refractive error had significant correlations with Z40, Z42, and Z44. Spherical equivalent refractive error (SE) had significant correlations with Z31, Z40, and Z42.

These results showed that Z40, a spherical aberration, and Z42, the 2nd astigmatism ( $45^\circ$ ), had correlations with all refractive errors that were categorized. Other HOAs had weak correlations with refractive errors. Since HOAs have very small values compared to refractive error and the values change greatly in each measurement, it is considered necessary to measure HOAs more precisely to identify the correlations among each other.

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# Design of Pipelined Radix-2, 4 and 8 Based Multipath Delay Commutator (MDC) FFT

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## ABSTRACT

FFT processor of pipelined FFT consists of a sub-class of architectures that are determinedly efficient in hardware. The pipeline FFT is a special class of FFT algorithms which can calculate the FFT in a serial manner; it attains real-time behavior with non-stop processing when the data is continually fed through the processor. This algorithm needs less computation due to its recursive operator named butterfly. In this paper, the pipelined structure of Radix-2, 4 and 8 based Multipath Delay Commutator (MDC) FFT has been proposed for enhancing the throughput and speed. The pipelined architecture of multi path delay commutator (MDC) FFT is utilized for different length of OFDM system by putting the data stream of  $N_s$  at the input.

**Keywords:** Fast Fourier Transform (FFT), Multipath Delay Commutator (MDC), Orthogonal Frequency Division Multiplexing (OFDM).

## INTRODUCTION

The FFT algorithm of mixed radix is depend on sub-transform modules with extremely optimized small length FFT which are combined to make large FFT. Algorithms of Higher radix such as radix-4, radix-8, etc can be involved to lessen the complex multiplications yet the butterfly structure becomes complex with the more than a few input complex adders. The fundamental design of the FFT algorithm is to split up an N-point DFT transform into consecutive smaller and smaller transform known as a butterfly. The small transform utilized can be a 2-point DFT known as Radix-2, 4-point DFT known as Radix-4, or different points.

Two complex additions and one complex multiplication are required in two-point butterfly structure and three complex multiplications and eight complex additions are required in the structure of four-point butterfly. Hence, a Radix-2 FFT reduces the complexity of an N-point DFT complex multiplications and additions. There are  $\log_4 N$  stages for a radix-4 FFT and, at each stage, there are  $N/4$  butterflies.

Generally, the radix-8 FFT processor is a twiddle factor based butterfly calculation. The significance of radix-8 FFT compare with radix-2 and radix-4 FFT, it's taking less calculation resources. A proficient method to recognize a mixed-radix butterfly element in a small area but maintaining high throughput. The circuit complexity

of butterfly element is reduced significantly and at the same time silicon area is decreased noticeably. In this paper, the radix-2, 4 and 8 based pipelined structure of multipath delay commutator has been designed to enhance the speed of FFT processor.

**Literature Survey:** Yang et al. <sup>[1]</sup> explained the MDC architecture and memory scheduling are suitable for FFT processor. The efficient structure of memory scheduling is to fully use memory. This method reduced the area because the requirement of memory normally dominates the chip area in FFT processor. Shin and Lee <sup>[2]</sup> described the Multipath Delay Commutator (MDC) structure perform with the high throughput and minimum hardware cost. The multiple data path methods are utilized to decrease the hardware cost compare than the four parallel data path approach. The number of complex multipliers and memory elements is further reduced by using the MDC architecture.

Cheng and Parhi<sup>[3]</sup> explained the high throughput VLSI architecture for FFT computation. The fetch and decode based pipelining architecture are used for improving the speed performances of FFT computations. The concurrent butterfly structure is used to reduce the complexity of dataflow structures. Ismail et al. <sup>[4]</sup> presented the OFDM architecture with various FFT algorithms. In these algorithms, complex adders and multipliers are required to optimize the circuit and exploit reusability.

Badar and Dandekar<sup>[5]</sup> explained the pipelined architecture of radix-4 FFT. For calculation, multipliers take more time and also it increases the delay, therefore the processing element depends on multipliers. Kim et al.<sup>[6]</sup> described the FFT processor for reducing the complex multipliers without improving delay and computational paths. Radix-8 pipelined SDF FFT in Geetha and Manimaran<sup>[7]</sup> for reducing the computational stages. Pipelined Architectures has been presented in Xiao-Bo<sup>[8]</sup> for Radix-2 Real-Valued FFT.

**Radix-2, 4 and 8 FFT algorithms:** The output sequence X(k) separates the odd and even samples in the decompositions of the Radix-2 Decimation In Frequency (DIF) and it is shown in figure 1.

For k=0, 1, ..., N/2-1, n=0 to N/2-1.

For k=0, 1, ..., N/2-1, n=0 to N/2-1.

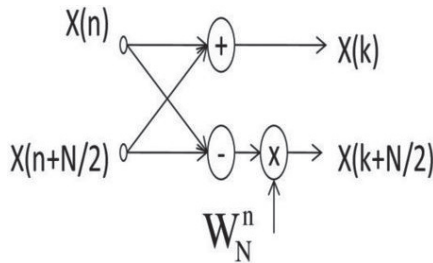


Figure 1: Radix-2 FFT

Transformations between the N into N/2 Point DFTs for decompositions of the 2-point DFTs. The N point data sequences into the two N/2 data sequences x1(n) and x2(n) for the odd and even numbered samples of the x(n).

In Radix-4 Fast Fourier Transform (FFT), the algorithm is explained by using different unused indices that is derived as below and it is shown in figure 2.

In divide and conquer approach, the Radix-4 FFT Algorithm is described by the selection of the L=4 and M=N/4 for the N=point FFT computations.

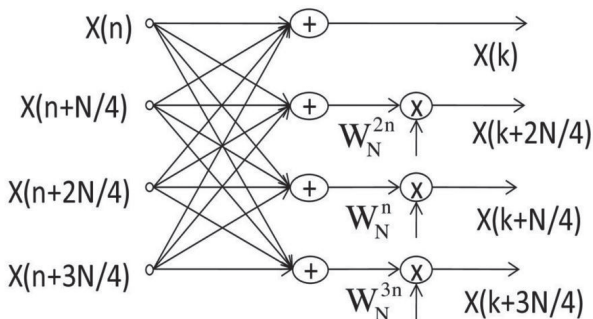


Figure 2: Radix-4 FFT

Radix-8 Fast Fourier Transform (FFT) Algorithm is designed to reduce the utilizations of the complex multiplications than the Radix-2 and Radix-4 FFT algorithm. In this algorithm, the requirements of multiplications are low but the hardware cost of the design is comparatively high so the implementations of this algorithm are leads to complexity. Radix-8 FFT has been shown in figure 3.

By using Radix-8 algorithm, we obtained the following equations,

$$X[8r] = \sum_{n=0}^{N-1} X[N]W_N^{8m}$$

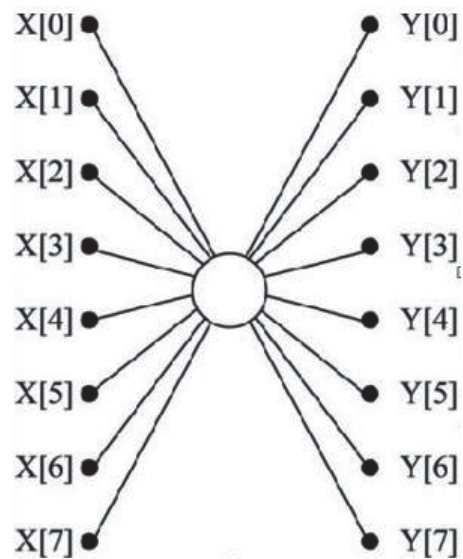
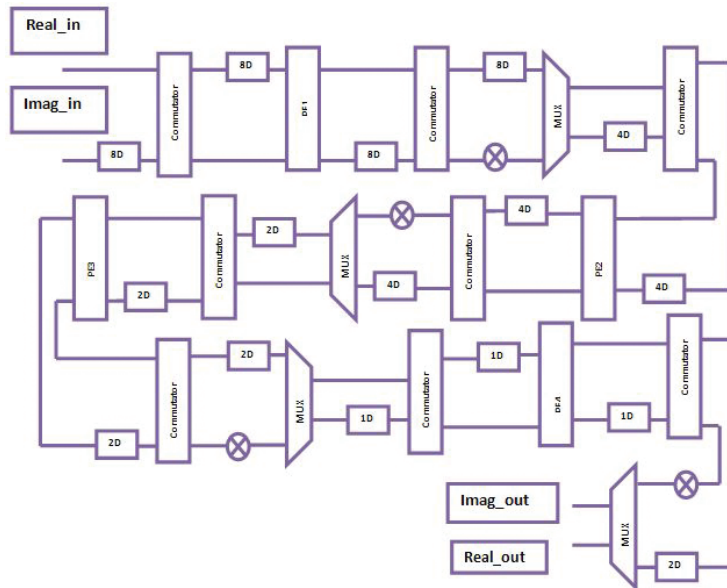


Figure 3: Radix-8 FFT

**Proposed architecture of Radix-2, 4 and 8 based Multipath Delay Commutator (MDC) FFT:** Figure 4 shows the architecture of 16 point Radix-2, 4 and 8 based Multipath Delay Commutator (MDC) FFT has been proposed for enhancing the speed of FFT processor. The computational stages are reduced in this FFT architecture and also enhance the speed. The inputs and outputs are sequential manner in the multipath delay Commutator. The sequential circuit has been used to control the flow of data transformation method through clock signals. The clock based control signals are utilized to exchange the imaginary and real values. The conversion of one signal to another signal is called commutator. The butterfly processing element performs the computation on the data. The addition and subtraction operation is done in butterfly elements.

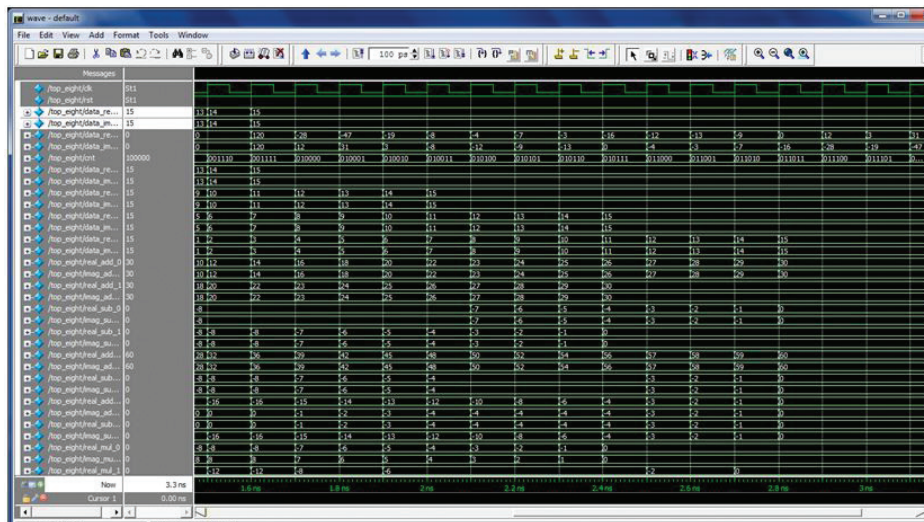


**Figure 4: Proposed 16 point Radix-2, 4 and 8 based MDC FFT**

In the existing R2MDC FFT, the inputs are given in sequential manner. However, the structure of hardware utilization is more and also the high power consumption due to utilizing large amount of unwanted intermediate signals. To conquer this issue, the design of radix-2, radix-4 and radix-8 based MDC FFT architectures are designed to reduce the hardware utilization of the processor. The proposed method which is significantly reduces the area, delay and power consumption. This proposed structure reduces the computational stages than the existing method. The radix-2, 4 and 8 based MDC FFT has been proposed in this architecture for reducing the computational stages. For example 64 point FFT, radix-2 FFT has 6 stages to compute the FFT output. Radix-4 FFT has only 3 stages. Compared to radix-2 and radix-4 FFT, radix-8 has only 2 stages. So we combined radix-2, 4 and 8 for improving performance of architecture.

### RESULTS AND DISCUSSION

The pipelined architecture of radix-2, 4 and 8 based Multipath Delay Commutator (MDC) FFT has been designed by using ModelSim 6.3C and synthesized by using Xilinx ISE 10.1 design tool. The simulation result of proposed Radix-2,4 and 8 based MDC FFT is shown in Figure 5.

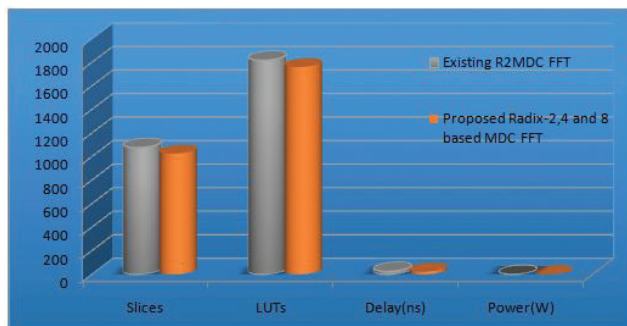


**Figure 5: Simulation Result of Proposed Radix-2, 4 and 8 based MDC FFT**

**Table 1: Comparison Analysis of existing R2MDC and proposed Radix-2,4 and 8 based MDC FFT**

Methods	Slices	LUTs	Delay (ns)	Power (W)
Existing R2MDC FFT	1078	1820	26.816	0.807
Proposed Radix-2,4 and 8 based MDC FFT	1025	1761	22.041	0.730
Percentage Reduction	4.91%	3.24%	17.8%	9.5%

From Table 1 show that the comparison analysis of existing R2MDC and proposed Radix-2, 4 and 8 based MDC FFT. When compared to existing method, The proposed method gives better performances .The performance evaluation of existing R2MDC and proposed Radix-2, 4 and 8 based MDC FFT is shown in Figure 6.

**Figure 6: Performance Evaluation of Existing R2MDC and Proposed Radix-2,4 and 8 based MDC FFT**

## CONCLUSION

In this paper, the pipelined structure of radix-2, 4 and 8 based Multipath Delay Commutator (MDC) FFT has been proposed for enhancing the speed of FFT processor. The proposed architecture has less computation path than the existing method. The proposed Radix-2, 4 and 8 based MDC FFT provides 4.91% reduction in slices, 3.24% reduction in LUTs, 17.8% reduction in latency and 9.5% reduction in power consumption than the existing R2MDC FFT. The proposed design can be extended to examine and optimize the power consumption in the future work.

**Ethical Clearance:** Taken from B.S. Abdur Rahman Crescent Institute of Science and Technology

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Key Escrow with Certificateless Elliptic Curve Segmentation for Grouping of Shared Data in Mobile Networks

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## ABSTRACT

In the recent years, Internet of Things (IoT) is a most emerging concept in Internet and Communication Technology (ICT) domain. Accessing of data over Internet through dynamic mobile network is the prime concern. Various business communities outsource their data in the cloud system to reduce the data secure management overhead. The data authentication and integrity are some of the basic security and trust requirements in the cloud distributed environment. Key Escrow with Certificateless Elliptic Curve Segmentation (KE-CECS) technique is a novel data security mechanism that provides data authentication for data transmission over IoT based Mobile Network environment. Certificateless ECC has evolved as a prime research area due to ability to solve the key escrow identity based problem in data management schemes. The development of Certificateless Signature ECC for light-weighted smart devices mounted in IoT based Mobile Networks has become one of the most focussed research works. This paper presents a new secret segmentation pairing based Certificateless Signature scheme without Map to Point hash function and pairing. The new KE-CECS is most secured against both Type-I and Type-II adversaries under the strong segmentation sharing ECC assumption respectively. Performance evaluation and comparison using simulation analysis prove that the proposed KE-CECS outperforms other certificateless schemes in the mobile networks environment.

**Keywords:** Certificateless Signature ECC, Cryptography, Key Escrow, IoT, Mobile Networks, Security, Segmentation Pairing

## INTRODUCTION

The broad acclimatization of various network devices and tools to intellect and gather data from the environment involves and share them across the Internet for the purpose of processing and utilization for multiple and diversified applications is termed as Internet of Things (IoT). Without compromising the human needs, the potential migration can be raised in the society by means of IoT. Improvisation of data security through adaptive surveillance mechanisms and conceptual environments can become more user-friendly.

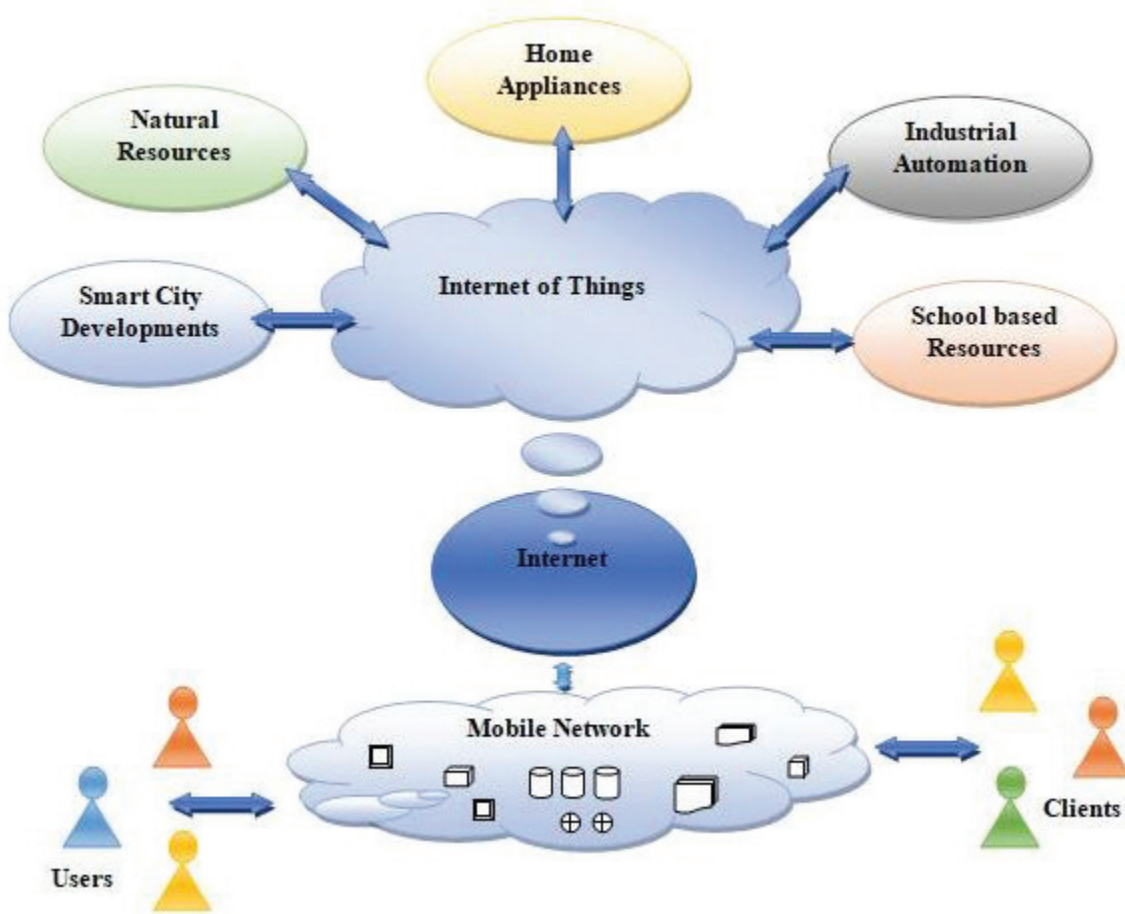
The idea of IoT was first introduced by Ashton in 1999 during his research on Radio Frequency Identification (RFID) [1]. Basically IoT provides as self establishing network of highly coupled heterogeneous objects such as various smart devices, RFID, sensors, actuators etc. These appliances are primarily used for data exchange in various applications [1]. IoT provides

interactions between the human and the applications. Moreover IoT is a technological phenomenon of impending computer and communication systems. The economic influence of IoT technology by the year 2020 is addressed in [2]. IoT has a significant demand for the technical infrastructure for the establishment of multiple trusts in organizational domain. Some of the key requirements of Information and Communication based infrastructures are faster replies at considerable costs, scalable and responsive operations. Through active internet processing mechanisms, industrial IoT is becoming popular and trustworthy in business environments [3]. In this mechanism, data management overhead is reduced by collecting data task from active users connected to internet.

IoT based operations can be combined in parallel with the most utilized communication techniques like dynamic mobile applications in the distributed networks [4]. Cloud provides a well-designed computational model

for data processing and facilitates users to utilize various applications including IoT data, globally through smart devices. Figure 1 shows an architectural overview of IoT based Mobile Network environment. Here the partially trusted cloud centric service is utilized for data segmentation and analysis of information collected from IoT network. Various IoT enabled devices mounted with sensors collect information from the end applications and transmit IoT data to the mobile network server over internet. Prior to the storage, any sensitive data in

the server need to be checked completely so that only authentic data have to be kept in the cloud storage space. So the authenticity of the IoT based Mobile Network totally relied on the security of the data server. Since such type of server is only partially trusted, the authenticity of the data should be ensured before outsourcing to the cloud server. To ensure authenticity and integrity, a number of Elliptic Public Key Infrastructure (EPKI) cryptographic techniques are proposed.



**Figure 1: IoT based Mobile Network Architecture**

The authenticity of the users' Elliptic Public Key is an important aspect in the data management scheme. So, secure communication has to be established over any public channel. For provision of data authenticity in IoT based Mobile Network, a technique called Certificateless Elliptic Curve Segmentation Signature is used. The applications using such authenticated mechanism implicitly send an Elliptic Curve Segmentation Signature using its physical address during the data transmission. On the other hand, the receiver also confirms the

authenticity by genuine verification of the segmentation in the received signature. For IoT based Mobile Network applications, the segmentation signature can be the optimal solution for data authenticity issue. By this mechanism, the users' elliptic public key is not tampered by means of any malicious entity. So the trusted third party security metric called Certificate Elliptic Curve Segmentation Authority is responsible for issuing and distributing certificates. This metric binds the users' identity with the corresponding elliptic public keys. To

avoid the overhead involved in the above process, the concept of Escrow is incorporated with Elliptic curve cryptosystem as in [5].

For establishing secured crypto measures in the mobile networks, various authentication protocols are discussed. To control the access to the dynamic network, authentication key agreement schemes and anonymous routing protocols are studied in [6]. Detection of deniable encryption methods in mobile networks are analysed in [7]. Traditional security measures which offer privacy, reliability and certification face critical challenges in the dynamic wireless networks. In the discussed scheme, the encrypted data is decrypted to various sensible plain text based on the key used by denial encryption. This method of encryption permits the sender to have credible deniability for giving up the encryption key.

The work studied in [8] shows the identity based encryption based on key escrow problem. To overcome this, a novel concept of segmentation among public and private keys is used. By this, the full access to the direct users is eliminated by means of sign of message. In the segmentation procedure, keys are determined by the user computation using a segmented value and segmented optimal private key. A chipper text or segmentation signature is sent along with the segmented public key to the available networked public directory in the organized manner. To assure the security feature, various certificateless cryptographic protocols [9][10] are used in industry based IoT and Distributed Systems. The work done in [11] shows Type I and Type II attacks under K-CAA (Collision Attack Algorithm with K Traitors) assumption, message signature property is found to be insecure. The paper [12] defined a new pairing free certificateless scheme using elliptic curve, which can be integrated with key escrow mechanism for improving the computational cost, execution time and key size of the secured transmission in the IoT based Distributive Network.

**IMPLEMENTATION**

The proposed Key Escrow with Certificateless Elliptic Curve Segmentation (KE-CECS) is implemented using segmentation pairing over prime order cyclic groups. In the scheme, the segmentation signature needs tow exponentiations during signature generation and the verifier requires two exponentiations with one pairing computation to verify the signature. Same ordered cyclic

group elements are used in the segmentation size. It is compared with the other ECC schemes. The performance efficiency is measured in terms of computational cost, time of execution and key size.

**Mathematical Analysis for Cryptographic Segmentation function:** For the given value of Cryptographic segmentation function C(s) and to derive the value for ‘s’, the improvement of signature of message ‘m’ defined by ‘z’ for the optimal solution ‘s’ is computed as follows:

$$|Kr [S \in R \{0, 1\} \text{ for } y \leftarrow C(s) \mid s' \leftarrow A(y) \text{ for } C(s') = y] | \geq z \dots(1)$$

where the notations used in the computation of the optimal solution is denoted in Table 1.

**Table 1: List of Notations Used**

Symbols	Meaning
s	large prime number used
C <sub>1</sub> , C <sub>2</sub>	cyclic group of similar order
r	generator of cyclic groups
C(s)	cryptographic segmented function
pvk	private key of the group
pubparam	public key parameters of the cyclic group
id	user identity
Si	secret value selected by user identity
Pi	public key of the set user i
z	Signature
sp(. , .)	segmentation pairing sp: C <sub>1</sub> x C <sub>2</sub> → C <sub>3</sub>

**KE-CECS Scheme Algorithm:** The formal structure of the KE-CECS Algorithm consists of the following steps.

1. Setup Phase: Generation of segmentation private key (pvk) and public key parameters (pubparam) for the cyclic group (C)
2. Segmenting Private Key Phase: Segmentation private key (pvk) is returned to the user identity (id) for the defined user (i). Then the identity of the particular user id (i) can verify the public key (Pi) anytime, whenever required.

3. Segmenting Secret Value Phase: The segmented secret value of the particular user identity ( $S_i$ ) is sent for secured transmission.
4. KE-CECS Signing Phase: Segmented signature ( $z$ ) is transmitted to the verifier through the secret value selected by the user identity ( $S_i$ )
5. KE-CECS Verification Phase: Generation of output as VALID if the segmentation signature ( $z$ ) is original and secured, otherwise if it is not original, generation of output as INVALID. This is executed by means of the signatory's public key id ( $i$ ) and the public key parameters of the cyclic group ( $pubparam$ ).

The networking components and their functioned are explained in brief as follows:

**User Identity:** It computes the system segmented group public keys and private keys for both the data owner and the client.

**Mobile Network Server:** Information processing like data storage, computation and data exchange

are communicated via IoT based Mobile Network Server. The segmented signed IoT data for signing and verification are processed through it.

**Data Owner:** For signing the IoT data, the data owner requires own segmented secret key along with the client and user identity's public keys. After successful execution, the signatory stores the signed segmented data in the mobile network server.

**Client:** The end user is responsible for taking of segmented parameters and performance of verification over signed information.

The proposed KE-CECS Algorithm can be implemented as simulation application software. In the required application, the IoT based Mobile Network administrator stores the generated segmented key for an individual MAC address in the network. So the segmented signature can be implicitly transferred along with the message in the encrypted format. In the receiving end, the segmented signature is verified by means of sender's MAC address and decryption mechanisms. The Network Model for KE-CECS Algorithm scheme is shown in Figure 2.

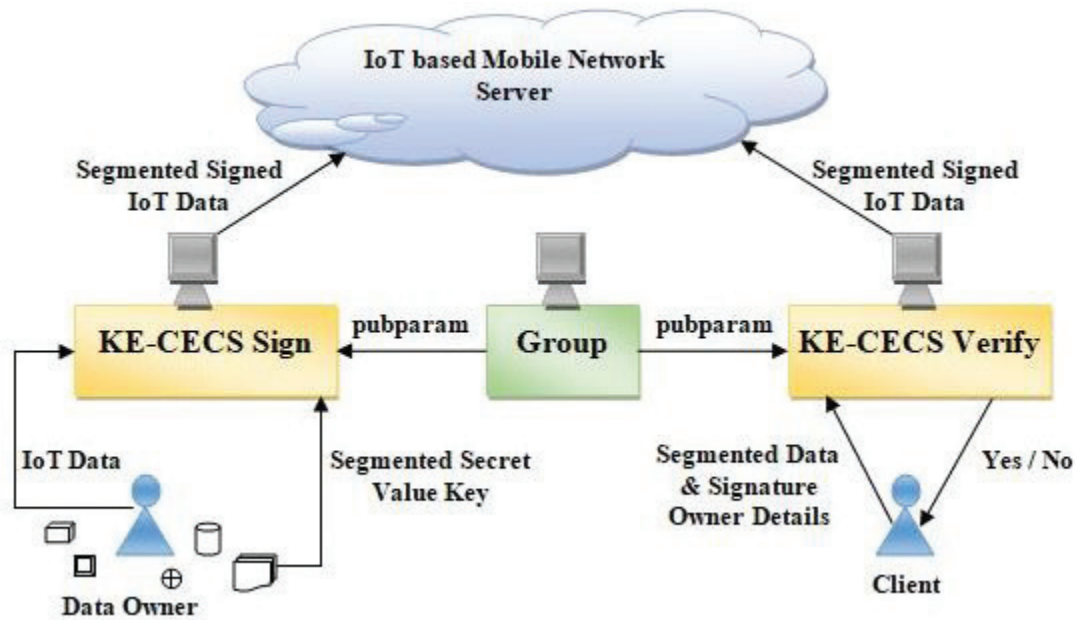


Figure 2: Network Model for Key Escrow with Certificateless Elliptic Curve Segmentation Scheme

**Performance Analysis:** The performance metrics of the KE-CECS Algorithm can be analysed by means of computational cost, time of execution and the authentication request of the encryption parameters. Simulation analysis is performed with the mentioned operational parameters and comparison graphs are

evaluated for KE-CECS Algorithm with Two Elliptic Curve Point Addition and Elliptic Curve Scalar Point Multiplication Algorithms. Computational Cost is defined as the time required for the setup algorithm to generate prime ordered key management in the simulation. Execution Time is defined as the time elapse



between the signing at the transmitter end and verifying of key schemes at the receiver end. Authentication Request is defined as the permission request from the sender with respect to the process of key management scheme executed. These three parameters need to minimum for the efficient and secured data transmission over mobile networks.

For Computational Cost analysis, Node Set Group is taken as x-axis and the Computation Time in seconds is taken as y-axis in Figure 3. From the simulation analysis, it is evident that the proposed algorithm Key Escrow with Certificateless Elliptic Curve Segmentation Scheme (KE-CECS) is better than the traditional certificateless algorithms like Two Elliptic Curve Point Addition (TECPA) and Elliptic Curve Scalar Point Multiplication (ECSPM) schemes.

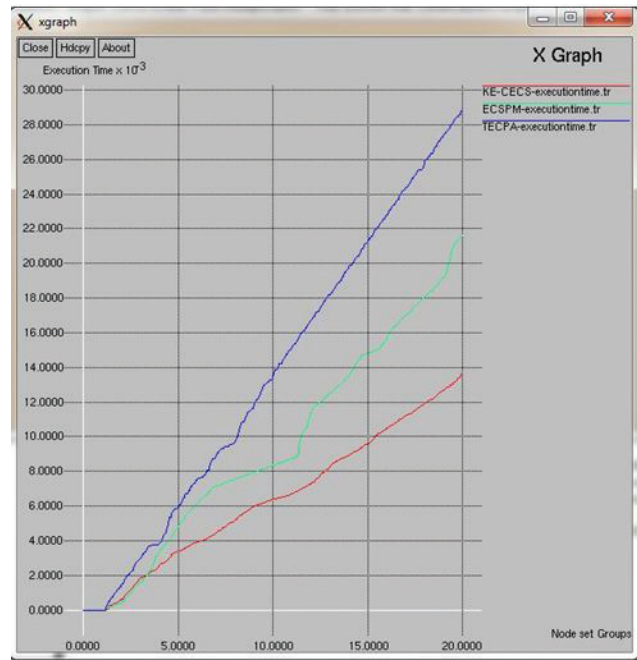


Figure 4: Simulation Analysis-Execution Time

For Authentication Request analysis, Node Set Group is taken as x-axis and the Authentication Request in numbers is taken as y-axis in Figure 5. From the simulation analysis, it is learnt that the proposed algorithm Key Escrow with Certificateless Elliptic Curve Segmentation Scheme (KE-CECS) shows better results when compared to the existing certificateless algorithms such as Two Elliptic Curve Point Addition (TECPA) and Elliptic Curve Scalar Point Multiplication (ECSPM).

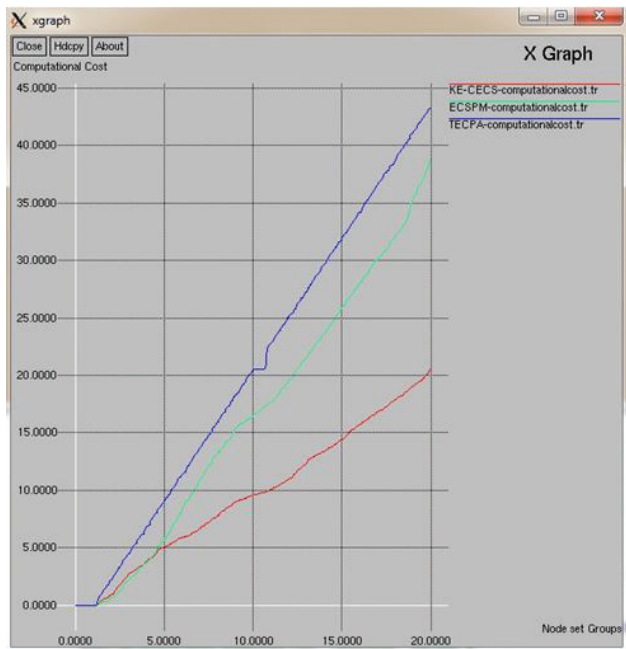


Figure 3: Simulation Analysis-Computational Cost

For Execution Time analysis, Node Set Group is taken as x-axis and the Execution Time in seconds is taken as y-axis whose details are explained in Figure 4. From the simulation analysis, it is shown that the proposed algorithm Key Escrow with Certificateless Elliptic Curve Segmentation Scheme (KE-CECS) is better when compared to the conventional certificateless algorithms, Two Elliptic Curve Point Addition (TECPA) and Elliptic Curve Scalar Point Multiplication (ECSPM).

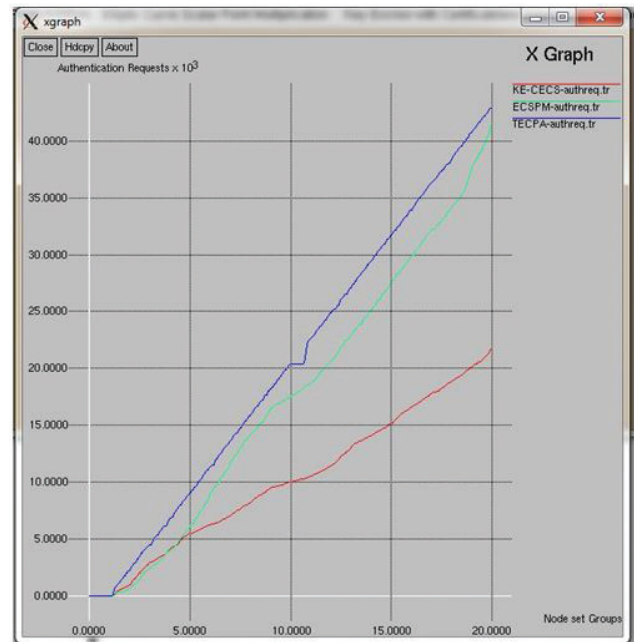


Figure 5: Simulation Analysis-Authentication Request

## CONCLUSION

Authenticity and Data Integrity are prime issues in the secured data transmission over IoT based Mobile Network environment. The proposed KE-CECS is resistant to both Type I and Type II attacks without considering the random oracle model. The proposed scheme avoids the security threat in identity based issue in key escrow problem and also reduces the overhead in IoT based Mobile Network data transmission. It is found to be computationally efficient and process better security features compared to other key escrow ECC algorithms. In the simulation scenarios, computational cost, time of execution and authentication request are analysed for the proposed and existing algorithms with respect to the communication bandwidth and storage space confined. The proposed Key Escrow with Certificateless Elliptic Curve Segmentation (KE-CECS) has better security parameters when compared with the other existing algorithms. As a future work, the algorithm can be incorporated for group key management schemes in the integration of heterogeneous networks in IoT based Cloud environments.

**Ethical Clearance:** Taken from Madurai Kamaraj University

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**Conflict of Interest:** NA

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# Design of Reconfiguration Based Modulation and Demodulation Scheme for OFDM System

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## ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) is a wireless data transmission based system. Modulation and De-Modulation are the most important technique in OFDM wireless communication scheme. A reconfigurable based modulation and demodulation technique improve the performance of OFDM system. The major aspire of this technique is achieving low power and high speed during the transmission of data in the OFDM system. Reconfigurable technique is varied from the adaptation technique. Adaptation does not improve the performance of the system, but reconfiguration technique improves the performance in various types. The proposed concept is introduced in OFDM based communication for performance and efficiency enhancements. This process is done in Xilinx simulation environment and ModelSim 6.3c.

**Keywords:** Modulation, OFDM, Reconfiguration, low power, high speed

## INTRODUCTION

To transmit and receive the modulated signal, transceiver is used in the system. Original message signal has been changed and recovered by modulation and demodulation technique. QAM and DPSK modulation technique mainly used to increase the data rate and spectral efficiency. Two types of modulation are present in the system that is analog and digital. Among the various modulation technique, only one modulation run at a time in existing method. To avoid this problem reconfiguration technique can be used and that technique allows more than one modulation at a time. Reconfiguration is mainly used to reduce the power dissipation in the system. Quality of the communication system improved by modulation and demodulation technique. Clock gating can used to reduce the power and avoid unnecessary switching activities. Reconfiguration of OFDM mainly used for less hardware utilization and more flexible. Then modulation and demodulation technique improve speed of the system.

## RELATED WORKS

Visible paradox between spectrum shortage and spectrum underutilization has been proposed by Lu et al. [1]. IFFT/FFT algorithm is used but FFT algorithm is not

efficient for this standard. So, transform decomposition of FFT algorithm mapped into the baseband processing architecture. In this method two mapping technique are presented. One is serial and another one parallel; it will reduce the number of cycles. To estimate orthogonal frequency offset (OFDM) system, the combination of symbol time offset (STO) and carrier frequency offset (CFO) used. OFDM provide high computational complexity that provides more power consumption. Orthogonal frequency division multiplexing (OFDM) used to establish multicarrier modulation method and this OFDM provide high band width efficiency. In this system complexity can be reduced by using adaptive real-time OFDM. Ramlall<sup>[2]</sup> proposed method increases the step size that can improve tracking accuracy. In this paper STO and CFO estimation provide low SNR.

Adaptive switching algorithm between diversity and spatial multiplexing is proposed by Mlayeh et al.<sup>[3]</sup> advanced OFDM-MIMO reconfigurable architecture and this technique adjust the modulation scheme MIMO can improve entire system performance and indicator bit exchange between transmitter and receiver that depend on Demmel condition. MIMO has two techniques and it provide high spectral efficiency. In the first technique link quality can be improved and the second technique used to improve link capacity. This method allow new

flexibility and low cost. Basic seamless upgradability achieved by combined use of Software Defined Ration(SDR) and Adaptive Antenna Systems(AAS) in 3G wireless system.SDR provide improvement in DSP and reduce complexity. In reconfigurable OFDM dynamically reorganization of OFDM that can preserve more times multiple designs. In different wireless standard takes enabling technology from reconfigurable OFDM system enabling and wireless communication continuously adapted by reconfigurable system described by Drakshayini<sup>[4]</sup>.

OFDM transceiver used to present SDR the concept was proposed by Krishna<sup>[5]</sup>. It has both QPSK and 64-QAM operation and this method implemented by MATLAB. Adaptive modulation can used to minimize the antenna size and it provide high data rate than the FFT programming mainly used for increases the execution speed. In OFDM recursive FFT design mainly used to reduces the utilization of power and speed up the clock frequency. Then this method butterfly method has less gate count. In this method two single port SRAM read and write the data simultaneously.

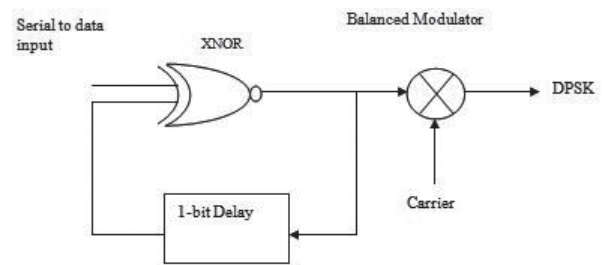
Spartan 6 FPGA development board can be used to develop the baseband OFDM transmitter and receiver. The chip scope mainly used to test the FPGA and resource consumed by CORDIC algorithm. In the FPGA based reconfigurable architecture that must be designed with high capacity and this FPGA provide good SQNR performance.4G-LTE application based on reconfigurable architecture and QAM modulation can be used. This scheme was proposed by Su et al<sup>[6]</sup>.

Ishtiaq et al.<sup>[7]</sup> FPGA modulated by OFDM that allows flexible architecture of electronic device and implement hardware adaptability of system. Technology implemented by VHDL coding used to improve scalability, which very versatile to complex system. Adaptation quickly adapted by this reconfigurable OFDM modulator. Visible Light Communication System (VLC) used to examine performance OFDM. Spectral efficiency increased by adaptive modulation technique that improves performance of OFDM based VLC system.

Orozco-Galvan et al.<sup>[8]</sup> proposed reconfigurable architecture based on FPGA for OFDM transmitter. This system is able to generate LTE standards and configuration parameter is used to adjust frame size,

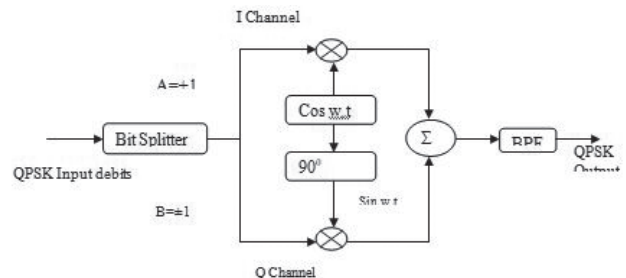
cyclic prefix size, data modulation type and pilot values. Hence, FPGA provides less power utilization and good signal quantization noise ratio.

**Digital Modulation Technique:** Digital modulation is an alternative standard to process the communication system effectively. Two successful modulation techniques named as “Differential phase shift keying Modulation (DPSK)” and “Quadrature Phase Shift Keying Modulation (QPSK)” modulation are used to design a reconfigurable based OFDM system. Differential phase shift keying (DPSK) is used for both amplitude and phase variation of the signals. Quadrature Phase Shift Keying (QPSK) modulation is a kind of digital modulation in Phase Shift Keying (PSK) modulation.



**Figure 1: Block diagram of DPSK**

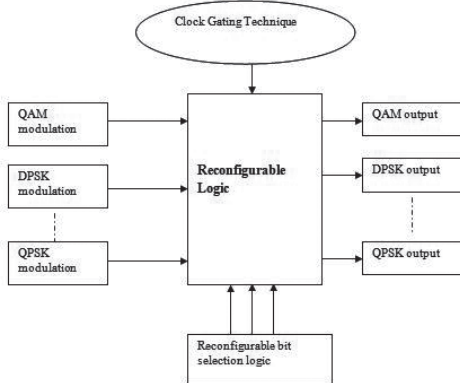
Four bit DPSK modulation is considered to perform the effective modulation. Like QPSK modulation, DPSK modulation also contain in phase and Quadrature components. QAM is able to take more bits of information per symbol. The block diagram of DPSK is shown in Figure.1, but difference is the input bits are four in case of DPSK modulation whereas input bits of QPSK is two.



**Figure 2: Block diagram of QPSK modulation**

QPSK modulation, two bits are to be measured to change the phase of information signal. QPSK modulation is efficient in bandwidth, because the signal point is represented by two bits. The block diagram of QPSK modulation is shown in Figure 2. The input frequency is divided into two parts known as in phase and Quadrature phase respectively.

**Reconfiguration Based OFDM system:** The above discussion two modulation schemes are used to make a reconfigurable OFDM system. Reconfiguration based system select QPSK modulation and demodulation scheme to decrease the hardware use and power consumption of the design. In other hand QAM modulation and demodulation scheme is to reduce the operating delay of the modulation operation. Based on separating more sampling the speed of the processors has been improved drastically.

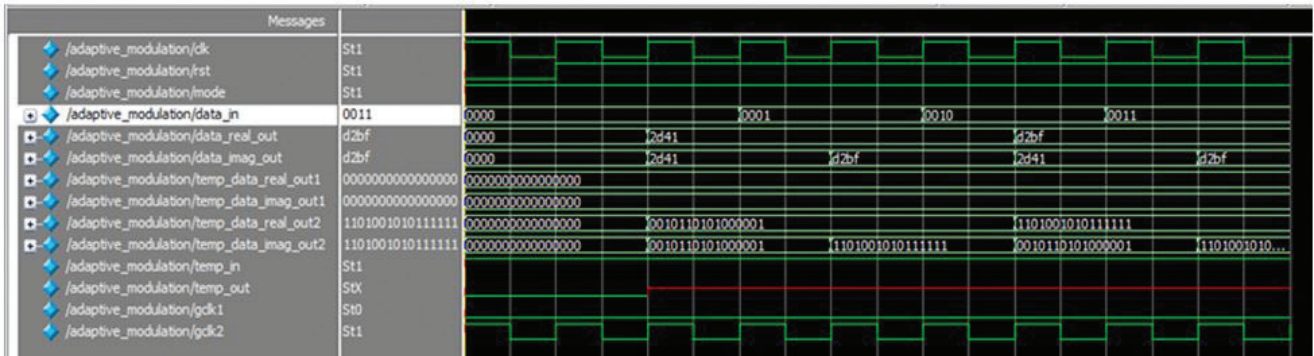


**Figure 3: Architecture of Reconfiguration based Modulation and Demodulation technique**

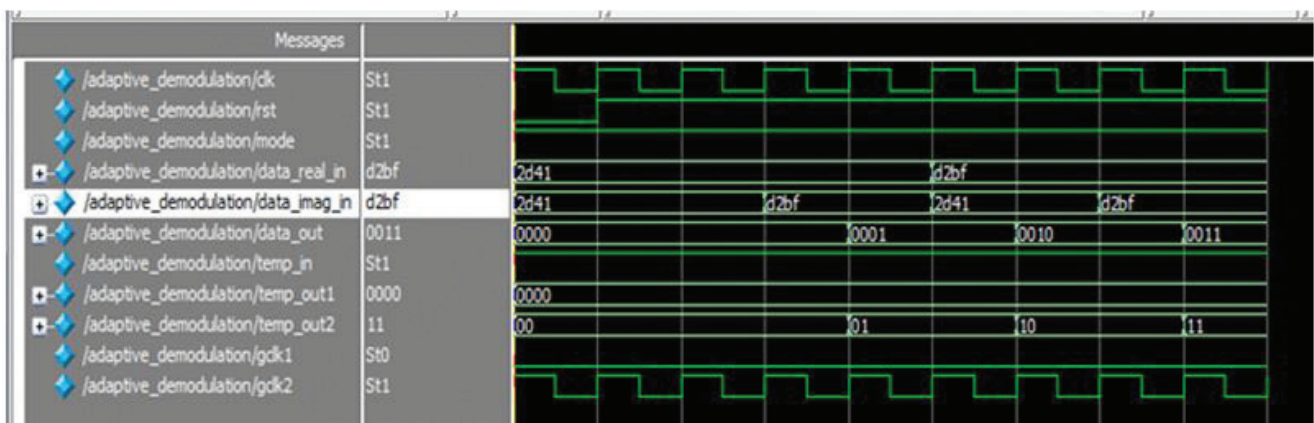
For example, QAM have  $2^4=16$  samples hence, more sampling signals gives more parallelism. But QPSK modulation has only  $2^2=4$  samples hence, less number of parallelisms which reduces the hardware consumption, but it does not affect the speed of the system. The architecture of proposed reconfiguration based modulation and demodulation technique is shown in Figure 3. Reconfiguration based modulation and demodulation techniques are designed for OFDM system with the help of QAM modulation and QPSK modulation. Reconfigurable OFDM is designed by combining all reconfigurable techniques known as reconfigurable FFT, reconfigurable Encoders/Decoder, and reconfigurable modulation/demodulation.

**RESULTS AND DISCUSSIONS**

To estimate the proposed reconfigurable modulation and demodulation scheme is done in ModelSim 6.3C. The simulation result of proposed reconfigurable QPSK modulation is shown in Figure 4. Similarly the proposed reconfigurable QPSK demodulation is shown in figure 5.



**Figure 4: Simulation Result of QPSK Modulation**



**Figure 5: Simulation Result of QPSK Demodulation**

The comparison results of both DPSK and QPSK modulation and demodulation techniques are shown in Table 1. The proposed modulation scheme is applied into the OFDM transmitter and the results are shown in table 2.

**Table 1: Comparison result of DPSK and QPSK Modulation scheme**

Type	Slices	LUT	Delay (ns)	Power (mW)	Application
DPSK modulation	17	38	5.141	242	High Speed Application
QPSK Demodulation	11	20	5.216	187	Low Power and Low area Application

**Table 2: Comparison of OFDM transmitter with DPSK and QPSK modulation**

	LUTs	Slices	Delay (ns)	Power (w)
OFDM Transmitter with QPSK modulation	298	159	22.28ns	8.501w
OFDM Transmitter with DPSK modulation	305	148	21.42ns	7.459w

## CONCLUSION

In this work, a reconfiguration based modulation and reconfiguration based demodulation model is designed by using two efficient modulation and demodulation techniques such as Differential phase shift keying (DPSK) and Quadrature Phase Shift Keying Modulation (QPSK) modulation. Verilog Hardware Description Language (Verilog HDL) is used to design a reconfiguration based modulation and demodulation method. OFDM with DPSK modulation scheme offers 12.25% reduction in power consumption. Likewise the system offers 3.6% reduction in delay. Based on input data length, different types of modulation and demodulation techniques are selected automatically in the reconfiguration system.

**Ethical Clearance:** Taken from St. Peters University Committee

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Probabilistic Broadcast Protocol for Data Gathering Using Neighbour Nodes in Mobile IoT

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## ABSTRACT

The current pattern of executing Internet of Things (IoT) applications is to transmit detecting data to a capable data focus and attempt to find the significant learning behind “Big Data” by different savvy yet asset expending calculations. This paper proposes an effective communicate convention to scatter data in portable IoT systems. The proposed convention abuses the neighbour learning of versatile nodes to decide a rebroadcast postpone that organizes diverse bundle communicates as indicated by their profits. A versatile availability factor is additionally acquainted with make the proposed convention versatile to the node thickness of various system parts. By joining the neighbour learning of nodes and versatile network factor, a sensible likelihood is ascertained to decide if a bundle ought to be rebroadcasted to different nodes or be disposed of to avert repetitive parcel communicate. Simulation analysis is done to demonstrate the execution of the proposed framework contrasted with the current framework.

**Keywords:** Simulation analysis, Internet of Things, Big Data, availability factor.

## INTRODUCTION

The idea of brilliant city that uses Internet-of-Things (IoT) advancements to reinforce social frameworks opens another entryway for imaginative answers for the previously mentioned issues and furthermore makes a big business advertise. In this IoT stage, many diverse social “Things” like candy machines, refreshment conveyance trucks, and taxicabs are furnished with Wi-SUN correspondence units that have a transmission scope of a few hundred meters in the genuine field. Therefore, these remote empowered “Things” involve extensive scale portable remote systems that cover an administration locale of 10 km<sup>2</sup>, i.e., over 70% territory of the Sumida ward. This sort of systems comprises of social “Things” is named portable IoT arranges in the paper. The principle commitments of this paper:

- A novel scheme for deciding the rebroadcast deferral of a bundle is proposed. The node which has more neighbors that have not gotten a data bundle triggers a shorter postponement to rebroadcast the parcel. This postpone plot not just declines the likelihood for nodes to rebroadcast repetitive parcels, yet in addition eases the impacts and impedance in remote channel that prompt exorbitant bundle misfortune.

- A novel plan for deciding the rebroadcast likelihood of a parcel is additionally proposed. This plan considers the insights of revealed neighbors and system network to decide the likelihood for nodes to rebroadcast a bundle. The subsequent likelihood is made out of two sections:
  - Additional coverage ratio that is the proportion of a transmitter’s neighbors that will be recently secured by one rebroadcast to its total amount of neighbors.
  - Adaptive connectivity factor that considers the local density of nodes in various parts of networks to maintain the connectivity of packet delivery.

## RELATED WORKS

Expecting to arrange a work/tree coordinate with information multi-bouncing capacity in light of the remote standard “Wi-SUN,” which is to utilize IEEE802.15.4e/4g for its MAC and PHY layers particulars, a system configuration can be connected to a genuine organization design in Sumida ward, Tokyo, Japan, considering crucial estimated RSSI versus distance execution in an observable pathway condition<sup>[1]</sup>.

A double-projection deep computation model (DPDCM) for huge information highlight learning was produced, which extends the crude contribution to two separate subspaces in the shrouded layers to learn collaborated highlights of huge information by supplanting the concealed layers of the conventional deep computation model (DCM) with double-projection layers<sup>[2]</sup>.

QL-HDS discretizes the framework state parameters with a specific advance size, bringing about a poor distinction of the framework states. Vitality proficient booking plan in view of deep Q-learning model was designed for occasional errands progressively frameworks (DQL-EES)<sup>[3]</sup>. In Decentralized distributed Space Time Block Coding (Dis-STBC) framework, the learning about the Channel State Information (CSI) isn't accessible at the transmitter<sup>[4]</sup>. Because of the absence of nonstop correspondences among versatile nodes and conceivable mistakes in the estimation of nodal contact likelihood, joining and soundness end up real difficulties in distributed bunching in DTMN<sup>[5]</sup>.

Regular on-request course revelation techniques in mobile ad hoc networks (MANET) utilize dazzle flooding, where a mobile node indiscriminately rebroadcasts got Route Request (RREQ) parcels until the point when a course to a specific goal is set up. This can possibly lead to high channel conflict, causing repetitive retransmissions and accordingly intemperate parcel impacts in the system<sup>[6]</sup>. An Unobservable secure routing plan offers finish unlinkability and substance inconspicuousness for a wide range of parcels<sup>[7]</sup>. Neighbor-based Dynamic Connectivity Factor routing Protocol (DCFP) can dynamically test the status of the fundamental system without the intercession of a framework administrator based on a novel connectivity metric, while decreasing the RREQ overhead utilizing another connectivity factor<sup>[8]</sup>. Neighbor Coverage-based Probabilistic Rebroadcast (NCPR) protocol reduces routing overhead in MANETs and decrease the number of retransmissions so as to reduce the routing overhead<sup>[9]</sup>.

## PROBABILISTIC BROADCAST PROTOCOL FOR DATA GATHERING

At the point when a node  $n_i$  gets an data packet  $p_k$  (the postfix  $k$  demonstrates the grouping number of bundle) from its past transmitter  $n_p$ , it can utilize the neighbour rundown of  $n_p$  contained in  $p_k$  to assess what number of its neighbours have not been secured by the  $p_k$  communicated by  $n_p$ . To evaluate this, the revealed neighbour set of  $n_i$  for  $p_k$  is given by

$$U_k(n_i) = N(n_i) - \{N(n_i) \cap N(n_p)\} - \{n_p\} \quad \dots(1)$$

where  $N(n_i)$  and  $N(n_p)$  are the neighbour sets of nodes  $n_i$  and  $n_p$ .

Because of the normal for broadcasting a parcel, the node  $n_i$  may get copy  $p_k$  from its neighbours other than  $n_p$ . In this manner,  $n_i$  can ceaselessly refresh  $U_k(n_i)$  with the copy  $p_k$  from different neighbours. Clearly when  $U_k(n_i)$  winds up discharge, there is no requirement for  $n_i$  to rebroadcast  $p_k$  since the greater part of its neighbours have gotten  $p_k$  as of now. This presents a tradeoff on the rebroadcast deferral of  $p_k$ . At the point when rebroadcast delay is long, there is a long stretch for  $n_i$  to listen stealthily copy parcels and exhaust its  $U_k(n_i)$  to avoid excess packet rebroadcast, while this also increases the end-to-end delay of data dissemination.

A node that has a more drawn out rebroadcast deferral may listen stealthily copy information parcels from different nodes that have shorter ones. For instance, when the node  $n_i$  gets a copy  $p_k$  from its neighbour  $n_j$ , it realizes that what number of its neighbours have been furthermore secured by this bundle. In this manner,  $n_i$  can refresh its revealed neighbour set by the neighbour rundown of  $n_j$ , by utilizing Eq. (1). In the wake of refreshing  $U_k(n_i)$ ,  $n_i$  disposes of this copy  $p_k$  since it has been communicated as of now. It ought to be noticed that NPB convention does not endeavor to refresh the rebroadcast postponement of  $p_k$  as indicated by the refreshed (i.e., littler)  $U_k(n_i)$ . This is a result of two reasons: It keeps the persistent increment of 1-bounce rebroadcast defer when  $n_i$  gets copy parcel without fail; It keeps the successive calculation of convention clock and keeps NPB convention basic and doltish, i.e., the general standard of mechanical advancement. At the point when the clock of rebroadcast delay lapses,  $n_i$  acquires the last  $U_k(n_i)$  that contains its neighbours which have not gotten  $p_k$  yet. This last  $U_k(n_i)$  is utilized to decide the likelihood for  $n_i$  to rebroadcast  $p_k$ .

$$C_k(n_i) = \frac{|U_k(n_i)|}{|N(n_i)|} \quad \dots(2)$$

With the increase of  $C_k(n_i)$ , more nodes will profit by  $n_i$  is rebroadcast. In this way, the likelihood for  $n_i$  to rebroadcast  $p_k$  ought to be expanded appropriately. At the point when each node associates with in excess of  $5.1774 * \log(N_{node})$  of its neighbours, the likelihood of a system being associated is moving toward one with the



expansion of  $N_{node}$ , where  $N_{node}$  indicates the aggregate number of nodes in the system. This implies, to disperse  $p_k$  to all nodes in the system, i.e.,  $|N(n_i) - U_k(n_i)| > 5.1774 * \log(N_{node})$ .

$$Ak(ni) = \frac{5.1774 * \log(Nnode)}{|N(ni) - Uk(ni)|} \dots(3)$$

It only indicates that the local node density of network around  $n_i$  is so low that  $n_i$  should rebroadcast this packet to maintain the connectivity of packet dissemination.

### PERFORMANCE EVALUATION

The performance of the proposed scheme is analyzed by using the Network Simulator (NS2). The NS2 is an open source programming language written in C++ and OTCL (Object Oriented Tool Command Language). NS2 is a discrete event time driven simulator which is used to model the network protocols mainly. The nodes are distributed in the simulation environment.

The simulation of the proposed scheme has 50 nodes deployed in the simulation area 900×900. The nodes are communicated with each other by using the communication protocol User Datagram Protocol (UDP). The traffic is handled using the traffic model CBR. The radio waves are propagated by using the propagation model two ray ground. All the nodes receive the signal from all direction by using the Omni directional antenna. The performance of the proposed scheme is evaluated by the parameters packet loss rate and throughput.

**Packet Loss Rate:** PLR is defined as the difference between the sent packets and received packets in the network per unit time as in equation 1.

$$PLR = \frac{\sum_n \text{Number of Packets dropped}}{\sum_n \text{Number of Packets Sent}} \dots(1)$$

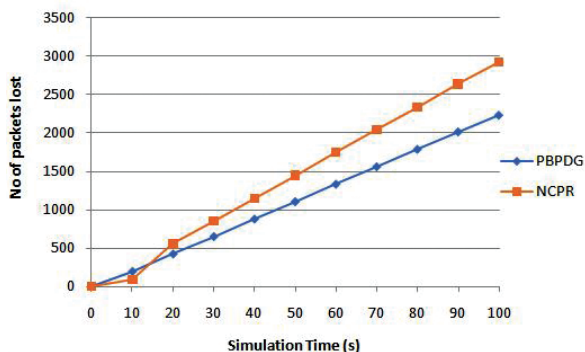


Figure 1: Packet Loss rate

Figure 1 shows the PLR of NCPR is greater when compared to that of PBPDG. The number of nodes is increased when the number of packets dropped is increased.

**Throughput:** Throughput is defined as the data that can be transferred from source to the receiver in a given amount of time. Throughput is obtained using equation 2.

$$\text{Throughput} = \sum_0^n \frac{\text{Number of Packets dropped}}{\text{Time Taken}} \dots(2)$$

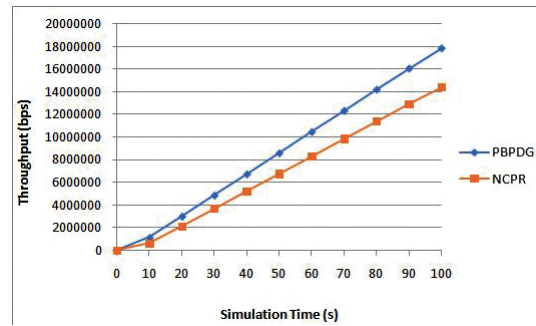


Figure 2: Throughput

It is observed from figure 2 that the number of packets received successfully for PBPDG is greater compared to that of the NCPR.

### CONCLUSION

Probabilistic Broadcast Protocol for Data Gathering using neighbour nodes in mobile IoT is proposed in this paper. The proposed convention abuses the neighbour learning of versatile nodes to decide a rebroadcast postpone that organizes diverse bundle communicates as indicated by their profits. A versatile availability factor is additionally acquainted with make the proposed convention versatile to the node thickness of various system parts. By joining the neighbour learning of nodes and versatile network factor, a sensible likelihood is ascertained to decide if a bundle ought to be rebroadcasted to different nodes or be disposed of to avert repetitive parcel communicate. Simulation analysis shows the performance of the proposed scheme contrasted with the existing scheme.

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# Correlation between Knowledge and Attitude about Pediatric Cardiopulmonary Resuscitation (CPR) of Nursing Students in Korea

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## ABSTRACT

The purpose of this study was to identify the degree of knowledge about pediatric CPR in 135 nursing college students. The data was collected by a structural questionnaire completed by 135 students who agreed to participate in the study. We analyzed the data using SPSS ver. 23.0. Program. Descriptive statistics for all study variables as well as the reliability assessment of the study instruments were computed. The knowledge level of pediatric CPR was  $44.24 \pm 11.47$  points in the range of 0~100 points. The degree of attitude toward pediatric CPR was  $15.43 \pm 1.91$  in the range of 5-20. Airway maintenance and artificial respiration were the highest with  $64.19 \pm 26.27$  points, Judgment of Emergency condition  $56.74 \pm 19.88$  points, General knowledge  $51.70 \pm 20.93$  points and Chest compression  $51.48 \pm 32.86$  points. CPR should be considered as essential knowledge required to save lives and education and training will be needed to acquire appropriate knowledge and attitudes about pediatric CPR as well as adults.

**Keywords:** Knowledge, Attitude, Pediatrics, Cardiopulmonary Resuscitation, Nursing, Students

## INTRODUCTION

Cardiopulmonary resuscitation is divided into adult, child, and infant, and requires chest compressions, breathing, and airway obstruction methods at each stage<sup>1</sup>.

In the cardiac arrest situation, first aid ability depends on the survival of the client. The survival rate of cardiopulmonary resuscitation in western countries is 15-18%, compared to 2.5-7% in Korea<sup>2</sup>. Cardiopulmonary resuscitation in patients with acute cardiac arrest is two to three times more likely to survive than in those without cardiopulmonary resuscitation<sup>1</sup> and an initial inappropriate response has a negative impact on prognosis<sup>3</sup>. In Park et al.,<sup>4</sup> the incidence of cardiac arrest in Korean infants was 67.1 per 100,000, and the rate of CPR was 82.1%. However, the survival rate was only 4.7%, suggesting that effective CPR training is needed for infants and children.

Adult cardiac arrest occurs with an increase in the prevalence of heart disease. In contrast, children's cardiac arrest is the main cause of respiratory illnesses,

asphyxia, trauma, drowning, sepsis<sup>5,6</sup>. If a child's cardiac arrest occurs in a non-hospital area, the survival rate is lower than that of an adult and the neurological damage is severe and the prognosis is poor<sup>7</sup>. In general, a nurse may be the first witness of a cardiac arrest within the hospital and may provide CPR. It also has an obligation to respond appropriately to emergencies within the community. They should also prepare for their role as educators in the community.

Cardiac arrest accounts for 50~78% of all acute deaths in hospitals.<sup>8</sup> Therefore, cardiopulmonary resuscitation is an essential skill for health care providers. That is, Nurses should be proficient in knowledge and skills in cardiopulmonary resuscitation as a medical practitioner who must take immediate action for the subject in case of an emergency in or outside the hospital. For this purpose, systematic preparation is needed from the time of nursing students.

The purpose of this study is to provide basic data for the development of educational materials that can help pediatric CPR in the future by confirming knowledge and attitude about pediatric CPR for nursing college students.

## MATERIALS AND METHOD

**Study design:** This study is a descriptive study to investigate knowledge and attitude about pediatric CPR in nursing students.

**Data collection:** The data was collected by a structural questionnaire completed by 135 nursing students who agreed to participate in the study. We analyzed the data using SPSS ver. 23.0. Descriptive statistics for all study variables as well as the reliability assessment of the study instruments were computed.

## MEASUREMENTS

**Knowledge about pediatric CPR:** Knowledge of pediatric CPR is based on the American Heart Association Guidelines<sup>4</sup>, tools developed by Park and Ha<sup>9</sup>, and tools modified and supplemented by Nam and Park<sup>10</sup> with reference to the 2015 CPR Guidelines. The total of 15 items is composed of 4 sub-factors (General knowledge, Judgement of Emergency condition, Chest compression, Airway maintenance and artificial respiration). The range of possible total points is 0-100, which means that the higher the score, the higher the knowledge about pediatric CPR. In this study, Cronbach's  $\alpha$  of the instrument is .70

**Attitude about pediatric CPR:** Attitudes towards pediatric CPR were measured using tools developed by Nam and Park<sup>10</sup> to measure attitudes toward pediatric CPR. The total score of 5 items was 5 points. The higher the score, the more positive the attitude toward pediatric CPR. Cronbach's  $\alpha$  was .68 in this study.

## RESULTS AND DISCUSSION

**Descriptive finding:** The general characteristics of the subject are the same as Table 1.

**Table 1: General characteristics (N = 135)**

Characteristics	Mean $\pm$ SD	n (%)
Age(years)	22.15 $\pm$ .78	
Sex	Male	31 (23.0)
	Female	104 (77.0)
Emergency experience (suffocation and respiratory arrest)	Yes	6 (4.4)
	No	129 (95.6)

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heart disease in family or acquaintances	Yes	16 (11.9)
	No	119 (88.1)
CPR education experience	Yes	101 (74.8)
	No	34 (25.2)
CPR certification status	Yes	7 (5.2)
	No	128 (94.8)

## Knowledge and attitude about pediatric CPR

**Table 2: The levels of knowledge and attitude about pediatric CPR (N =1 35)**

	Range of Scale	Sub domain	Mean $\pm$ SD
Knowledge about pediatric CPR	0-100		44.24 $\pm$ 11.47
		General knowledge	51.70 $\pm$ 20.93
		Judgement of Emergency condition	56.74 $\pm$ 19.88
		Chest compression	51.48 $\pm$ 32.86
		Airway maintenance and artificial respiration	64.19 $\pm$ 26.27
Attitude about pediatric CPR	5-20		15.43 $\pm$ 1.91

The knowledge level of pediatric CPR was 44.24  $\pm$  11.47 points in the range of 0~100 points. The degree of attitude toward pediatric CPR was 15.43  $\pm$  1.91 in the range of 5-20 (Table. 2).

**Knowledge and attitude about pediatric CPR according to general characteristics:** Knowledge about pediatric CPR showed statistically significant differences by CPR certificate status ( $t=-2.905$ ,  $p=.004$ ). Attitude about pediatric CPR showed statistically significant differences by sex ( $t=2.673$ ,  $p=.008$ ), CPR education experience ( $t=-3.547$ ,  $p=.001$ ), and CPR certificate status ( $t=-3.353$ ,  $p=.001$ ) (Table 3).

**Table 3: Knowledge and attitude about pediatric CPR according to General characteristics (N = 135)**

Characteristics Mean ± SD		Knowledge about pediatric CPR		Attitude about pediatric CPR	
		t (p)	Mean±SD	t (p)	
Sex	Male	44.73 ± 11.18	.267	16.22 ± 1.74	2.673
	Female	44.10 ± 11.61	(.790)	15.20 ± 1.90	(.008)
Emergency experience (suffocation and respiratory arrest)	Yes	36.66 ± 10.11	1.666	15.43 ± 1.93	-.082
	No	44.59 ± 11.45	(.098)	15.50 ± 1.37	(.935)
heart disease in family or acquaintances	Yes	40.41 ± 10.46	1.427	16.06 ± 1.38	-1.397
	No	44.76 ± 11.55	(.156)	15.35 ± 1.96	(.165)
CPR education experience	Yes	45.14 ± 11.34	-1.582	15.76 ± 1.77	-3.547
	No	41.56 ± 11.61	(.116)	14.47 ± 2.00	(.001)
CPR certification status	Yes	56.19 ± 12.68	-2.905	17.71 ± 1.25	-3.353
	No	43.59 ± 11.09	(.004)	15.31 ± 1.86	(.001)

**Correlation between Knowledge and attitude about pediatric CPR:** There was not a statistically significant correlation between knowledge and attitude about pediatric CPR shown in Table 4.

**Table 4: Correlation between knowledge and attitude about pediatric CPR (N = 135)**

	Knowledge about pediatric CPR			
	General knowledge	Chest compression	Judgement of Emergency condition	Airway maintenance and artificial respiration
Attitude about pediatric CPR	r (p)	r (p)	r (p)	r (p)
	.116 (.182)	.049 (.573)	.006 (.942)	.154 (.074)

**DISCUSSION**

Recently, Korea has been emphasizing the importance of CPR education due to rapid aging and increased cardiovascular disease. Although CPR training is conducted for elementary, middle, and high school students, it is difficult to expect qualitative educational effects in the process of receiving education by many students in a short period of time only by a school nurse.

In this study, 74.8% of the subjects received CPR training, but the knowledge score about pediatric CPR was 44.24 out of 100. Using the same instrument, Nam and Park<sup>10</sup> were lower than the 56.1 point measured by kindergarten teachers. The instrument are not identical and it is difficult to make a direct comparison. However, Park & Ha<sup>9</sup> is lower than 10.38 out of 15 points for early childhood education students, and Lee, Choi & Park<sup>11</sup> is lower than the general population.

Although 74.8% of the subjects had received CPR training, the results of this study, in which the knowledge

of CPR was below the midpoint, showed that most of the CPR - related education is adult - oriented, one - time lecture focused on large - scale lectures, which is considered to be a result of not contributing to knowledge expansion. In addition, since the knowledge of students who received the CPR certificate was significantly higher in this study, it is necessary to improve appropriate and effective education through systematic and repetitive training to acquire adequate learner placement and sufficient instructor.

In this study, the attitude toward pediatric CPR was 15.43 out of 20, which was higher than the 40.76 (out of 50 points) of Lee and Sung<sup>13</sup> for hospital staff.

In addition, the same instrument was found to have a positive attitude toward cardiopulmonary resuscitation, higher than the 14.81 points of Nam and Park<sup>10</sup> measured by kindergarten teachers. In subjects with male students, CPR education experience and CPR certificate, attitude toward pediatric CPR was higher. This may

be interpreted as a result of the relatively passive and conservative tendency of women, the cardiopulmonary resuscitation training experience has been identified as affecting positive attitude. It is important to consider their attitude improvement in CPR training for prospective nurses because attitude is an important factor leading to behavior, it is thought that CPR education needs to include various factors to contribute not only to knowledge expansion but also attitude improvement.

No significant correlation between CPR knowledge and attitude was found. This is in contrast to the results of Nam and Park<sup>10</sup>, which showed a positive correlation between knowledge and attitude. As Lee and Sung<sup>12</sup> maintained that factors other than knowledge can also affect attitude, it is necessary to identify factors on CPR knowledge. Besides that CPR training needs to help with obtaining knowledge and skills for CPR, it also need to provide trainees with confidence to volunteer for help in emergency situations<sup>13</sup>. It is critical for CPR, which requires accurate judgement and skills, to maintain expert's attitude in saving life. Therefore, CPR-related training programs should be assured to improve both knowledge and attitude of the trainees regarding CPR.

Recently, more CPR education programs have been provided because of growing interests in cardiac arrest by the society. For nursing students in college, CPR training programs are provided by the colleges without any relevant regulations. In 2011, the Korean Academy of Accreditation Board of Nursing<sup>14</sup> developed and applied core basic nursing skills to improve the nursing performance of nursing graduates, and added CPR and defibrillator items to the list.<sup>15,16,17</sup>

Although child resuscitation skills are included in the list, increasing number of dual-income families and infant and child care facilities will promote the inclusion of children-CPR training programs day-care works through relevant trainings for health professionals. In addition, CPR education in nursing education can reduce their chance of experiencing the feeling of despair in emergency situation in the future. It can also minimize their psychological and physical burden during their adaptation to clinical settings, and eventually will contribute to saving lives of children.

Based on these results, it can be seen that nursing students are required to develop knowledge and skills and positive attitude through systematic education of pediatric CPR.

## CONCLUSION

The purpose of this study was to identify the knowledge and attitude about pediatric CPR for nursing college students and to understand the relationship between knowledge and attitude of CPR, and to provide basic data for developing the program.

The results showed that knowledge and attitude about pediatric CPR of nursing college students with CPR training experience and adult CPR certificate were positive. Although there was no significant correlation between knowledge and attitude about pediatric CPR, CPR education should be able to contribute not only to the expansion of knowledge but also to attitudes. Therefore, we found that it is necessary to check the operating system in order to provide the quality education and the necessity of checking the educational components.

Based on the results of this study, the following suggestions are made.

First, it is suggested to develop and apply a pediatric CPR education program for nursing students.

Second, we suggest to evaluate the improvement of knowledge and attitude through repetitive application of CPR education

**Ethical Clearance:** Taken from Howon University

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Influence of Social Support and Resilience on the Nurse Job Performance

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## ABSTRACT

A descriptive study to determine the effect of social support and resilience of nurses on the job performance of nurses. This is a descriptive survey research to identify the correlations of nurse job performance with social support and resilience among nurses, and to identify the factors affecting nurse job performance. The survey subjects were 183 nurses. The collected data were analyzed with the SPSS / WIN 23.0 program, using the descriptive statistics, Pearson's correlation coefficient and Stepwise multiple regression analysis. Social support was scored as  $3.62 \pm .50$ , resilience was scored as  $3.38 \pm .49$ , nurse job performance was scored as  $3.63 \pm .52$ . Nurse job performance had a significant positive correlation with social support ( $r=.383$ ,  $p<.001$ ) and resilience ( $r=.545$ ,  $p<.001$ ). In addition, there was a significant positive correlation between social support and resilience ( $r=.484$ ,  $p<.001$ ). The variable that has the greatest effect on the nurse job performance of the subjects was resilience ( $\beta=.44$ ,  $p<.001$ ), followed by position higher than head nurse ( $\beta=.13$ ,  $p<.033$ ), social support ( $\beta=.16$ ,  $p=.007$ ), fixed working hours or other working patterns ( $\beta=.13$ ,  $p=.042$ ). In addition, resilience, positions, social support and working patterns explained about 37 percent of the nurse job performance ( $F=34.71$ ,  $p<.001$ ,  $R^2=.37$ ,  $Adj-R^2=.35$ ). All these results of this study suggest that higher resilience and social support levels, positions higher than head nurse in comparison with staff nurses and fixed working hours or other working patterns rather than shift work lead to a higher nurse job performance level. It is necessary to change the hospital environment that can enhance the resilience and social support of nurses. There is a need for an effective nursing staff management that can help improve nurse job performance.

**Keywords:** social support, resilience, nurse job performance, job stress, nurses

## INTRODUCTION

As the efficiency and qualitative aspects of work are emphasized in medical service environments, nurses (60% of the total personnel in medical institutions), in particular, are required to continuously add to their specialized knowledge and training.<sup>1</sup> Particular attention is given to the job performance of nurses, which promotes an improvement of nursing quality and the development of nursing as a specialized job.<sup>2</sup> Recently, the domestic medical environment is demanding differentiated services due to intensified competition, and it is necessary to cope flexibly with the changes. Therefore, it is interested in nursing work performance to improve quality of nursing and development of nursing profession. Because the nurse is closest to the patient, the efficiency of the nursing work is directly related to the overall work efficiency of the hospital, which is an important strategy for ensuring the productivity of the

hospital and quality care services.<sup>3,4</sup> Because nurses are the medical personnel who deal with patients most closely, the efficiency of nursing work is directly related to the overall work efficiency of the hospital, and becomes an important strategy to ensure the productivity of the hospital and quality nursing services.<sup>5</sup> As can be seen here, since nurse job performance is a key priority for the improvement of nursing quality and the development of nursing as a specialized job, continuous attention needs to be paid to various factors in order to improve nurse job performance.<sup>2</sup> Social support is an important resource for nurses. When they receive attention, affection and trust from their environment, nurses can better resolve their anxiety and gain a sense of worth, feel a sense of stability, have lower stress level and affective tension and strengthen their problem-solving ability.<sup>6</sup> Given that higher social support leads to higher nurse job performance, it can be seen that



social support has both direct and indirect effects on nurse job performance in clinical situations.<sup>7</sup> Resilience, an ability to overcome difficulties at the nursing field, affects nurses' job engagement and exhaustion. Nurses with higher resilience suffer less from job-related anxiety, depression and exhaustion.<sup>8, 9</sup> Such resilience can serve as a factor that has positive effects on nurses experiencing various types of job stress, thus enhancing nurse job performance.<sup>10, 11</sup> In particular, it was reported that nurses with higher social support and ego resilience exhibit higher job performance.<sup>12</sup> Consequently, there is a need for multilateral research on the relation between resilience and nurse job performance. This study intends to investigate the social support received, resilience and nurse job performance of nurses, thus providing preliminary data in searching for ways to effectively manage nursing personnel, with the ultimate aim of improving nurses' job satisfaction and nurse job performance. The main aim of this paper is to investigate the degrees of social support received, resilience and nurse job performance, to determine the correlations of nurse job performance with nurses' social support received and resilience, and to learn which factors affect nurse job performance.

## METHOD

**Research Design and Subjects:** This is a descriptive survey research to identify the correlations of nurse job performance with social support and resilience among nurses, and to identify the factors affecting nurse job performance. The survey subjects were 183 nurses.

**Survey Tools:** Social support was measured by a tool used by<sup>13</sup>. This tool consists a total of 21 questionnaire items. The items were scored on a five-point Likert scale, with a higher score indicating higher social support. The reliability of the tool measured by Cronbach's  $\alpha$  was 0.91 in the study by<sup>13</sup> and 0.93 in this study.

**Resilience:** Resilience was measured using the Korean Connor-Davidson Resilience Scale (K-CD-RISC) translated by.<sup>14</sup> This tool consists of a total of 25 questionnaire items. The items were scored on a five-point Likert scale with a higher score indicating higher resilience. The reliability of the tool measured by Cronbach's  $\alpha$  was 0.93 in the study by<sup>14</sup> and 0.94 in this study.

**Nurse Job Performance:** Nurse job performance was measured using the tool developed by.<sup>5</sup> This tool consists

of a total of 17 questionnaire items. The items were scored on a five-point Likert scale with a higher score indicating higher nurse job performance. The reliability of the tool measured by Cronbach's  $\alpha$  was 0.95 in both the study by<sup>5</sup> and this study.

**Data Collection:** Data collection was performed from July 3 to July 24, 2016, the hospitals were randomly selected. The researcher provided information about the purpose of research and the questionnaire to the nursing department of each hospital and received approval for collecting data. Subsequently, the researcher posted notices to recruit subjects, and a convenient sampling was used to recruit nurses who voluntarily expressed their intention to participate in the survey. Before data collection, the researcher explained the purpose and content of this research and the ethical aspects to subjects, using the explanation form. Nurses who expressed their intention to participate filled out the written consent form and answered a self-administered questionnaire. It took about 10 to 20 minutes for respondents to answer the questionnaire, and they were provided a small gift for participating. Completed questionnaires were put in an retrieval envelope and sealed by the survey subjects themselves, and the researcher visited hospitals to retrieve them.

**Data Analysis:** Collected data were analyzed using the SPSS/WIN 23.0 program.

- The social support, resilience and nurse job performance were analyzed using descriptive statistics.
- The correlations of nurse job performance with social support and resilience were analyzed using Pearson's correlation coefficient.
- Factors affecting nurse job performance were analyzed using multiple regression analysis.

## RESULTS

Table 1 shows degrees of social support and nurse job performance. "Social support" was scored as  $3.62 \pm .50$ . Social support helps reduce expression of negative feelings, and thus nurses can better resolve affective tension and strengthen their problem-solving ability.<sup>15</sup> Social support reduces the stress coming from an environment and thus helps people adapt well to their environment, while having positive

effects on productivity or psychological satisfaction.<sup>16</sup> Consequently, there is a need for education and systematic methods to increase social support. “Resilience” was scored as  $3.38 \pm .49$ . Given that higher resilience leads to less stress and higher job satisfaction, it can be seen that resilience affects clinical nurses’ nurse job satisfaction.<sup>12</sup> Consequently, support through various programs such as a stress-relief program needs to be provided to nurses to enhance their resilience. “Nurse job performance” was scored as  $3.63 \pm .52$ .

The degree of nurse job performance was found to be both high and low. It was also found that working conditions, differences in organizational culture and nursing department environment lead to differences in patients’ severity of illness, personnel and nursing workload.<sup>17</sup> Consequently, research and supplementary measures regarding education to strengthen nurses’ capacity and application of nursing courses are required for nurse job performance that considers nursing environments and characteristics of the scale.

**Table 1: Degree of Social Support, Resilience and Nurse Job performance**

	Value range	Min	Max	M ± SD
Social support	1-5	2.38	5.00	$3.62 \pm .50$
Resilience	1-5	1.52	5.00	$3.38 \pm .49$
Nurse job performance	1-5	2.00	5.00	$3.63 \pm .52$

Table 2 shows the correlations of nurse job performance with social support and resilience. Nurse job performance was positively correlated at a statistically significant level with social support ( $r=.383$ ,  $p<.001$ ) and resilience ( $r=.545$ ,  $p<.001$ ). Social support and resilience were positively correlated at a statistically significant level, while the experience of violence did not display a statistically significant positive correlation with social support ( $r=-.010$ ,  $p=.872$ ) and resilience ( $r=-.049$ ,  $p=.444$ ). Because higher social support can lead to reduced job stress and higher nurse job performance, it is considered that strategies to enhance social support are necessary to improve nurse job performance. In addition, resilience can help to improve nurse job performance because it affects job engagement and exhaustion, while reducing the exhaustion that could occur from job-related stress and in problematic situations.<sup>18</sup>

**Table 2: Correlations Among Social Support, Resilience and Nurse Job Performance**

	Social support	Resilience	Nurse job performance
Social support	1		
Resilience	.484 ( $<.001$ )	1	
Nurse job performance	.383 ( $<.001$ )	.545 ( $<.001$ )	1

Table 3 shows factors affecting nurse job performance. The variables affecting nurse job performance included resilience ( $\beta=.44$ ,  $p<.001$ ), position of head nurse or higher ( $\beta=.13$ ,  $p<.033$ ), social support ( $\beta=.16$ ,  $p=.007$ ) and working pattern-fixed working hours or other working patterns ( $\beta=.13$ ,  $p=.042$ ). In other words, higher nurse job performance was found among those who had higher resilience, received higher social support, held a position of head nurse or higher compared to general nurses, had fixed working hours or other working patterns compared to shift work nurses. And resilience, positions, social support and working patterns explained about 37 percent of nurse job performance ( $F=34.71$ ,  $p<.001$ ,  $R^2=.37$ ,  $Adj-R^2=.35$ ).

Nurses with higher resilience displayed higher nurse job performance. Nurses’ resilience affected nurse job performance because nurses with longer clinical experience and a higher sense of responsibility and self-respect held a higher position and could deal with problems through more active communication with different personnel in the organization.<sup>18</sup> The major factors of resilience are the capacity for self-regulation and for interpersonal relationships. Since these abilities can be obtained through education and training<sup>19</sup>, there is a need for concrete and active education, job training and institutional policies to enhance nurses’ resilience. Furthermore, it is considered that nurses at an older age and with longer nursing experience are skilled in performing nursing care, and thus not only have the ability to perform nursing care using their clinical experience and expertise but also can maintain a psychologically stable state due to their job satisfaction and sense of reward. Consequently, to increase job performance, methods that can help nurses maintain their clinical career are required. This will involve appropriate rewards and measures. In addition, it appears that a system to manage nurses with long nursing experience is urgently needed to retain skilled nurses who successfully

provide nursing care for a long time. Nurses with a shorter career history need to be provided with career development programs. The results of this study showed that fixed working hours or other working patterns had a higher effect on nurse job performance compared to shift work. Given that nurses who did not do shift work displayed a higher level of organizational commitment

and that shift work nurses displayed a higher stress level and reduced nurse job performance<sup>20</sup>, it can be seen that nurses working fixed working hours had less physical stress than those who did shift work and thus could concentrate on their job. Therefore, strategies to reduce shift work nurses' physical stress are required to enhance nurse job performance.

**Table 3: Factors Influencing Nurse Job Performance**

	<b>B</b>	<b>SE</b>	<b>β</b>	<b>t</b>	<b>p</b>	<b>R<sup>2</sup>Variation</b>	<b>Accumulate R<sup>2</sup></b>
Constant	1.27	.23	-	5.53	<.001	-	-
Resilience	.46	.06	.44	7.34	<.001	.30	.30
Position(General nurse standards) -More than a head nurses	.20	.09	.13	2.14	.033	.04	.34
Social support	.17	.06	.16	2.70	.007	.02	.35
Working style (Shift working standards) -Fixed work system & Etc	.14	.07	.13	2.04	.042	.01	.37
Durbin-Watson=1.99, F=34.71, p<.001, R <sup>2</sup> =.37, Adj-R <sup>2</sup> =.35							

**CONCLUSION**

All these results of this study suggest that higher resilience and social support levels, positions higher than head nurse in comparison with staff nurses and fixed working hours or other working patterns rather than shift work lead to higher nursing work performance level. Social support has a strong influence on job satisfaction and organizational commitment of nurses, and resilience has a positive effect on nurses with various job stresses. In particular, the higher the social support and resilience of nurses, the higher the performance of nursing work. Nurses need to be encouraged to have various opportunities to enhance their job performance and concentrate on their work in an affectively and psychologically stable state. In addition, social support systems and working conditions need to be created that can increase their sense of belonging. For the purpose of strengthening nurses' resilience, programs for stress management and ego resilience improvement need to be implemented. These programs can help reduce stress and anxiety, and thus can improve the quality of life. In this light, continuous support to enhance nurses' resilience need to be provided. When nurses provide nursing care, they establish therapeutic relationships with patients and their guardians as well as cooperative relationships with different medical personnel. Therefore, improving

nurses' capacity for interpersonal relationships is directly related to improving nurse job performance. The capacity for interpersonal relationships is a key factor in relation to nurse job performance in the hospital organization, and this study found that nurses who had more people to whom they could open themselves up displayed higher nurse job performance. Consequently, measures need to be established to enhance nurses' capacity for interpersonal relationships.

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**Conflict of Interest:** NA

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# Clinical Predictors Related to Organizational Effectiveness in Dental Hygienists at Dental Clinics and Hospitals

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## ABSTRACT

This study was conducted to examine the level of burnout, self-efficacy, social support and organizational effectiveness as well as the relationship among variables in dental hygienists. The subjects were 192 dental hygienists who were selected by random sampling from dental hospitals and clinics. Self-administered questionnaires were given to the subjects from August 14 to October 15, 2012, to identify the degree of burnout, self-efficacy, social support, and organizational effectiveness. The mean of burnout overall recorded 3.05 points. Self-efficacy recorded 2.80 points overall. Social support recorded a mean of 2.50 points overall. Organizational effectiveness recorded a mean of 3.00 point overall. Organizational commitment recorded 3.01 points, and 2.58 points were recorded for job satisfaction. Self-efficacy, social support and organizational effectiveness had a negative correlation to burnout, and there was a positive correlation among self-efficacy, social support and organizational effectiveness. Burnout had a negative impact on organizational effectiveness, and self-efficacy and social support exerted a positive influence on organizational effectiveness. The findings of the study proved that burnout, self-efficacy and social support of the dental hygienists were correlated to organizational effectiveness. In order to boost organizational effectiveness, dental hygienists themselves should take a positive attitude and try not to be affected by possible burnout factors, and they should perform more specialized duties to bolster their own satisfaction with and pride in the occupation.

**Keywords:** *Burnout, Dental hygienist, Organizational effectiveness, Self-efficacy, Social support*

## INTRODUCTION

The majority of people in modern industrial society have occupations. They have a desire to feel valued for themselves and their work. When this desire is met, they make cognitive assessment that what they are doing is valuable and that they are needed in an organization and thus a psychological state including positive emotional response is reached. This psychological state plays an important role in the value of work and organization<sup>1</sup>.

In recent years, there has been a lot of research on job burnout in the area of stress on job in the field of organizational behavior in Korea. Job burnout refers to a type of psychological phenomenon of a chronic stress response caused by cumulative and long-term negative effects of job stress.

Job stress, job tension, job satisfaction, social support, self-efficacy and self-esteem are known to be variables related to burnout. Burnout is a form of work

stress reaction that occurs when you are no longer able to cope with stress, and is referred to as the syndrome of physical, emotional, and mental burnout. Physical exhaustion is manifested as helplessness, chronic fatigue, weakness, boredom, emotional exhaustion is depression, frustration, helplessness, mental burnout is manifested by self-concept deterioration, and dissatisfaction with work.

The turnover rate of dental hygienists at dental hospitals and clinics in recent years has significantly increased due to personal and professional reasons, making it difficult to secure needed personnel in the hospital. Most dental hospitals and clinics have difficulties in securing dental hygienists because of the insufficient supply of personnel. The most effective approach to prevent the shortage of personnel is to identify the job turnover of the existing workforce and minimize their turnover<sup>2</sup>. Among the factors leading to high turnover rate, difficulty in maintaining physical and mental health due to accumulation of fatigue, such as

stress due to job burnout, is considered to be the greatest factor of turnover. Through a multidisciplinary study of the psychological factors of dental hygienists engaged in dental hospitals and clinics, a plan to increase job satisfaction and organizational commitment is required.

Previous studies were fragmented, generally focusing on the dental hygienist's job satisfaction, organizational commitment, turnover intention, empowerment, and stress<sup>1,3-7</sup>. There is also insufficient research to identify the effects of self-efficacy and social support on organizational effectiveness measured by job satisfaction and organizational commitment, and burnout, a psychological factor perceived by dental hygienists when they work at dental hospitals and clinics.

Given this backdrop, the purpose of this study is to provide a basic data for development of a program that can manage dental health care more efficiently by identifying the relationship between burnout, self-efficacy, social support and organizational effectiveness of dental hygienists.

## SUBJECTS AND METHOD

This study is a descriptive correlation research that aims to identify the relationship among burnout, self-efficacy and social support, and organizational effectiveness perceived by dental hygienists working in dental clinics.

**Subjects:** Dental clinics in Seoul, Gyeonggi, Chungcheong and Gyeongsang provinces were randomly selected and dental hygienists who currently work in those dental clinics were chosen as subjects after getting consent from them. The size of the sample was calculated to be 94, using the G\*Power program (ver. 3.19.2, Germany) with the significance level of  $\alpha=0.05$  and medium magnitude of the effect, which was 0.25, and power=0.95. Considering the low survey response rate, however, 350 dental hygienists working at dental clinics were selected as subjects.

This study was conducted from August 14 to October 15, 2012. Dental hygienists working in dental hospitals and clinics were randomly selected, and a structured questionnaire describing the purpose and objective of the study was sent to the subject via a mail survey. Subjects who agreed to participate in the study were asked to respond to the questionnaire by self-entry, and the

questionnaires were collected. Of the 350 questionnaires distributed (100%), 220 (62.9%) were collected and 192 (54.9%) were selected as the final analysis subjects except for 28 (8%) copies with insufficient responses.

**Methods:** The study consisted of 8 items of demographic characteristics (gender, age, marital status, education, clinical experience, workplace, work area, number of employees), 20 items of burnout, 24 items of self-efficacy, 21 items of social support, and 25 items of organizational effectiveness, and after completing the consultation with two oral health professionals, 50 dental hygienists were used to conduct a preliminary survey to verify the reliability and validity of the study tool, after which it was used in the survey. In positive questions, the higher the score in inverse measurement, the higher the level of burnout<sup>8</sup>. There were 20 questions in total, made up of 6 questions about physical burnout, 7 questions about emotional burnout, and 7 questions about mental burnout. 5 point Likert scale was used and depending on the frequency of experience, different points were given: none=1 point, sometimes=2 points, usually=3 points, frequently=4 points, and always=5 points. Among the questions, five were inversely measured. In this study, Cronbach's  $\alpha$  was 0.90.

As for the tool to measure self-efficacy of dental hygienists, general self-efficacy measurement scale developed by Ah-young Kim and Jeong-eun Cha and modified by Ah-young Kim (1997)<sup>9</sup> was used. Self-efficacy consisted of 24 questions in the three sub-factors, self-confidence, self-control, and task difficulty preference, and 5 point Likert scale was used (never=1 point, sometimes=2 points, usually=3 points, frequently=4 points, and always=5 points). 7 questions about confidence and 2 questions about task difficulty preference was inversely measured. In Ah-young Kim's research Cronbach's  $\alpha$  was 0.86 and in this study, it was 0.89.

For social support of dental hygienists, among the social support scales developed by Jiwon Park, the tool for indirectly perceived social support was used. The test for social support consisted of 21 questions that measure four types of support—informational support, emotional support, material support, and appraisal support. As for the perception of social support, the subjects were asked to answer to each question according to the degree they felt. 5- point Likert scale (1 point=almost never ~ 5 points=very much so) was used, and the higher the score, the higher the social support. In Jiwon Park<sup>10</sup> study, Cronbach's  $\alpha$  was 0.95 and in this study, it was 0.97.

To measure organizational effectiveness, 13 questions on organizational commitment and 12 questions on job satisfaction were used, with the most representative questions in the performance variables of psychological dimension that depend on the perceptual judgement of the members of the organization. As for organizational commitment, questions that Kim and Lee used were modified based on the questions of Mowday<sup>11</sup>, and the Cronbach's  $\alpha$  of this study was 0.89. As for job satisfaction, the tool that Kim and Lee used was adopted based on the questions of Hackman<sup>12</sup> and the Cronbach's  $\alpha$  of this study was 0.89.

**Analysis method:** The collected data were first subjected to the normality test using IBM 22.0 SPSS program, and technical statistics were obtained according to the characteristics of the variables. Concerning the correlations between burnout, self-efficacy, social support, and organizational effectiveness of dental hygienists, Pearson's correlation analysis and multiple regression analysis were conducted, with the significance level being set at  $\alpha = 0.05$ .

## FINDINGS

**General characteristics of subjects:** The demographic characteristics of the subjects surveyed in the study were age, marital status, final education, clinical experience, working area, workplace type, and number of employees. <Table.1>

The age group was 39.5% for those under 25 years old, 31.4% for 25-29 years old, and 15.2% for those over 30 years old.

The more frequent marriage status was unmarried and the final education was in the order of college (71.3%), four year (13%), master (1.3%) and others (0.4%). Clinical experience was the highest in less than 1 year (28.3%), more than 6 years (24.2%), 2 ~ 3 years (19.3%) and 4 ~ 5 years (14.3%), and clinic (68.2%) was the most common type of workplace the subjects worked in. Work area was in the order of Gyeonggi (Incheon) (33.6%), Seoul (28.3%), Chungcheong Province (18.4%) and Kyungsang Province (5.8%), and number of employees was in the order of 6 ~ 10 persons (26.5%), 16 ~ 20 persons (23.8%), 11 ~ 15 persons (17.5%), fewer than 5 persons (10.8%) and more than 20 persons (7.6%).

**Table 1: General characteristics of the subjects**

Characteristics	Division	Frequency	Percent
Age	<25	88	45.8
	25~29	70	36.5
	≥30	34	17.7
Marital status	Single	156	81.3
	Married	36	18.8
Education level	College	159	82.8
	University	29	15.1
	Master	3	1.6
	Etc.	1	0.5
Current work career	<1	63	32.8
	2~3	43	22.4
	4~5	32	16.7
	≥6	54	28.1
Work type	Dental clinic	152	79.2
	Hospital	38	19.8
	Public health center	1	0.5
	Etc.	1	0.5
Work area	Seoul	63	32.8
	Gyeonggi (Incheon)	75	39.1
	Chungcheong	41	21.4
	Gyeongsang	13	6.8
The number of staff	<5	24	12.5
	6~10	59	30.7
	11~15	39	20.3
	16~20	53	27.6
	≥20	17	8.9

**The degree of burnout, self-efficacy, social support and organizational effectiveness in dental hygienists:** Burnout, self-efficacy, social support, and organizational effectiveness were measured using a 5-point Likert scale, with higher points indicating a higher degree of burnout, self-efficacy, social support, and organizational effectiveness. <Table 2>

Sub-factors of burnout were in the order of emotional burnout (3.11), physical burnout (2.88), and mental burnout (2.43), self-efficacy was task difficulty (3.11), self-control efficacy (2.88), and confidence (2.43). For social support, it was in the order of emotional support (2.56), appraisal support (2.53), informative support (2.52), and material support (2.39).

In organizational effectiveness, organizational commitment (3.01) was higher than job satisfaction (2.58).

**Table 2: Burnout, self-efficacy, social support and organizational effectiveness**

Variables	N	Min	Max	Mean	SD
<b>Burnout</b>					
Physically burnout	192	1.27	4.82	2.88	0.74
Mental burnout	192	1.67	5.00	2.43	0.56
Emotional burnout	192	1.00	5.00	3.11	0.84
<b>Self-efficacy</b>					
Self-control efficacy	192	1.17	4.33	2.88	0.56
Self-confidence	192	1.00	4.57	2.43	0.63
Task difficulty	192	1.00	5.00	3.11	0.81
<b>Social support</b>					
Informative support	192	1.00	3.81	2.52	0.65
Appraisal supporting	192	1.00	4.25	2.53	0.64
Material support	192	1.00	3.73	2.39	0.61
Emotional support	192	1.00	4.11	2.56	0.66
<b>Organizational Effectiveness</b>					
Organizational commitment	192	1.00	5.00	3.01	0.61
Job satisfaction	192	1.00	4.17	2.58	0.53

**The relationship of burnout, self-efficacy and social support and organizational effectiveness in dental hygienists**

**Table 3: Relationship of burnout, self-efficacy, social support and organizational effectiveness in dental hygienists**

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Physically Burnout	1											
2. Mental Burnout	0.493**	1										
3. Emotional Burnout	0.607**	0.411**	1									
4. Self-control efficacy	-0.183**	-0.397**	-0.123	1								
5. Self-confidence	-0.340**	-0.303**	-0.486**	0.289**	1							
6. Task difficulty	-0.346**	-0.373**	-0.085	0.492**	0.246**	1						
7. Informative support	-0.342**	-0.486**	-0.238**	0.153*	0.067	0.148**	1					
8. Appraisal supporting	-0.402**	-0.556**	-0.330**	0.139	0.124	0.259**	0.703**	1				
9. Material support	-0.354**	-0.454**	-0.263**	0.156*	0.108	0.165**	0.820**	0.736**	1			
10. Emotional support	-0.403**	-0.497**	-0.249**	0.196**	0.112	0.239**	0.820**	0.672**	0.770**	1		
11. Job satisfaction	-0.581**	-0.589**	-0.453**	0.273**	0.286	0.227**	0.604**	0.634**	0.569**	0.552**	1	
12. Organizational commitment	-0.533**	-0.408**	-0.319**	0.131	0.161*	0.135	0.472**	0.445**	0.479**	0.485**	0.684**	1

\* p<0.05 by the Pearson correlation test, \*\* p<0.01 by the Pearson correlation test

Relationship of burnout, self-efficacy, social support, and organizational effectiveness were analyzed using Pearson's correlation analysis. Correlation analysis was conducted to examine how closely one variable changed with other variables. <Table 3>



Correlation showed that the higher the burnout of dental hygienists, the lower the organizational effectiveness, and the higher the self-efficacy and social support, the higher the organizational effectiveness.

**Clinical predictors related to organizational effectiveness in dental hygienists of dental clinics and hospitals:** The results of multiple regression analysis on the effects of burnout, self-efficacy and social support on job satisfaction are shown in Table 22, where physical burnout ( $\beta=-.298$ ,  $P=0.001$ ), mental burnout ( $\beta=-.168$ ,  $P=0.011$ ), informational support ( $\beta=.285$ ,  $P=0.004$ ),

and evaluation support ( $\beta=.232$ ,  $P=0.004$ ) were the influential factors. In other words, job satisfaction decreased as physical burnout and mental burnout increased, and it increased as informational support and evaluation support increased. The modified explanatory power of this model was 57.9%. <Table 4>

The influential factor for organizational commitment was physical burnout ( $\beta=-.433$ ,  $P=0.001$ ). That is, the greater the physical burnout, the lower the organizational commitment, and the explanatory power of this model was 37.3%.

**Table 4: Clinical predictors related to organizational effectiveness in dental hygienists of dental clinics and hospitals**

Variables	Job satisfaction		Organizational commitment	
	$\beta$	p-value*	$\beta$	p-value*
<b>Burnout</b>				
Physically Burnout	-0.298	0.001	-0.433	0.001
Mental Burnout	-0.168	0.011	-0.077	0.339
Emotional Burnout	-0.031	0.646	0.069	0.401
<b>Self-efficacy</b>				
Self-control efficacy	0.058	0.324	0.017	0.807
Self-confidence	0.079	0.171	0.010	0.885
Task difficulty	-0.079	0.180	-0.121	0.095
<b>Social support</b>				
Informative support	0.285	0.004	0.083	0.489
Appraisal supporting	0.232	0.004	0.037	0.699
Material support	0.022	0.815	0.147	0.196
Emotional support	-0.067	0.456	0.107	0.326
	R <sup>2</sup> =0.601, Adjust R <sup>2</sup> =0.579 F=27.309, p<0.001		R <sup>2</sup> =0.406, Adjust R <sup>2</sup> =0.373, F=12.352, p<0.001	
* by multiple regression analysis at $\alpha=0.05$				

**CONCLUSIONS**

With the nation-wide surge in the number of new hygienists department at universities or an expansion of existing departments, the number of dental hygienists is increasing each year. On the other hand, dental clinics are suffering from the issue of securing dental hygienists, due to a high turnover rate of dental hygienists who are exhausted and have low job satisfaction. The purpose of this study was to investigate the relationship between burnout, self-efficacy and social support of dental hygienists on organizational effectiveness and their

effects, and it was attempted to increase the satisfaction and pride as a dental hygienist by reducing burnout and increasing organizational effectiveness.

The overall average of burnout was 3.05, with physical burnout 2.88, mental burnout 2.43, and emotional burnout 3.11. The overall average of self-efficacy was 2.80, with self-control efficacy 2.88, confidence 2.43, task difficulty 3.11. The overall average of social support was 2.50, with informative support 2.52, appraisal support 2.53, material support 2.39, emotional support 2.56. The overall average of organizational

effectiveness was 3.00, with organizational commitment 3.01, job satisfaction 2.58. Self-efficacy, social support, organizational effectiveness showed an inverse correlation with burnout, and self-efficacy, social support, organizational effectiveness showed pure correlation. Burnout had (-) effect on organizational effectiveness, self-efficacy and social support had (+) effect on organizational effectiveness.

The above results show that the burnout, self-efficacy and social support of dental hygienists are related to organizational effectiveness, it is suggested that strategies should be made to enhance the organizational effectiveness in consideration of the psycho-social factors of dental hygienists, and for this, practical and active participation should be provided at the organizational level such as relevant associations, academies and universities.

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# Relationship of Maternity Leave Realization, Dental Clinic Attitude and Organizational Effectiveness of Dental Hygienists

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## ABSTRACT

The purpose of this study was to examine the level of maternity leave realization, dental clinic attitude and organizational effectiveness, as well as to examine the relationship among variables in dental hygienists. A total of 227 dental hygienists were selected, who provided written consent to participate in the study from October 2016- February 2017. Data was analyzed employing the IBM SPSS 21.0 program. An independent t-test, one way ANOVA, and Duncan's multiple comparison for post hoc analysis were conducted. Results found a strong positive correlation between attitude and job satisfaction ( $r = 0.384$ ,  $p < 0.01$ ) and organizational commitment ( $r = 0.386$ ,  $p < 0.01$ ). Regression analysis showed that the attitude toward maternity leave at the workplace and clinics had a statistically significant effect on job satisfaction ( $\beta = 0.383$ ) and organizational commitment ( $\beta = 0.325$ ). Our findings suggest that an education program should be developed and implemented for dental hygienists for conservation of an education program by the association or society for improved understanding of maternity leave and the rights defined by the law.

**Keywords:** Dental hygienists, Maternity leave, Organizational effectiveness, Dental clinic attitude, Low birth

## INTRODUCTION

There has been no improved quality of employment for women which greatly affects the birthrate, family relationship, poverty and development for children<sup>1</sup>. Although the number of dental hygienists is increasing each year with the majority of them being women, the number of dental hygienists is also decreasing due to marriage and childbirth. In consideration of today's importance of competence and professionalism of dental hygienists, it is important to seek solutions to prevent a break in the career trajectory of dental hygienists as professionals and promote professionalism.

Many different systems at the state level are being implemented in order to address the problems of low birthrates and promote work-life balance for female workers. According to Article 74 of the Labor Standards Act, all female workers are permitted 90 days for maternity leave (before and after childbirth), and the period can extend to 90-120 days in the case of plural births (birth of more than 2 babies). In addition, the salary for the first 60 days should be paid during the maternity leave (before and after childbirth) and the remaining 30 days

is without payment. If an employer recognizes a shorter period of maternity leave than the stipulated period, or incites disadvantages to the employee resulting from receiving maternity leave, this is an illegal act and subject to punishment (refer to Article 110 of Labor Standards Act)<sup>2</sup>. To solve the problems of compatibility of home and work of women as well as the low birthrate which emerged as key social issues, many policies at the state level have been implemented.

However, in terms of unfair treatment towards female employees at the workplace, such as forced retirement due to pregnancy and maternity leave, provision of a maternity leave period of less than the legal requirement, and disadvantageous and discriminated restructuring after the use of maternity leave as compared with the period before the maternity leave<sup>3</sup>. Therefore, this study suggests management and enforcement of legal systems to improve the working environment for dental hygienists and to prevent unfair treatment by disseminating legal information regarding maternity leave and the attitudes of hospitals and clinics where they work.

## SUBJECTS AND METHODS

**Subjects:** Taking into account the distribution of dental hospitals and clinics, convenience sampling was conducted in the network of dental hospitals and clinics throughout the 7 regions of Seoul, Gyeonggi-do, Incheon, Chungcheong-do, Gyeongsang-do, Jella-do and Gangwon-do. A total of 227 dental hygienists were selected, who provided written consent to participate in the study from October 2016- February 2017. Research was conducted based on self-administered questionnaires. Excluding the 4 incomplete questionnaires, a total of 223 questionnaires (98% return rate) were used for data analysis. In consideration of research participants, this research was deliberated by the Korea National Institute for Bioethics Policy (IRB No: P01-201508-22-003).

### Methods

**Knowledge of maternity leave:** Based on Article 74 of the Labor Standards Act, the questionnaire survey was comprised of 6 questions regarding the knowledge of maternity leave of dental hygienists. They responded using the answers “Yes”, “No” and “I don’t know very well”. The higher response rate of “Yes” reflects knowledge of maternity leave.

**Attitudes of hospitals and clinics toward maternity leave:** The measurement tool used in Jeong<sup>4</sup> was modified and utilized in 11 questions in accordance with the purpose of this study. Participants were required to answer based on the five-point Likert Scale (1= strongly agree, 5= strongly disagree). The higher score relates to stronger negative attitudes of hospitals and clinics toward maternity leave.

**Organizational effectiveness:** Regarding job satisfaction, this study employed questions utilized in Hackman<sup>5</sup>. As well as 12 questions used in Lee<sup>6</sup>. Concerning organizational commitment, this study follows Mowday<sup>7</sup> and utilized 13 questions employed in Lee<sup>6</sup>. As for the measurement of organizational commitment and job satisfaction, participants gave their responses on a five-point Likert Scale (1= strongly agree, 5= strongly disagree). The higher score represents lower levels of organizational commitment and job satisfaction.

**Questions concerning working environment improvement regarding maternity leave:** With advice of specialists based on preceding studies regarding family-friendly institutions, 7 questions related to improvement factors for maternity leave were composed. Participants answered based on a five-point Likert Scale (1= strongly unimportant, 5= strongly important). The higher value

implies a higher importance for the improvement of the working environment.

**Analysis method:** Collected data was analyzed employing the IBM SPSS 21.0 program. The descriptive statistics were obtained regarding the general features of research participants and measurement variables. Regarding the differences in knowledge of maternity leave, attitude of hospitals and clinics, and organizational effectiveness by the general features, we conducted an independent t-test, one way ANOVA, and Duncan’s multiple comparison for post hoc analysis. In order to determine the correlation among knowledge of maternity leave, attitudes of hospitals and clinics and organizational effectiveness, multiple regression analysis was conducted using organizational effectiveness as the dependent variable.

## FINDINGS

**General characteristics of subjects:** Shows the general characteristics of subjects. 36.8% of the total, 69.5% of participants were single, and 65.9% were graduates of three-year colleges. In terms of service career, 47.5% had less than 5 years of experience, and 65.5% worked in dental clinics. 40.8% of participants worked in Incheon. The number of people working both in hospitals and clinics turned out to be between 5 and 9, recording the highest rate by 27.8%.

**Table 1: General characteristics of subjects**

Variables	Division	N	%
Age (year)	<25	70	31.4
	25~29	82	36.8
	30~34	45	20.2
	35≤	26	11.7
Marital status	Unmarried	155	69.5
	Married	68	30.5
Education	College	147	35.9
	University	62	27.8
	Master	8	3.6
	Doctor	4	1.8
	Others	2	0.9
Job career (year)	<5	106	47.5
	5~9	67	30.0
	10~14	38	17.0
	15≤	12	5.4

Types of dental clinic	Dental clinic	146	65.5
	Dental network	48	21.5
	Dental hospital	24	10.8
	University dental hospital	5	2.2
Residential area	Seoul	26	11.7
	Gyeonggi-do	19	8.5
	Incheon	91	40.8
	Chungcheong-do	20	9.0
	Jeolla-do	62	27.8
	Gyeongsang-do	4	1.8
	Gangwon-do	1	0.4
Number of dental hygienists	<5	31	13.9
	5~9	62	27.8
	10~19	39	17.5
	20~39	41	18.4
	40≤	50	22.4

**Descriptive statistics of variables:** This distribution of subjects regarding descriptive statistics of variables is shown in.<Table 2>

**Table 2: Descriptive statistics of variables**

Variables	N	Min	Max	M ± SD	Cronbach's α
Maternity leave knowledge	223	1.00	3.00	2.06 ± 0.58	0.74
Attitudes of dental clinic	223	1.00	5.00	2.47 ± 0.81	0.93

Conted...

Job satisfaction	223	1.00	4.33	2.40 ± 0.62	0.93
Organizational commitment	223	1.00	5.00	2.80 ± 0.67	0.92
Working environment improvement	223	1.57	5.00	4.16 ± 0.67	0.94

The knowledge of dental hygienists concerning maternity leave was 2.06 on average and the reliability of Cronbach's α was 0.74. This result shows that knowledge of maternity leave (before and after the childbirth) is very shallow. The attitudes of hospitals and clinics were 2.47 on average and Cronbach's α was 0.93. The average score of job satisfaction was 2.40 and Cronbach's α was 0.93. The organizational commitment averaged 2.80 and Cronbach's α was 0.92. The average score of working environment improvement was 4.16 while Cronbach's α was 0.94.

**Organizational effectiveness according to general characteristics:** Shows the difference of organizational effectiveness by general characteristics. <Table 3> The results show that older age was correlated with higher job satisfaction (p=0.001) and higher organizational commitment (p<0.001).In addition, greater clinical service careers relate to higher job satisfaction (p=0.005) and organizational commitment (p=0.001). Job satisfaction (p=0.015) and organizational commitment (p<0.001) were most prevalent among those with a final education level of Master's degree. Regarding the type of workplace, results show that organizational commitment (p=0.029) was highest at university hospital dental clinics, followed by network dental clinics, private dental clinics and dental hospitals.

**Table 3: Level of organizational effectiveness according to general characteristics**

Characteristics	Division	N	Job satisfaction	p*	Organizational commitment	p*
Age (year)	<25	70	2.57 ± 0.63 <sup>b</sup>	0.001	2.99 ± 0.69 <sup>b</sup>	<0.001
	25~29	82	2.40 ± 0.61 <sup>b</sup>		2.86 ± 0.65 <sup>b</sup>	
	30~34	45	2.39 ± 0.50 <sup>b</sup>		2.74 ± 0.53 <sup>b</sup>	
	35≤	26	2.00 ± 0.64 <sup>a</sup>		2.26 ± 0.65 <sup>a</sup>	
Education	College	147	2.41 ± 0.57 <sup>ab</sup>	0.015	2.81 ± 0.61 <sup>bc</sup>	<0.001
	University	62	2.49 ± 0.63 <sup>b</sup>		2.90 ± 0.70 <sup>bc</sup>	
	Master	8	1.68 ± 0.79 <sup>a</sup>		1.89 ± 0.68 <sup>a</sup>	
	Doctor	4	2.37 ± 1.05 <sup>ab</sup>		2.42 ± 1.14 <sup>ab</sup>	
	Others	2	2.66 ± 0.47 <sup>b</sup>		3.53 ± 0.21 <sup>c</sup>	

Conted...

Job career (year)	<5	106	2.52 ± 0.61 <sup>b</sup>	0.005	2.94 ± 0.67 <sup>c</sup>	0.001
	5~9	67	2.37 ± 0.61 <sup>b</sup>		2.82 ± 0.66 <sup>bc</sup>	
	10~14	38	2.28 ± 0.56 <sup>b</sup>		2.56 ± 0.51 <sup>ab</sup>	
	15≤	12	1.93 ± 0.67 <sup>a</sup>		2.30 ± 0.86 <sup>a</sup>	
Types of dental clinic	Dental clinic	146	2.43 ± 0.63	0.347	2.85 ± 0.71 <sup>ab</sup>	0.029
	Dental network	48	2.30 ± 0.56		2.61 ± 0.49 <sup>ab</sup>	
	Dental hospital	24	2.51 ± 0.56		3.00 ± 0.64 <sup>b</sup>	
	University dental hospital	5	2.15 ± 0.91		2.38 ± 0.61 <sup>a</sup>	
*by the independent t-test or one way ANOVA test at $\alpha < 0.05$ <sup>a,b,c</sup> Means followed by different letters (Duncan) are significantly different at $\alpha = 0.05$						

Correlation analysis of knowledge of maternity leave, attitudes of dental clinics, and organizational effectiveness

The correlation between maternity leave knowledge and attitudes of the dental clinical, organizational effectiveness is shown in.<Table 4>

**Table 4: The correlation between maternity leave knowledge and attitudes of the dental clinical, organizational effectiveness**

Variables	Maternity leave knowledge	Attitudes of dental clinic	Organizational effectiveness	
			Job satisfaction	Organizational commitment
Maternity leave knowledge	1			
Attitudes of dental clinic	0.225**	1		
Organizational effectiveness				
Job satisfaction	0.060	0.384**	1	
Organizational commitment	0.123	0.386**	0.737**	1
** p<0.01 by the pearson's correlation coefficient				

There was a positive statistical correlation between the knowledge of dental hygienists regarding maternity leave and the attitudes of hospitals and clinics ( $r=0.225$ ,  $p<0.01$ ). There was a strong positive correlation among attitudes of hospitals and clinics and job satisfaction ( $r=0.384$ ,  $p<0.01$ ) as well as organizational commitment ( $r=0.386$ ,  $p<0.01$ ). These results suggest that better attitudes of hospitals and clinics toward maternity leave contribute to higher job satisfaction and organizational commitment.

**Factors affecting organization effectiveness:** Results of the multiple regression analysis are displayed insert <Table 5>. Organizational effectiveness is influenced by the variables, which showed statistically significant differences from organizational effectiveness across different general characteristics such as age, final

educational level, clinical career, type of employer, knowledge of dental hygienists regarding maternity leave and attitudes of hospitals and clinics.

Analysis excluded age 1, final education level 1, clinical career 1, 2, 3, type of working hospitals and clinics 1, which included correlation coefficients containing missing data. According to the analysis, results show that final education level 3 gives statistically significant influences on job satisfaction ( $\beta=-0.380$ ) and organizational commitment ( $\beta=-0.464$ ). Moreover, the attitudes of hospitals and clinics towards maternity leave had a statistically significant effect on job satisfaction ( $\beta=0.383$ ) and organizational commitment ( $\beta=0.325$ ). In other words, better attitudes of hospitals and clinics toward maternity leave was correlated with improvement of organization effectiveness.

**Table 5: Factors affecting organizational effectiveness**

Variables	Division	Job satisfaction		Organizational commitment	
		$\beta$	t	$\beta$	t
Age (year)	35≤	0.106	0.751	0.121	0.824
Education	College	0.059	0.397	0.026	0.169
	University	-0.380*	-2.514	-0.464*	-2.951
Types of dental clinic	Dental clinic	0.058	0.382	0.029	0.182
	Dental hospital	-0.272	-1.811	-0.149	-0.957
Maternity leave knowledge		-0.155	-1.027	-0.108	-0.685
Attitudes of dental clinic		0.383*	2.684	0.325*	2.188
Working environment improvement		-0.282	-1.829	-0.111	-0.693
		R <sup>2</sup> =0.48 Adjust R <sup>2</sup> =0.33 F=3.31(p<0.001)		R <sup>2</sup> =0.43 Adjust R <sup>2</sup> =0.28 F=2.77(p<0.001)	
*Statistically significant differences by multiple regression analysis at $\alpha = 0.05$ Reference: Age=< 25 years; Education=Junior college; Types of dental leave knowledge=Dental clinic					

## DISCUSSION AND CONCLUSIONS

To identify the relationships between knowledge of dental hygienists regarding maternity leave, attitudes of hospitals and clinics, and organizational commitment and job satisfaction of dental hygienists, this study conducted a self-administered questionnaire survey of 223 dental hygienists in 7 regions from October 2016-February 2017.

The knowledge of dental hygienists regarding maternity leave is 2.06 on average, showing a very low level of knowledge of maternity leave (before and after childbirth). Results found the attitudes of hospitals and clinics were 2.47, job satisfaction was 2.40, and organizational commitment was 2.80. This indicates that the degree of knowledge of dental hygienists regarding maternity leave is low, according to the survey of National Human Rights Commission of Korea<sup>8</sup>. The results show that older workers experience higher job satisfaction ( $p=0.001$ ) and organizational commitment ( $p<0.001$ ). In addition, a longer career in clinical service correlates with higher job satisfaction ( $p=0.005$ ) and organizational commitment ( $p=0.001$ ). Final education level of Master's degree completion relates to the highest levels of job satisfaction ( $p=0.015$ ) and organizational commitment ( $p<0.001$ ). Regarding the type of workplace, results show that organizational commitment

( $p=0.029$ ) is greater for university hospital dental clinic, network dental clinic, private dental clinic and dental hospital respectively. There was a positive statistical correlation between the knowledge of dental hygienists regarding maternity leave and the attitudes of hospitals and clinics ( $r=0.225$ ,  $p<0.01$ ). In addition, there was a strong positive correlation among attitudes of hospitals and clinics and job satisfaction ( $r=0.384$ ,  $p<0.01$ ) as well as organizational commitment ( $r=0.386$ ,  $p<0.01$ ). Based on these results, better attitudes of hospitals and clinics toward maternity leave contributed to higher job satisfaction and organizational commitment.

According to the analysis, the results show that final education level 3 significantly affects job satisfaction ( $\beta=-0.380$ ) and organizational commitment ( $\beta=-0.464$ ). Moreover, the attitudes of hospitals and clinics towards maternity leave exhibits statistically significant influences on job satisfaction ( $\beta=0.383$ ) and organizational commitment ( $\beta=0.325$ ). In other words, better attitudes of hospitals and clinics toward maternity leave contribute to improvement of organization effectiveness. According to the study of Kwon Hye-won<sup>9</sup>, it was analyzed that the compatibility system of work-home of companies (childcare, maternity leave, nursery facilities) served as the improvement factor for organizational commitment for female administrators. Likewise, in the study of Yoo<sup>10</sup> demonstrated that the

higher execution rate of family-friendly system of companies contributed to higher job satisfaction of workers ( $\beta=0.23$ ,  $p<0.05$ ).

In the conclusion, dental hygienists were found to have low legal knowledge of maternity leave, and it was deduced that dental hygienists working at dental clinics could not properly utilize maternity leave during pregnancy and childbirth. While the government is well aware of the problem of low fertility and an aging population, and thus is making efforts to develop political measures to address these issues, dental hygienists should develop and operate educational programs for the conservation education program at their association or society so that they can acquire proper knowledge on maternity leave and their associated rights under the law.

In addition, it is necessary to improve the attitude of the dental clinics and health clinics in complying with the law. Knowledge concerning maternity leave and find out the rights defined by the law by themselves.

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# An Analysis of Radiation Safety Management of Radiation Workers in Research and Educational Fields in South Korea: Based on the Level of Knowledge, Attitude, and Behavior

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## ABSTRACT

This study surveyed the knowledge, attitude, and behavior regarding radiation safety of radiation managers and workers in fields of research and education in South Korea.

A questionnaire based on the Haddon Matrix was prepared after expert consultation and administered on May 4, 2015. The investigation lasted 30 days and a total of 180 responses were analyzed. For statistical analysis, SPSS/WIN 15.0 was utilized to derive mean, standard deviation, and Pearson's correlation coefficient. Additionally, t-test, ANOVA, and multiple linear regression analysis were performed to determine the effect of knowledge, attitude, and behavior regarding radiation safety. The knowledge and attitude level of radiation workers was higher than the behavior level. However, the knowledge, attitude, and behavior levels differed depending on the use of radiation sources and the users. There were statistically significant differences between material and physical environment factors in the behavior variable, and the level of safety managers' behaviors was higher than that of workers. Overall, radiation workers were positive about the need for radiation safety management and appropriate environment and education systems in order to ensure safety practices. As a result of the comparison between groups according to the use of radiation sources, the level of knowledge, attitude, and behavior were all different. Behavior levels were the lowest especially in the institutions that only used opened sources. The result of multiple linear regression analysis using the behavior of radiation workers as the dependent variable showed that the level of radiation safety management behavior was affected by knowledge levels of material and human factors. The Korean legal and education systems should be supplemented to enable them to use radiation sources efficiently and practice safety. Efforts must be made to optimize radiation safety culture.

**Keywords:** Knowledge, Attitude, Behavior; Haddon Matrix, Radiation safety management.

## INTRODUCTION

Currently, the radiation sources used in research and educational institutions in Korea may only be used after completing the licensing or declaration procedures as per Article 53 (such as obtaining permits for the use of radioisotope and radiation generating devices) of the Nuclear Safety Act. According to the statistical data of the 2015 Nuclear Safety Yearbook by the Nuclear Safety and Security Commission (NSSC), the number of research institutes that received permissions and notifications for the use of the radiation source was 300, and that of educational institutions (including

universities with health departments) was 285, while the number of radiation workers were 2,183 in research institutes and 4,521 in educational institutions, which was close to 16% of the 42,000 radiation workers in Korea; this cannot be ignored<sup>1</sup>. In addition, there are 179 types of sealed sources and 32 kinds of opened sources used in research and educational institutions, and radiation generators are also very diverse depending on their applications<sup>2</sup>. Now in Korea, even if the same radiation source is used, it differs depending on whether it is used for medical, educational, or research purposes<sup>3-6</sup>. In this situation, there is a concern about the lack of knowledge on radiation safety management in

the case of small universities and research institutes that do not offer radiation-related majors or a radiation safety management operating system. According to the NSSC, the exposure radiation dose for the radiation workers in the research and educational institutions is 0.03mSv/y and 0.04mSv/y <sup>7</sup>. This value is slightly lower than that of other fields. Radiation accidents in Korea occur mostly in the non-destructive testing workplace where radioactive isotopes are used, or overexposure due to quality control of radiation generator and calculation error in the medical field is the majority <sup>8</sup>. Hence, we recognize that the risk of safety accidents is low due to low incidence of accidents and that there is no data on the safety management of radiation generating devices and radioactive isotopes in research. Internationally, the International Atomic Energy Agency (IAEA), the European Commission (EC), the Nuclear Regulatory Commission (NRC), and other organizations recommend guidelines and reference levels for quality control of radiation sources for medical use and radiation exposure but there is no guideline for research and educational institutions <sup>9-11</sup>. Considering this situation, there will be a lot of confusion in the safety management of radiation sources installed and operated by research and educational institutions. In addition, after evaluation of the defense environment for the actual use of the radiation source, it is considered that the safety behavior is insufficient and safety management is neglected. Considering that it is the radiation workers, who handle

the radiation generator and isotopes, creating a safety culture in this field will be very important in terms of safety accident prevention.

Therefore, this study sought to derive a pedagogical basis by understanding the knowledge, attitudes, and behavior levels regarding radiation safety management for radiation safety managers and workers who use radiation sources in research and educational institutions.

## MATERIALS AND METHOD

**Subjects and data collection:** Before conducting the survey, with the cooperation of the NSSC, information on the research and educational institutions and characteristics of radiation sources in use were identified. Using this information, we derived specific safety management items for the questionnaire. The causes of safety problems and the analysis of human, material (radiation sources), social environment, and physical environment factors have led to considerations for safety culture propagation. Additionally, the items for the questionnaire were constructed through expert consultations with radiation safety managers and regulatory agencies. The subjects of the study were radiation safety managers and workers who are currently employed. They were from small institutions with little or no knowledge of safety management in using the permits or notifications regarding radiation sources.

**Table 1: General features of survey participants**

Item	Classification	Safety manager		Worker	
		Frequency	(%)	Frequency	(%)
Gender	Men	33	76.7	85	62
	Women	10	23.3	52	38
	Total	43	100	137	100
Radiation source *multiple responses	Sealed RI	31	31.3	66	30.7
	Opened RI	35	35.4	60	27.9
	RG	33	33.3	89	41.4
	Total	99	100	215	100
Completed safety education type *multiple responses	Compulsory	40	57.1	99	46.5
	Self-education	13	18.6	51	23.9
	School education	8	11.4	56	26.3
	Symposium	9	12.9	6	2.8
	Total	70	100	212	99.5

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Corresponding area	Metropolitan	17	39.5	61	44.5
	Chungcheong	9	20.9	19	13.9
	Yeongnam	15	34.9	37	27
	Honam	2	4.7	20	14.6
	Total	43	100	137	100

\* RI = Radioisotope, RG = Radiation Generator

The survey was conducted through visits, mails, and e-mails; a total of 180 responses collected were analyzed. The survey was administered on May 4, 2015, and the investigation lasted for 30 days. Table 1 shows the general characteristics of the survey participants (gender, use of radiation source, completed safety education type, corresponding area).

### QUESTIONNAIRE

The questionnaire constructed included items on knowledge, attitude, and behavior regarding radiation safety management (29 questions) and self-efficacy and expectations (4 questions each), which are factors that affect human behavior in general. The variables measured included knowledge, attitude, and behavior regarding the human factors (10 questions regarding the use of a personal dosimeter, medical check before the first experiment, etc.), the material (radiation source) factors (5 questions regarding possession of a checklist for radiation sources, quality management of radiation sources, etc.), the social environment factors (7 questions regarding the regularity of radiation safety committee meetings, support for the safety management budget, etc.), and the physical environment factors (7 questions regarding possession of locks, shielding tools, radiation dosimeters, safety equipment, etc.). The questionnaire was based on the Haddon Matrix, which has been applied as a basic concept of public health to safety issues for over 20 years as a useful tool to develop ideas to prevent various types of accidents<sup>12</sup>. It has been widely applied to safety management modeling as a strategy to identify the risk factors that cause accidents<sup>13-16</sup>. The questionnaires were developed by the professors providing education, the safety managers of the educational institutions, and the experts of the regulatory agencies, who revised the items for collecting the necessary information for research purposes.

To verify the reliability of the questionnaire, Cronbach's alpha coefficient was used. Regarding knowledge, the human factor was 0.914, the material

factor was 0.948, the social environment factor was 0.830, and the physical environment factor was 0.845. The Cronbach's alpha coefficient of the entire knowledge variable was 0.964. Regarding attitude, the human factor was 0.971, the material factor was 0.955, the social environment factor was 0.924, and the physical environment factor was 0.866. The Cronbach's alpha coefficient of the entire attitude variable was 0.986. Finally, regarding behavior, the human factor was 0.953, the material factor was 0.955, the social environment factor was 0.909, and the physical environment factor was 0.916. The Cronbach's alpha coefficient of the entire behavior variable was 0.975. Therefore, Cronbach's alpha coefficient was relatively high in all areas and it was confirmed that reliability was secured. For statistical analysis, SPSS/WIN 15.0 was utilized to derive mean, standard deviation, and Pearson's correlation coefficient. Additionally, t-test, ANOVA, and multiple linear regression analysis were performed to determine the effect of knowledge, attitude, and behavior regarding radiation safety by different groups, using radiation source and four factors of the Haddon Matrix.

### RESULTS AND DISCUSSION

**Level of radiation safety knowledge, attitude, and behavior according to m ± sd:** The general level of knowledge on radiation safety management was 4.15 ± 0.81 (out of 5) points. Among the four factors of the Haddon Matrix, the material factor showed the highest level of knowledge with 4.37 ± 0.93 points. On the other hand, the social environment factor showed the lowest knowledge level at 3.91 ± 0.80 points. This means that there is a lot of knowledge about safety management of radiation sources, but there is a lack of knowledge about the social environment, which should be provided to institutions for radiation safety management. Therefore, in order to raise the level of radiation safety management knowledge of research and educational institutions, it is necessary to supplement guidelines or regulations that can create a safety culture at an organizational level.

The general attitude towards radiation safety management was  $4.49 \pm 0.67$  (out of 5) points. As a result, all four factors of the Haddon Matrix are close to a perfect score. This means that most participants have a positive perception of radiation safety management.

Finally, the general behaviors related to radiation safety management was found to be  $4.02 \pm 1.04$  (out of 5) points. This is relatively low compared to knowledge ( $4.15 \pm 0.81$ ) and attitude ( $4.49 \pm 0.67$ ) levels in this study. It is very important to practice radiation safety activities as part of improving the quality of life and health of radiation workers. However, the fact that the level of behavior is lower than the level of knowledge

and attitude does not guarantee the prevention of health impairment caused by radiation exposure. Moreover, among the questionnaire items, periodical meetings on the topic of radiation safety management at the organizational level were observed to be the lowest among all behaviors ( $2.94 \pm 1.50$  points). It may be considered to be difficult for the staff and administrative practitioners (not the radiation workers) of the research and educational institution to acquire the knowledge necessary to carry out radiation safety management, and it will be necessary to supplement this part. Table 2 shows the knowledge, attitude, and behavior levels for each item on the four factors of the Haddon Matrix.

**Table 2: The level of knowledge, attitude, and behavior on radiation safety management (m  $\pm$  sd)**

Classification	Question contents	Knowledge	Attitude	Behavior
Material factor	We have a checklist for the radiation source.	$4.19 \pm 1.16$	$4.44 \pm 0.80$	$3.82 \pm 1.42$
	We manage the quality control on radiation source (type, quantity, and performance)	$4.35 \pm 0.98$	$4.47 \pm 0.76$	$3.93 \pm 1.39$
	We check the performance of the radiation field control equipment.	$4.36 \pm 1.05$	$4.53 \pm 0.76$	$3.94 \pm 1.40$
	We keep and use the radiation generator in a controlled area only.	$4.48 \pm 0.98$	$4.55 \pm 0.70$	$4.27 \pm 1.26$
	We check the ground equipment, exterior leakage current, and half value layer periodically.	$4.45 \pm 0.96$	$4.53 \pm 0.70$	$4.14 \pm 1.32$
	Total	$4.37 \pm 0.94$	$4.50 \pm 0.68$	$4.02 \pm 1.25$
Human factor	We undergo a medical check-up before the first practice education.	$4.43 \pm 0.96$	$4.46 \pm 0.81$	$4.27 \pm 1.16$
	We wear personal dosimeters during practice education.	$4.47 \pm 0.92$	$4.53 \pm 0.71$	$4.13 \pm 1.25$
	We perform radiation shielding during practice education.	$4.49 \pm 0.87$	$4.56 \pm 0.71$	$4.36 \pm 0.99$
	We keep the exposure time as short as possible.	$4.48 \pm 0.89$	$4.55 \pm 0.73$	$4.35 \pm 1.00$
	We maintain a distance from the radiation generator as far as possible.	$4.49 \pm 0.87$	$4.51 \pm 0.75$	$4.13 \pm 1.15$
	We receive education before practice for preventing radiation exposure.	$4.44 \pm 0.91$	$4.52 \pm 0.72$	$4.28 \pm 1.07$
	We do not engage in prohibited actions (smoking, wearing makeup, and eating).	$4.52 \pm 0.83$	$4.56 \pm 0.75$	$4.49 \pm 0.97$
	We are well-informed of the precautions necessary for the defense of radiation disturbances at the practice room entrance.	$4.43 \pm 0.89$	$4.58 \pm 0.68$	$4.22 \pm 1.08$
	We are well-informed of the path or way to escape when an emergency situation occurs.	$4.42 \pm 0.91$	$4.56 \pm 0.70$	$4.08 \pm 1.06$
	We are well-informed of the process of carrying in/out guidelines.	$2.23 \pm 1.69$ (R)	$4.44 \pm 0.86$	$4.15 \pm 1.09$
	Total	$4.24 \pm 0.75$	$4.53 \pm 0.66$	$4.25 \pm 0.90$

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Social environment factor	The safety measures are communicated among students, professors, and radiation safety manager.	4.34 ± 0.99	4.51 ± 0.71	4.07 ± 1.18
	We can check the exposure dose, medical records, and the expected dose at any time.	4.35 ± 0.95	4.51 ± 0.73	3.83 ± 1.28
	Radiation safety manager promotes safety for educational personnel and students.	4.34 ± 1.03	4.39 ± 0.89	4.02 ± 1.20
	It has been operating with budget support for safety management from the department.	4.33 ± 0.97	4.41 ± 0.80	3.39 ± 1.33
	The management recognizes the importance of radiation safety.	1.99 ± 1.51 (R)	4.33 ± 0.88	3.56 ± 1.16
	The radiation safety committee meeting is convened periodically.	3.85 ± 1.23	4.08 ± 1.03	2.94 ± 1.50
	The complete radiation safety information has been collected from regulatory agencies.	4.19 ± 1.12	4.42 ± 0.90	3.48 ± 1.30
	Total	3.91 ± 0.80	4.38 ± 0.71	3.61 ± 1.03
Physical environment factor	Having a lock in the practice room.	4.50 ± 0.86	4.57 ± 0.68	4.37 ± 1.01
	We post notice and maximum expected dose necessary to avoid radiation disturbances through the use of radiation sources.	4.39 ± 0.91	4.49 ± 0.73	4.02 ± 1.24
	Shielding tools (lead apron, gorget and glasses, etc.) are present in the practice room.	4.44 ± 0.89	4.58 ± 0.69	4.18 ± 1.01
	We post the contact list of the radiation safety managers in the practice room.	4.43 ± 0.91	4.56 ± 0.70	4.19 ± 1.26
	We have radiation dosimeters in the practice room.	4.42 ± 0.95	4.56 ± 0.67	4.14 ± 1.34
	Safety equipment (exhaustion/distributing installations, emergency stop button, mars light, glove box) installed in the lab is operating normally.	4.46 ± 0.91	4.59 ± 0.65	4.21 ± 1.18
	Emergency reaction tools (decontamination, ventilation) are present in the practice room.	1.97 ± 1.61 (R)	4.52 ± 0.83	4.19 ± 1.18
	Total	4.09 ± 0.75	4.55 ± 0.65	4.19 ± 0.96

\* In the knowledge part, the correct answer for each question was scored 1, the wrong answer or the answer what they do not know was scored 0. "R" denotes a reverse scored item.

\* In the attitude variable, the minimum score is 1 point and the maximum score is 5 points. A higher score means that the attitude is more positive.

\* In the behavior variable, the minimum score is 1 point and the maximum score is 5 points. A higher score indicates more behaviors related to radiation safety management.

**Correlation between knowledge, attitude, and behavior regarding radiation safety management:**

There was a significant correlation between all variables, except attitude and self-efficacy. For the three categories (knowledge, attitude, behavior), as shown in Table 3, higher knowledge led to higher attitudes (p <.01) and expectations (p <.01). In addition, when the knowledge of social and physical environments was higher, self-efficacy was also higher (p <.05, p <.01). When the

attitude was positive, the expectation that the safety management could be done well was high (p <.01); higher the expectation, higher was self-efficacy (p <.01). Finally, higher behavior may be associated with higher perceived knowledge, attitude, expectation, and self-efficacy (p <.01). That is, in order to increase the behaviors regarding radiation safety management, it is necessary to increase the level of knowledge and attitude.

The Pearson’s correlation coefficient for each variable is shown in Table 3; variables that have the highest correlation with individual behavior are knowledge about human behavior (0.809). This means that, if radiation workers do not have enough knowledge of human factors, there is a limit to increasing their radiation safety behavior level. Therefore, an education system to improve the knowledge of human factors will

be needed to raise the level of radiation safety behavior of research and educational institutions. Second, the level of individual radiation safety management attitude highly correlated with the attitude toward the material factor (0.962). Therefore, it would be good to supplement the variables of the material factor in order to raise the level of individual attitudes toward radiation safety management.

**Table 3: Correlation of knowledge, attitude, and behavior related to radiation safety management**

KM		Knowledge				Attitude				Behavior				Expectancy	Self-efficacy
		KH	KS	KP	AM	AH	AS	AP	BM	BH	BS	BP			
Knowledge	KM	1													
	KH	.794**	1												
	KS	.834**	.787**	1											
	KP	.832**	.873**	.851**	1										
Attitude	AM	.622**	.719**	.607**	.703**	1									
	AH	.632**	.756**	.631**	.732**	.962**	1								
	AS	.571**	.678**	.646**	.675**	.898**	.894**	1							
	AP	.621**	.738**	.640**	.722**	.908**	.909**	.861**	1						
Behavior	BM	.654**	.566**	.592**	.577**	.366**	.390**	.388**	.390**	1					
	BH	.776**	.809**	.703**	.722**	.560**	.592**	.531**	.592**	.771**	1				
	BS	.672**	.523**	.650**	.550**	.317**	.358**	.340**	.352**	.749**	.706**	1			
	BP	.742**	.749**	.717**	.701**	.486**	.528**	.473**	.545**	.789**	.899**	.780**	1		
Expectancy		.286**	.220**	.311**	.317**	.280**	.245**	.306**	.236**	.275**	.252**	.244**	.211**	1	
Self-efficacy		.132	.139	.263**	.190**	.036	.058	.100	.033	.351**	.238**	.414**	.268**	.334**	1

\* KM (knowledge of material factor), KH (knowledge of human factor), KS (knowledge of social environment factor), KP (knowledge of physical environment factor), AM (attitude of material factor), AH (attitude of human factor), AS (attitude of social environment factor), AP (attitude of physical environment factor), BM (behavior of material factor),

BH (behavior of human factor), BS (behavior of social environment factor), BP (behavior of physical environment factor).

**Difference in knowledge, attitude, and behavior according to the performer:** In order to confirm knowledge, attitude, and behavior regarding radiation safety management for each performer, t-test analysis was conducted by dividing participants into group of 43 radiation safety managers and 137 radiation workers. As shown in Table 4, in the knowledge variable, there were statistically significant differences in human, social environment, and physical environment factors ( $p < .05$ ,  $p < .01$ ,  $p < .001$ ), and all radiation safety managers showed higher knowledge of radiation safety management than radiation workers. In the attitude variable, there was no statistically significant difference between the users.

Finally, there was a statistically significant difference between material and physical environment factors in the variable of behavior, and the level of safety managers’ behaviors was higher than that of workers.

Overall, it was found that the knowledge level of the radiation safety managers was higher than that of radiation workers. Additionally, radiation safety managers showed good practice of safety activities. However, since the performer who uses the radiation source is the radiation worker, an education system that can raise the behavior level of the radiation workers will be needed.

**Table 4: Difference in the knowledge, attitude, behavior level according to user**

Classification		Knowledge				Attitude				Behavior			
		m	sd	t	p	m	sd	t	p	m	sd	t	p
Material	Safety manager	4.57	.480	1.622	.107	4.60	.503	1.052	.294	4.40	.598	2.271*	.024
	worker	4.30	1.031			4.47	.730			3.91	1.373		
Human	Safety manager	4.58	.456	3.460***	.001	4.65	.485	1.444	.150	4.45	.521	1.712	.089
	worker	4.13	.798			4.49	.705			4.18	.979		
Social environment	Safety manager	4.16	.504	2.377*	.019	4.54	.490	1.787	.076	3.83	.611	1.568	.119
	worker	3.84	.857			4.33	.756			3.55	1.126		
Physical environment	Safety manager	4.36	.538	2.815**	.005	4.60	.508	.578	.564	4.50	.513	2.527*	.012
	worker	4.00	.782			4.54	.685			4.09	1.046		

\*p<.05, \*\*p<.01, \*\*\*p<.001

**Difference in knowledge, attitude, and behavior level according to the type of use of radiation sources:**

For comparison between groups according to the use of radiation sources, ANOVA was performed in four parts (using only sealed sources, only opened sources, only radiation generators, and two or more sources). As shown in Table 5, in the knowledge variable, statistically significant differences were found in human, social environment, and physical environment factors (p < .05, p < .01). The human and social environment factor was the highest among institutions when using two or more radiation sources. In case of the physical environment factor, the knowledge level of institutions when using only sealed sources was the highest. The attitude variable showed statistically significant differences in the use of sources (p < .05, p < .01). Attitudes toward human and

social environment factors were highest in institutions when using two or more sources. In addition, the level of attitude toward human and physical environment factors was highest in institutions that use only sealed sources. In the behavior and attitude variables, statistically significant differences were found in all factors (p < .05, p < .01). It was found that the behavior level was the highest in the institutions where two or more radiation sources were used. It was found that, especially in the institutions that used only opened sources, behavior level was the lowest.

The level of knowledge, attitude and behavior were all different according to the use of radiation sources. Therefore, a case study based on the type of radiation source will be needed to take measures to improve the behavior level of radiation safety management in the future.

**Table 5: Difference in the knowledge, attitude, and behavior level according to the use of radiation source types**

Classification		Knowledge					Attitude					Behavior				
		m	sd	F	p	Scheffe	m	sd	F	p	Scheffe	m	sd	F	p	Scheffe
Material	Sealed RI <sup>a</sup>	4.60	.597	1.918	.128		4.69	.559	2.708*	.047	a, d>b	4.07	1.309	4.535**	.004	d>b
	Opened RI <sup>b</sup>	4.23	.622				4.25	.637				3.69	1.185			
	RG <sup>c</sup>	4.24	1.276				4.53	.767				3.83	1.517			
	Above two <sup>d</sup>	4.57	.575				4.61	.590				4.51	.624			
Human	Sealed RI <sup>a</sup>	4.41	.527	3.077*	.029	d>b, c	4.59	.613	2.772*	.043	a, c, d>b	4.43	.663	3.306*	.022	d>b, c
	Opened RI <sup>b</sup>	4.05	.508				4.27	.583				4.07	.529			
	RG <sup>c</sup>	4.14	.969				4.57	.742				4.09	1.206			
	Above two <sup>d</sup>	4.46	.563				4.64	.580				4.53	.580			

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Social environment	Sealed RI <sup>a</sup>	4.11	.459	4.312**	.006	d>b, c	4.53	.496	4.150**	.007	a, d>b	3.80	.893	3.038*	.031	d>b
	Opened RI <sup>b</sup>	3.69	.576				4.10	.676				3.30	.791			
	RG <sup>c</sup>	3.79	1.029				4.34	.801				3.53	1.356			
	Above two <sup>d</sup>	4.19	.553				4.59	.573				3.90	.577			
Physical environment	Sealed RI <sup>a</sup>	4.33	.524	3.933**	.010	a, d>b	4.73	.478	3.271*	.023	a>b	4.31	.702	3.583*	.015	d>b, c
	Opened RI <sup>b</sup>	3.86	.467				4.28	.557				3.98	.565			
	RG <sup>c</sup>	4.00	.945				4.60	.738				4.03	1.308			
	Above two <sup>d</sup>	4.31	.589				4.64	.571				4.51	.568			

\*p<.05, \*\*p<.01

**Regression analysis:** In order to investigate the effect of knowledge and attitude levels on the behavior level of radiation workers in research and educational institutions, we conducted a multiple linear regression analysis using the behavior of radiation workers as the dependent variable. As shown in Table 6, the explanatory power (R<sup>2</sup>) was 71.5% and the regression equation was significant (p < .001). As for the effect of each variable on the radiation safety management behavior level,

the beta coefficient (indicating the importance of a variable) was 0.556 for knowledge of material factor and 0.376 for the knowledge of human factor. The level of radiation safety management behavior was affected by knowledge levels of material and human factors. It can be considered that knowledge of material factors was thus high, and those who have adequate knowledge about behaviors for radiation safety are good at radiation safety management.

**Table 6: Multiple linear regression analysis of education and research institution**

	B	sd	β	t	p	Collinearity		F	p	R <sup>2</sup>	
						Tolerance	VIF				
(constant)	-.785	.373		-2.104	.037			42.449***	.000	.715	
Knowledge	Material	.548	.086	.556	6.359***	.000	.220				4.545
	Human	.459	.116	.376	3.965***	.000	.188				5.323
	Social Environment	.103	.110	.089	.931	.353	.184				5.440
	Physical Environment	-.213	.132	-.173	-1.613	.109	.147				6.798
Attitude	Material	-.392	.228	-.290	-1.719	.087	.059				16.936
	Human	.196	.237	.141	.828	.409	.058				17.233
	Social Environment	-.078	.138	-.060	-.567	.572	.150				6.665
	Physical Environment	.207	.155	.145	1.336	.183	.143				6.992
Expectation	.009	.049	.008	.178	.859	.755	1.325				
Self-efficacy	.253	.051	.226	4.925***	.000	.797	1.255				

\*\*\*p<.001



## DISCUSSION

In this study, the level of knowledge, attitude, and behavior regarding radiation safety management were analyzed for radiation safety managers and workers in Korean research and educational institutions. Generally, the level of behavior was lower than that of knowledge in both groups. In contrast, attitude level was the highest. Therefore, in order to raise the safety behavior level of safety managers and workers, it is important to strengthen the education policy before their first engagement with radiation practices or during work. In this study, most of the participants completed compulsory education. Moreover, according to previous studies, it is said that the effects of revisions to national laws can be seen not only in industrial and health fields but also in education and research fields, where improvements have been made in safety knowledge according to prior safety education<sup>17-21</sup>. Therefore, strengthening the education on radiation safety management at a the compulsory education level will have a great influence on the improvement of the radiation safety management activities of the radiation safety managers and workers (including non-specialists in radiology).

The radiation safety manager, as defined by Korea's Nuclear Safety Act, is required to implement "measures to prevent radiation damage listed under Article 91 for those who engage in radiation work or access radiation control zones"<sup>3</sup>. In this study, it was confirmed that knowledge and behavior levels of radiation workers were relatively lower than those of radiation safety managers. Exposure to even little amounts of radiation can lead to diseases caused by stochastic effects, such as cancer, and prolonged exposure could cause genetic defects<sup>22</sup>. According to the Nuclear Safety Act, radiation safety managers should manage the exposure of radiation to workers and their working environment under optimal conditions. Therefore, first, there is a need for enhanced training for this purpose. Second, regarding the individuals' actions (which are highly correlated with the level of safety behavior and associated with human factors), it will be necessary to raise the knowledge level regarding radiation safety management and support the culture to positively change the attitude toward the radiation source.

In recent years, studies have been carried out in Korea on the identification of actual conditions and the preparation of resources such as manuals and checklists

for the establishment of radiation safety<sup>23</sup>. In this study, it was found that the behavior level of social environment was rather low. If we do not strive to improve our knowledge of safety at the organizational level, we cannot expect that users will engage in their own safety activities. Therefore, we should strive to raise the level of safety behavior in research and educational institutions by developing and providing manuals for establishing a culture of radiation safety management.

In Korea, the kind of use of radioactive isotopes in research and educational institutions include 179 types of sealed sources and 32 types of opened sources, and it varies widely with regard to the number and capacity of industrial and medical institutions<sup>2</sup>. In addition, the radiation generating apparatus has been found to have a wide variety of types and capacities depending on the use in the research institutes<sup>1</sup>. When we look at the level of knowledge, attitude, and behavior of radiation safety management by the type of use of the radiation source, the level of behavior is high in places where more than two radiation sources were used. Moreover, the lowest level of behavior was observed in places where opened sources were used. In terms of Haddon Matrix factors, the level of knowledge about social environment was the lowest in places where the open sources were used. Currently, most Korean research and educational institutions use opened radiation sources. Therefore, to raise the level of knowledge about such sources, effort at the organizational level and the guidelines for raising the level of behavior of the institutions using only opened sources will be needed. In this study, we divided participants into four groups(using only sealed sources, only opened sources, only radiation generators, and two or more sources), but the type and capacity of sources were different according to each institution. Thus, we need to conduct a case study according to the use of radiation sources.

## CONCLUSION

It is very important for radiation workers to be aware of safety culture and management of radiation exposure, as these individuals will be the main agents dealing with the radiation source. The incidence rates of accidents in the education and research fields were low compared to that of other industries, and there was a tendency to underestimate the exposure due to the indifference toward safety management and low-dose

exposure environments. A failure to understand the grave implications of radiation exposure would be very negative in terms of prevention of safety accidents. As a result, efforts must be made to optimize the radiation safety culture and use of radiation among radiation workers.

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# The Person-in-the-Rain Projective Drawing as a Measure of Coping Strategies in Korean College Students

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## ABSTRACT

The paper went to proceed with the goal of investigating whether PITR drawing test is worth as an auxiliary measurement tool for counseling college students under stress situations. Participants were a convenience sample of 162 students. The data were collected by the Person in the Rain drawing and questionnaire of the coping strategies. Two raters used revised PITR rating scales to score the drawings for stress and protection indicators. This paper seeks for applicability of PITR drawing test as diagnostic tool for stress coping behavior of college students with the focus being on stress coping behavior. Stress coping behavior showed  $2.38 \pm 0.36$  points out of 4 points. Stress coping behavior showed  $2.38 \pm 0.36$  points out of 4 points. The average score of each subscale indicated that seeking assistance coping behavior ( $2.64 \pm 0.59$ ) was the highest. Total stress score of the subjects was  $6.19 \pm 2.05$  points, coping resources of  $4.91 \pm 3.08$  points and coping ability of  $-1.28 \pm 3.63$  points. Problem focused coping behavior showed significant difference depending on the exposure of figure's body in 'clothed figure' item R10 of resource scale ( $t = -2.752$ ,  $p < .05$ ). Problem focused coping behavior showed statistically significant difference ( $t = 3.078$ ,  $p < .05$ ). Stress calculated from drawing a person in the rain has statistically significant and weak correlation ( $r = -.167$ ,  $p = .034$ ) with problem focused coping behavior. And PITR drawing analysis indicated that calculated coping ability or problem focused coping ability have statistically significant and weak positive correlation ( $r = .195$ ,  $p = .013$ ). Coping ability of PITR drawing can be interpreted to express problem focused coping behavior which signifies 'effort of facing and shifting stress inducing individual-environmental issues into applying into stress cause.' The PITR is related to the problem focused coping and the emotion focused coping of coping strategies. This drawing test appears to be a promising instrument in measuring coping strategies.

**Keywords:** *Person in the Rain, Drawing test, Stress coping, Coping strategy, College students.*

## INTRODUCTION

College students need to cope with stress coping and adaptation as well as belonging to the period of starting social life as an autonomous adult and preparing for future occupation independent from the normal life style up to high school. Against Korean educational system backdrop, high school students in their adolescence suffer from a major stress from college entrance examination. After Entering into college, they are once again situated under complex circumstances in the anxiety for dim future including employment as well as their own challenges such as educational attainments, interpersonal relationships, and their personality issues<sup>1-3</sup>.

Korean college students, in particular, usually turn their heteronomous way of life into self-regulating

adulthood to start their career, which necessitates effective stress coping behavior and adaptation during their time to prepare for future occupations. Considering the impact of the stress which may have on their mental and physical health, the issue of coping ability of stress in their campus life may have negative effect on their health during their future adulthood and old age; therefore, stress coping behavior needs to be established to promote college students adaptations of stress from academic achievements, interpersonal relationships and employment issues<sup>1,4-6</sup>.

Concerns by Korean college students during their campus life factually become potential cause of stress brought by credit taking, time management, various interpersonal relationships, future career, job seeking and their financial issues. Those stresses have negative

influence on psychological health including depression or uneasiness as well as their physical health, which also has negative influence on school life adaptation coupled with reduced confidence and declining grades<sup>1,7-10</sup>.

Stress coping behavior is a responsive behavior taken to minimize the resulting harm against individuals under stress triggering situations, which is a way of thought and behavior to deal with relieving stress situations and releasing resulting negative emotions. Stress in itself may threaten individual peace; to top it off, those have influence on individual adaptations are stress coping behavior and individuals under same degree of stress show different coping behavior. That is, since different cognitive appraisals of stress situations lead to different coping behavior taken by each individual<sup>11</sup>, the coping behavior of stress perceptions, interpretation and their reactions, rather than the issue whether they suffer stress or not, leads to different adaptation result.

The effective stress coping behavior to enhance individual's mental health, however, rarely comes down to one simple conclusion. In contrast with the study result which states that those with emotion focused coping behavior show more signs of their mental and physical status than those with problem focused coping<sup>11</sup>, there is another study result which states that emotional focused coping behavior which has grounds for essence of stress and problem themselves is more effective<sup>8</sup>. In other words, it is difficult to simply say that taking active coping behavior such as problem solving and seeking assistance in the face of coping relief is more effective and that taking passive coping behavior such as wishful thinking or emotional focused relief is effective. Instead, there is a view that both active and passive coping behavior encourages one another in terms of stress coping efforts to relieve stress. While the relation between coping ability and disease failed to be proved, the repeated use of ineffective coping behaviors likely cause chronicle stress, which alerts individuals not to overlook the vulnerability to diseases<sup>1-3,10,12-15</sup>.

Coping behavior can be identified by judging from how individuals cope with the situations while they are confronted with severe frustrations. Person-In-The-Rain (PITR) drawing test was employed as measurement tool of employment stress and career stress recently perceived by Korean college students<sup>1,16</sup>. This is a projective test which measures environmental stress and coping ability

which added 'Rain' as the metaphor of environmental stress to the human figure drawing test. The 'Rain' in the drawing metaphorically indicates environmental stress, and individual's stress coping behavior can be valued from seeing the PITR drawings since the nature which comes from coping stress behavior in adversity symbolizes the quantity and quality of protecting the subjects from the 'Rain'.

PITR drawing test, one of psychological drawing tests, was used by various scholars after modifications from the initial development by Fay in 1923 and, with continuity, the test was used against various subjects including college students in the realm of Korean studies<sup>1,16-18</sup>.

This paper, in a way, seeks for applicability of PITR drawing test as diagnostic tool for stress coping behavior of college students with the focus being on stress coping behavior. The paper went further to proceed with the goal of investigating whether PITR drawing test is worth as an auxiliary measurement tool for counseling college students under stress situations.

## MATERIALS AND METHOD

**Research Design:** The study is a descriptive correlation research seeking to identify college students' stress coping strategies.

**Research Subjects:** Research subjects were chosen from convenient sampling from Korean nursing college students. In consideration of research ethical issues, subjects were adequately explained about the goal and point of the research conducted and that those refused to participation can withdraw during and after the test, and also with retrieved data be processed anonymously. Questionnaire survey including PITR drawing test, stress coping behavior and general characteristics was conducted on those approved subjects.

## RESEARCH TOOL

**Person in the Rain: PITR:** To measure college students' stress and coping ability, PITR-LACK-SRC tool developed by Lack<sup>19</sup> and adapted by Son<sup>20</sup> was employed. 35 items was used according to PITR-SRC scoring system adapted by Son<sup>20</sup> among which stress (16 items), stress (19 items) and coping ability (related 3 items) were calculated as score. Stress consists of 16

items including ‘There is no rain, There is rain, heavy rain, raining mode and others,’ and the total score indicates the amount of stress which means that higher score leads to higher amount of stress. Resource is calculated after adding and subtracting of 19 items including ‘whether or not having protections like umbrellas, facial expression and others’ and higher resource score signifies having more resource to relieve stress. Stress coping ability score is the resource score which deducted the stress score. If a coping ability score is positive number, it means as much resource is attained to deal with stress, and if the calculation result shows the negative number, it is interpreted to have as much amount of stress.

In this study, PITR drawing appraisals were conducted with the participation of two educated appraisers and Inter-rater reliability Kappa coefficients was found to be high with reliability of .99.

**Stress Coping Behavior:** To measure stress coping behavior, the tool for stress coping behavior developed by Lazarus & Folkman<sup>11</sup> and adapted by Jeong<sup>21</sup> was employed. This tool for stress coping behavior consists of four subscales as problem focused solving, seeking assistance, wishful thinking and emotional focused relief, and each coping behavior with 5 each items comprise total of 20 items. As each item with 4 point Likert Scale which ranges from ‘never’ of 1 point to ‘very likely’ with score of 4 point is higher, as much coping behavior is taken. The reliability of Cronbach  $\alpha$  of the tool in the study by Jeong<sup>21</sup> was .87~.93, while this study was found to be .85~.93.

**Data Collection and Analysis Method:** Researchers themselves provided PITR drawing test and distributed

self-reporting stress coping behavior questionnaire to all of subjects. Ahead of PITR drawing test, researchers gave instructions to the recipients after handing pencils with even erasers and a sheet of A4 paper that say ‘It is raining,’ ‘Please draw a person in the rain,’ and ‘Please draw the complete human but not the cartoonish or stick-like figures’. Collected data were analyzed using SPSS/PASW 21.0. The researcher estimated the frequency, percentage, mean, and standard deviation of the collected data by a descriptive statistics and frequency analysis. To grasp the relation, Pearson’s correlation was conducted.

## RESULTS AND DISCUSSION

Stress coping behavior showed  $2.38 \pm 0.36$  with the full score of 4 points. The average score of each subscale indicated that seeking assistance coping behavior was the highest with score of  $2.64 \pm 0.59$  with wishful thinking ( $2.44 \pm 0.45$  points), problem focused ( $2.24 \pm 0.45$  points), emotion focused ( $2.21 \pm 0.50$  points) in succeeding order as shown in Table 1. Preliminary Study results on college nursing students<sup>7-10,15</sup> indicated that coping behavior and emotional focused relief showed similar results with low score, while this study mainly used more problem focused coping behavior as active coping behavior unlike the conclusion from existing studies that passive stress coping behavior is more frequently used. This finding is in accordance with the research finding<sup>8,10,15,22</sup> which states that college students generally take pursuing social support coping behavior most often. As it is said that higher dependence on active coping behavior and lower dependence on passive coping behavior lead to higher adaptation of campus life<sup>8,10,15</sup>, active stress coping behavior was found to be adequately taken.

**Table 1: Mean score of PITR and coping strategies**

Variables		Total score				Items score			
		Min	Max	Mean	sd	Min	Max	Mean	sd
coping strategies	Active Coping Strategies			24.45					
	Problem Focused	6	31	11.24	2.89	1.20	3.80	2.24	0.49
	Seeking Assistance	5	20	13.21	2.97	1.00	4.00	2.64	0.59
	Passive Coping Strategies			22.23					
	Wishful Thinking	5	18	12.20	2.24	1.00	3.60	2.44	0.45
	Emotion Focused	5	17	11.03	2.49	1.00	3.40	2.21	0.50
PITR-SRC	Stress	1	16	6.19	2.05				
	Coping Resource	-4	13	4.91	3.08				
	Coping Ability	-11	7	-1.28	3.63				

Analyses result of PITR drawing showed that total stress score of the subjects was 6.19±2.05 points, coping resources of 4.91±3.08 points and Coping Ability of -1.28±3.63 points, which was the similar degree of result from the other study<sup>23</sup> on college students under employment stress.

The analysis of the difference of average subscale of resource scale and stress coping behavior indicated in the PITR drawing shows the resulted as shown in Table 2. Problem focused coping behavior showed significant difference depending on the exposure of figure's body in 'clothed figure' item R10 of resource scale (t=-2.752, p<.05). Groups

**Table 2: Average difference between stress coping resources and coping behavior in PITR drawing**

Coping Behavior Coping Resources		n	Problem Focused			Seeking Assistance			Wishful Thinking			Emotion Focused		
			M	SD	t	M	SD	t	M	SD	t	M	SD	t
R1 Protections	No	30	2.12	0.42	-1.443	2.70	0.59	.592	2.48	0.42	.479	2.16	0.39	-.595
	Yes	132	2.26	0.50		2.63	0.60		2.44	0.46		2.22	0.52	
R2 Umbrella	No	39	2.14	0.43	-1.359	2.71	0.63	.792	2.44	0.42	-.136	2.19	0.46	-.273
	Yes	123	2.27	0.51		2.62	0.58		2.45	0.46		2.21	0.51	
R3 Umbrella held by men	Not Proper	47	2.16	0.44	-1.313	2.74	0.59	1.294	2.46	0.41	.196	2.21	0.45	.068
	Proper	115	2.27	0.51		2.60	0.59		2.44	0.47		2.21	0.51	
R4 Protections	No	135	2.23	0.49	-.623	2.61	0.59	-1.739	2.44	0.45	-.468	2.19	0.46	-1.352
	Yes	27	2.29	0.52		2.82	0.61		2.48	0.44		2.33	0.64	
R5 Size of Protections	Small	54	2.20	0.45	-.585	2.71	0.56	1.048	2.52	0.45	1.564	2.22	0.47	.179
	Big	108	2.25	0.51		2.61	0.61		2.41	0.45		2.20	0.51	
R6 Protections with absolute Perfections	Not Proper	156	2.24	0.49	.354	2.64	0.59	-.243	2.45	0.45	.987	2.21	0.50	.715
	Proper	6	2.17	0.60		2.70	0.63		2.27	0.52		2.07	0.45	
R7 Raincoat	No	151	2.24	0.49	.763	2.63	0.59	-.914	2.45	0.45	.200	2.21	0.49	-.192
	Yes	11	2.13	0.51		2.80	0.67		2.42	0.51		2.24	0.59	
R8 Rain Cap	No	156	2.25	0.49	1.373	2.63	0.59	-.804	2.44	0.45	.061	2.21	0.50	.547
	Yes	6	1.97	0.61		2.83	0.67		2.43	0.56		2.10	0.52	
R9 Rain Boots, High Boots	No	140	2.23	0.50	-.461	2.63	0.60	-.801	2.43	0.45	-.826	2.19	0.47	-1.028
	Yes	22	2.28	0.48		2.74	0.56		2.52	0.43		2.34	0.65	
R10 Clotched Figure	Exposure	15	1.91	0.40	-2.752*	2.65	0.38	.113	2.49	0.35	.441	2.24	0.39	.257
	No Exposure	147	2.27	0.49		2.64	0.61		2.44	0.46		2.21	0.51	
R11 Facial Figure	veiled	35	2.36	0.62	1.401	2.67	0.43	.450	2.55	0.39	1.641	2.23	0.51	.268
	in full view	127	2.20	0.45		2.63	0.63		2.41	0.46		2.20	0.49	
R12 Facial Smile	No	76	2.18	0.51	-1.473	2.63	0.58	-.209	2.38	0.43	-1.754	2.16	0.49	-1.100
	Yes	86	2.29	0.47		2.65	0.61		2.50	0.46		2.25	0.49	
R13 Locations of Figure	away from the center	150	2.23	0.48	-.252	2.67	0.60	1.782	2.44	0.45	-.577	2.21	0.49	-.300
	Center	12	2.28	0.68		2.35	0.45		2.52	0.46		2.25	0.62	
R14 Size of Figure	below/over	99	2.22	0.47	-.649	2.59	0.61	-1.294	2.41	0.47	-1.148	2.14	0.49	-2.124*
	2inch-6inch	63	2.27	0.53		2.72	0.57		2.50	0.41		2.31	0.50	
R15 Bodily Expression	Partial Expression	19	2.18	0.50	-.568	2.85	0.54	1.655	2.46	0.52	.192	2.14	0.33	-.941
	Entire Expression	143	2.24	0.49		2.61	0.60		2.44	0.44		2.22	0.51	
R16 linear texture	various/imperfect	144	2.25	0.51	.963	2.66	0.58	.992	2.43	0.44	-1.337	2.21	0.51	-.224
	consistent	18	2.16	0.36		2.51	0.72		2.58	0.48		2.23	0.40	

Conted...

R17 Naked	Clothed	147	2.27	0.49	3.078*	2.65	0.61	.535	2.44	0.46	.061	2.21	0.50	-.257
	Partially Naked	15	1.87	0.35		2.59	0.40		2.44	0.27		2.24	0.47	
R18 Skipping Body Part	Express entirely	36	2.24	0.49	-.992	2.64	0.58	-.042	2.47	0.45	.252	2.16	0.43	-.870
	partially skipped	36	2.36	0.50		2.64	0.53		2.44	0.48		2.25	0.49	
* p<.05														

with no exposure (M=2.30±0.59 points) take more problem focused coping behavior than that with naked or partially exposed figure (M=1.91±0.40 points). In relation to this, problem focused coping behavior showed statistically significant difference (t=3.078, p<.05) depending on whether 'naked' expression was used in the R17 item of resource scales used in the real resource score calculations on subjects. Groups drawing clothed figures (M=2.27±0.49 points) were shown to take more problem solving coping behavior than that of unclothed figure (M=1.87±0.35 points) as shown in Table. Likewise, whether the naked body was expressed showed somewhat meaningful difference in taking wishful thinking, emotion focused relief and seeking assistance coping behaviors. In comparison of clothed groups with unclothed ones, active stress coping behavior of problem focused coping behavior and seeking assistance, and wishful thinking as passive stress coping behavior was employed similarly with emotion focused relief coping behavior more in use.

In the 'Size of Figure', the R14 item of resource scale, emotion focused coping behavior showed significant difference (t=-2.124, p<.05) according to the size of the figure (including apparel). The group with size of the figure of 'over 2 inch and below 6 inch' (M=2.31±0.50 points) was shown to take more emotion focused relief coping behavior than that of the figure of 'below 2 inch or over 6 inch' (M=2.14±0.49 pints). Although there was no significant difference, the group with the size of the figure of 'over 2 inch and below 6 inch' is shown to take every type of coping behavior including seeking assistance, wishful thinking, problem focused coping behavior than that with less or bigger figure size.

The analysis of the correlation among coping strategies for each stress, coping resource and coping ability with PITR drawing analysis lays out the result in Table 3. This result shows that stress calculated from drawing a person in the rain has statistically significant and weak correlation (r=-.167, p=.034) with problem

focused coping behavior. That is, the higher total amount of stress calculated from PITR drawing, the less active coping behavior of problem focused solving is to be taken.

**Table 3: Correlation of PITR and coping strategies**

Coping Strategies		PITR-SRC		
		Stress	Actual Resource	Coping Ability
Active Coping	Problem Focused	-.167*	.118	.195*
	Seeking Assistance	-.056	-.056	-.016
Passive Coping	Wishful Thinking	-.079	.029	.069
	Emotion Focused	-.038	.063	.075

And PITR drawing analysis indicated that calculated coping ability or problem focused coping ability have statistically significant and weak positive correlation (r=.195, p=.013). That is, the higher calculated coping score, the higher active coping ability of problem focused solving is to be shown.

Coping ability of PITR drawing can be interpreted to express problem focused coping behavior which signifies 'effort of facing and shifting stress inducing individual-environmental issues into applying into stress cause.'

Therefore, coping ability in the PITR drawing changes the problematic environment itself thought to arouse stress with facing the stressful situation rather than explaining seeking assistance, wishful thinking and emotion focused coping behavior, which tells us the usefulness of explaining problem focused stress coping behavior

### CONCLUSION

This study was attempted to investigate whether the PITR drawing is useful to gauge stress coping type after figuring out stress coping related items among PITR drawing nature with a focus on stress coping behavior.



PITR is a simple and cost-effective picture diagnostic test that can be used for the early detection of a subject suffering from mental suffering through the assessment of stress coping style of college students and ineffective coping method. Among the subscales of the stress coping scale, the problem - centered coping style was positively correlated with stress totaling ability and coping ability score in the PITR picture. The more stressful the coping ability was, the more active the problem - centered coping method was utilized. The coping ability shown in the PITR drawing test was considered to be useful in explaining the problem - oriented solution coping method which is an effort to cope with stress by changing the problem environment which causes stress without avoiding the stress situation.

It is difficult to find the previous study using the person painting test in the rain for college students. As described above, the PITR-related studies performed at home and abroad did not have standardized scoring standards clearly.

The analysis of stress coping resources through PITR drawings showed that the group which drew figures with no contact with rain and clothed figure were proved to take more active problem focused coping behavior. The group which drew figures of over 2 inch and below 6 inch was proved to take more passive emotion focused coping behavior. Active problem focused coping behavior among coping behavior subscales have statistically significant correlation with total stress amount, coping ability score in the PITR drawing. Less stress and bigger coping ability leads to more active problem focused coping behavior.

PITR drawing test, as a simple and economical test diagnostic test, can be employed in the early period to find mentally suffering ones from assessing coping behavior and ineffective way of coping behavior. PITR drawing shown coping ability is found to be useful way of explaining the problem focused coping behavior as the efforts to cope with the stress by changing the stress arousing environment itself not hiding away from stressful situations.

This paper found that PITR drawing test can be conducive to assessing coping behavior of college students and be used to find in the early period mentally ill subjects due to suffering from taking ineffective coping behavior.

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# Preceptor Role Self-Perceptions: New Nurses' Education in Korean Hospital Setting

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## ABSTRACT

Human resources development is a core part of human resources management and it is effective. The purpose of this study is intended to review preceptor role self-perceptions in hospital setting. The researcher selected 9 hospitals randomly chosen in Korea. After explaining the purpose of the study, 263 preceptors were surveyed using Bashoff's Prescribed Preceptor Role Scale. Preceptor role self-perceptions were examined in four classifications: role model, designer, resource person, and supervisor. The format of the study is descriptive survey research using a direct survey method. The researcher selected 263 preceptors from 9 randomly chosen hospitals as the subjects in Korea. Overall mean score on the preceptor's role that preceptors perceived by themselves was  $4.74 \pm .46$  points out of 6 points. The role of supervisor score was the highest as  $4.86 \pm .54$  points, and the role recognition was the lowest as  $4.60 \pm .51$  points. There was a statistically significant negative correlation ( $r = -.200$ ,  $p < .01$ ) within the 99% significance level between the total number of new nurses that the Preceptor has been leading during that time and the perception of role as Supervisor. The perceived preceptor role as a "supervisor" showed significantly negative correlations to their age ( $r = -.157$ ,  $p < .05$ ) and their working period ( $r = -.161$ ,  $p < .05$ ). The results of this study are expected to provide basic data necessary for establishing and developing efficient and systematic new nursing education programs that meet the needs of new nurses in the future. The results are expected to provide basic data necessary for establishing and developing efficient and systematic new nursing education programs in the future.

**Keywords:** Preceptor, Nurse, Preceptor ship, Hospital setting, Clinical education.

## INTRODUCTION

Human resource development is an essential part of human resource management to make them contribute achieving the goals of organization and individuals upon demonstrating individual's capability at maximum by training and education, and also effective tool to secure the competitiveness of the medical institutions<sup>1,2</sup>. Interest level in the quality nursing talents has been increased to enhance the quality of medical services competitively among the institutions, and they paid attention to the training for the capable nurses by systematic training program from the entry level.

Preceptor ship course is the effective training course to successfully and rapidly assist the adaptation of the new nurses to the society in the stable psychological state upon being a role model by one to one interaction between a skilled nurse and a newly assigned nurse in the clinical practice so as to teach them safe and professional nursing practices and to fill in the gap between the theories and practices<sup>2</sup>. And the Preceptorship course teaches and counsels safe and professional nursing practice by providing skilled nurse 1: 1 interaction with role nurses in clinical nursing field and narrows the gap between theory and practice. It is an effective educational method that helps people to adapt quickly and successfully in a psychologically stable state<sup>1,3</sup>.

Although the studies on preceptor ship courses had been conducted mainly on the new nurses who experienced preceptor utilizing model, students' adaptation and their enhancement of practical skills, satisfaction level and so on, few studies were performed

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in the subjects of preceptor with several publications only in a single center. Human resources development, which contributes to the achievement of organizational goals and individual goals by maximizing individual abilities through training and training in human resources management, is a core part of human resources management and it is effective. In recent years, interest in quality nursing staff has been increasing in order to improve the quality of medical services competitively in each medical institution. From the beginning of entering new employees, we have been interested in training as qualified nurses through systematic education programs.

Hence, this study aimed to investigate the practices of preceptor ship programs operated for the new nurses in the general hospitals in Korea and to secure the fundamental data on the preceptor ship program as a pilot training program for the new nurses upon investigating self-perceptions on the role of preceptor to analyze the effect of preceptor ship program.

## MATERIALS AND METHOD

**Study design:** This is a descriptive survey study to understand the practices of preceptorship program operations in the Korean general hospital setting and to investigate preceptor's roles, importance level of self-perceptions and the related variables.

**Subjects:** Among 109 general hospitals with over 500 beds in Korea, 37 hospitals were found to have preceptorship programs for the new nurses upon telephone survey, and 9 hospitals out of them were randomly selected as the subject hospitals in this study. The survey sheets were distributed to 313 nurses who agreed the study participation out of the list provided by Nursing Department of each hospital. Out of these, 265 were collected with 84.66% of collection rate. Two respondents had many missing values to be excluded in the analysis, so 263 were the final subjects.

**Measurements:** Self-perceptions of preceptor role mean the role of preceptor himself or herself to recognize it. In this study, 'Preceptor Roles Tool' amended and supplemented by Morrissey<sup>4</sup> from 'Prescribed Preceptor Roles' by Bashoff<sup>5</sup> was used after translation by the investigator with 6-point scale of 52 questionnaires. By checking the importance level of self-perceptions, it is classified with four sub-domains; role model, designer of instruction, resource person and supervisor. Cronbach's  $\alpha$

values which were the reliability of the study tools were .8751, .9032, .7789 and .8303, respectively. Higher points mean higher level of importance on the preceptor's role to be perceived by preceptor himself or herself.

**Data analysis method:** Collected data were analyzed using the IBM SPSS Statistics Version 22 program. The researcher estimated the frequency, percentage, mean, and standard deviation of the collected data by a descriptive statistics and frequency analysis. To grasp the relation, Pearson's correlation, t-test, and one-way ANOVA were conducted.

## RESULTS AND DISCUSSION

**General characteristics:** The age range of the preceptors who experienced the preceptorship programs for the new nurses was from 23 to 47 years old, with mean age of  $30.52 \pm 3.94$  years old. The duration after the graduation of the respondents was about 9 years, and 261 excluding two were females. With respect to the education level, 95 (36.1%) were university graduates followed by 90 (34.2%) with college graduates, 36 (13.7%) with in-master courses, 26 (9.9%) with RNBSN, 11 (4.2%) with master of nursing and 5 (1.9%) with master of non-nursing. In terms of preceptor's title, 95.8% of total respondents were general nurses while only 11 nurses (4.2%) were answered as charge nurses. They practiced the preceptor's role in about 3 years of clinical experiences after entering the hospitals and about 9 years of total clinical experiences. Rowland et al.<sup>6</sup> mentioned on the qualifications of preceptor with at least one year of clinical practice, Knauss<sup>7</sup> with one to three years, and Shamian<sup>8</sup> with 9 months or more of clinical experiences in the nursing department, and the results of this study did not differ from these opinions. On the other hand, Benner and Tanner<sup>9</sup> defined experts as the nurses with at least 6 years of experiences in the clinical departments. The results of this study were shown to start preceptor's role at the lower level of experts than at the level suggested by Benner and Tanner<sup>9</sup>, and to take in charge of the roles with more clinical experiences now. To the questionnaire whether they participated in the pilot training program of official preceptor, 185 nurses (70.3%) answered yes and 78 (29.7%) did no. To the questionnaire whether the pilot training program of preceptor is necessary for the new nurses, 256 nurses (97.7%) agreed and only 6 (2.3%) did not agree.

**3.2 Outcomes of preceptor role self-perceptions:**

Overall mean score on the preceptor’s role that preceptors perceived by themselves was 4.74±.46 points out of 6 points. The greatest perceived preceptor’s role was shown as ‘Supervisor’ which coincided with the preceptor’s role perceived by the preceptor in the training for master’s nursing students by Morrissey<sup>4</sup>. The other roles were followed by the order of ‘Role Model,’ ‘Resource Person’ and ‘Designer of Instruction’ as shown in Table 1. So, the role recognition was the lowest as 4.60 ± .51 points out of 6 points.

**Table 1: Mean values of preceptor role self-perceptions n = 263**

Preceptor Role Scale	Item	Min.	Max.	Mean	SD
Role Model	15	3.27	6.00	4.78	.48
Designer of Instruction	17	3.35	6.00	4.60	.51
Resource Person	4	2.50	6.00	4.65	.65
Supervisor	16	3.31	6.00	4.86	.54
Total	52	3.40	6.00	4.74	.46

The item to show the highest score on the question to ask the preceptor’s role as Role Model that the preceptors perceived by themselves was ‘to build the trust with preceptee’ with mean value of 5.44±.65 points, and the lowest score was ‘to make preceptee spend the time together’ with mean value of 4.43±.86 points. The item to show the highest score on the question to ask the preceptor’s role as Designers of Instruction that the preceptors perceived by themselves was ‘to provide preceptee with constructive feedback’ with mean value of 5.13±.69 points, and the lowest score was ‘to attend three party meeting, preceptee-supervisor of clinical training-preceptor’ with mean value of 4.21±.83 points. The item

to show the highest score on the question to ask the preceptor’s role as Resource Person that the preceptors perceived by themselves was ‘to be willing to share professional skills’ with mean value of 4.93±.76 points, and the lowest score was ‘to help preceptee find out the other resources in the proper timing’ with mean value of 4.52±.84 points. The item to show the highest score on the question to ask the preceptor’s role as Supervisor that the preceptors perceived by themselves was ‘to provide with positive feedback including complement and encouragement when preceptee performed the tasks well’ with mean value of 5.43±.68 points, and the lowest score was ‘to accept him/her as it is not to try changing preceptee’ with mean value of 4.21±1.07 points.

**3.3 Variables related to preceptor role self-perceptions:**

As the age was lower, higher the score on self-perceptions was shown on the preceptor’s role as shown in Table 2. These results reflect the review needs on the compensation to the preceptors as well as strengthening the recognition of preceptor’s role by repeated operations of pilot training program for preceptors. The perceived preceptor role as a “supervisor” showed significantly negative correlations to their age ( $r = -.157, p < .05$ ) and their working period ( $r = -.161, p < .05$ ).

And Statistically significant inverse correlation was found between ‘total number of the new nurses that preceptor has trained so far’ and ‘overall mean value of self-perceptions on preceptor’s role’ ( $p=.034$ ). However, only the role as ‘Supervisor’ among the self-perceptions on preceptor’s role showed the significant relation with total number of the new nurses that preceptor has trained so far, considering four sub-domains of self-perceptions on preceptor’s role as shown in Table 2.

**Table 2: Correlation of self-perceptions of preceptor’s role and preceptors’ characteristics N = 263**

Item	Role Model	Designer Instruction	Resource Person	Supervisor	Total
Age	-.076	-.103	-.043	-.157*	-.117
Working period	-.094	-.089	-.065	-.161*	-.126*
Total number of Preceptee	-.078	-.113	-.010	-.200**	-.133*

\*Correlation is significant at the 0.05 level. \*\*Correlation is significant at the 0.01 level.

Past trained experiences from preceptors were shown to be related with self-perceptions in four role dimensions of the preceptor with statistical difference

as shown in Table 3. This coincided with the result that the experience as preceptee in the school days affected the viewpoint on preceptor’s role in the report by

Morrissey<sup>4</sup>, and supported with the study result of Shah and Polifroni<sup>10</sup> that the experience in the school days affected the responsibility on preceptor's role.

**Table 3: Experiences to get trained by preceptor and preceptor role self-perceptions**

Scale	F	Sig
Role Model*	3.007	.019
Designer of Instruction*	3.005	.019
Resource Person*	2.933	.021
Supervisor*	3.813	.005
Total*	4.066	.003

\*Correlation is significant at the 0.05 level.

\*\*Correlation is significant at the 0.01 level.

From the above Table 4, statistically significant inverse correlation was found between total number of the new nurses that preceptor has trained so far and self-perceptions on preceptor's role as Supervisor with 99% of significance level ( $p=.001$ ). This means the lower is the score of self-perceptions as Supervisor as the number of the new nurses that preceptor trained is higher. Whether to get trained on preceptee training method and to participate in the pilot program were shown to affect the overall domains of self-perceptions on preceptor's role significantly. The group with participation experience in the training program showed significantly higher scores in all the domains of self-perceptions on preceptor's role than the group without any experience did as shown in Table 4.

**Table 4: Participation experience in the pilot program for preceptee and self-perceptions on preceptor's role**

		N	Mean	SD	Sig
Role Model*	Yes	185	4.83	.48	.017
	No	78	4.68	.46	
Designer of Instruction*	Yes	185	4.66	.48	.002
	No	78	4.45	.54	
Resource Person*	Yes	185	4.70	.63	.039
	No	78	4.52	.66	
Supervisor*	Yes	185	4.93	.52	.001
	No	78	4.69	.55	

The group with participation experience in the pilot stage by expectation of preceptor's role, goals of training courses for the new nurses, training methods and official pilot training program for preceptors demonstrated

higher score in self-perceptions on preceptor's role supporting Usatine and Irby's report<sup>11</sup> that planned preparation for the preceptor was essential.

Also, Ferguson<sup>12</sup> claimed that preceptor and preceptee should work in the same period of time, manual should assist the roles and responsibilities of preceptor, and they should hold the workshop before implementing preceptorship program and have the detailed documents of working processes. These results support the claims of Shamian<sup>8</sup> that it was essential to lessen the workload of preceptors, to compensate it properly within the organization and to acknowledge preceptor officially, and also suggest the needs for the activation of preceptor's role preparations.

And it was determined that 29.6% of preceptors had not taken part in the official preceptor preparation program and 97.9% had agreed the program was needed. According to the preceptor's suggestions, training performance, personal communication, and general nursing performance are the major factors that should be included in the preceptor preparation program. The variables affecting preceptor role self-perceptions were as follows: age, experience being trained by a preceptor in the past, total number of newly-employed nurses to instruct, and participation in the official preceptor preparation program.

## CONCLUSION

The purpose of this study was to investigate the current status of Preceptorship for new nurses in Korea, and to understand the role of Preceptor in analyzing the effect of Preceptorship. Preceptor role self-perceptions were examined in four classifications: role model, designer, resource person, and supervisor. The pilot training program of preceptor is the must to operate preceptorship program for the new nurses effectively, and the advancement of efficient pilot training program can be considered only if the professors and the hospitals should collaborate it as the educators of pilot training program. In addition, the results in the group with participation experience in the pilot stage by expectation of preceptor's role, goals of training courses for the new nurses, training methods and official pilot training program for preceptors demonstrated higher score in self-perceptions on preceptor's role suggest the needs of preceptor's role preparations. The consolidation results to be included as the first item of 'pilot training program for

preceptors' that the current preceptors want showed the order of training implementation capacity, interpersonal communication, general nursing implementation skill, leadership, training plan and evaluation capability, and establishment as the position of the professional, reflecting them to be applied in the activations of 'pilot training program for preceptors.'

Considering the result that higher score of self-perceptions on preceptor's role as the age of preceptors was lower, strengthening the recognition of preceptor's role by repeated operations of pilot training program for preceptors and compensation for preceptors should be reviewed,

As the total number of the new nurses that preceptor trained was higher, the level of self-perceptions on preceptor's role was lower. This result seems to be the same context with the results of higher self-perceptions scores on preceptor's role as the age of preceptor was lower and the graduation date of the university was more recently. It is thought the interest from the hospitals in the preceptorship programs currently operated and the preceptors are essential.

Considering that the older the preceptor is, the more recent the graduation from college is, the higher the self-recognition score of Preceptor role, the reinforcement of recognition of role of Preceptor and the compensation for Preceptor through repetitive operation of Preceptor preparation education program I think it will be necessary. The greater the number of their new nurses in charge of the preceptor, the lower the perceived preceptor roles. These results are interpreted in the same context as the results of the preceptor being younger and college graduation being more recent, showing a higher self-recognition score for Preceptor role. In other words, I think that the hospital's interest in Preceptorship and Preceptor which is currently operating is desperately needed. And for the preceptor preparation program, the selection of a preceptor is required. Furthermore, we need to enhance the content of preceptorship training regarding role expectations, goals, methods, training performance, personal communication, and general nursing performance.

Therefore, the results of this study are expected to provide with the basic data to be required for the establishment and development of effective and systematic training programs for the new nurses to meet their needs further.

Based on the results of this study, the followings are suggested.

It is necessary to study on the development of standardized tools for the evaluation of preceptorship program.

It is suggested to conduct the studies on the selection criteria for preceptors, evaluation criteria, and compensation and so on as the measure to provide empowerment for the experienced nurses to perform the preceptor's roles.

It is suggested to conduct the study on 'analysis of relationship between self-perceptions of preceptor's role and socialization of preceptee's role' by the qualitative research on preceptee to preceptor who participated in the preceptorship programs.

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**Conflict of Interest:** NA

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# Evaluation of a Reconstruction Algorithm in Clinically Low-Dose Computed Tomography: Comparison of Phantom Images at Various Contrast Media Concentrations

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## ABSTRACT

To evaluate the feasibility of using clinically low-dose computed tomography (CT) with an iterative reconstruction (IR) algorithm in CT angiography (CTA) with various contrast media (CM) concentrations. We performed a phantom study using 128-channel MDCT with 270, 300, and 350 mg iodine/ml, first at 120 kV tube voltage combined with a conventional algorithm (standard protocol), and then at clinically low-dose (80 kV), combined with conventional (filtered back-projection; FBP) and IR (ASIR-V) algorithms. The signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the tube centre and background were measured and the clinical radiation dose (CTDI<sub>VOL</sub>) determined.

In all phantom studies, the higher the CM concentration was, the higher was the CT value. At all concentrations of iodine CM, clinically low-dose radiation with an IR algorithm significantly increased the SNR and CNR of the phantom study ( $P < .001$ ). Compared to the standard protocol using a CM of 350 mg iodine/ml, the low-tube voltage with an IR algorithm using a CM of 300 mg iodine/ml significantly increased the SNR ( $43 \pm 7$  vs.  $82 \pm 22$ , respectively;  $P < .001$ ) and CNR ( $32 \pm 7$  vs.  $70 \pm 21$ , respectively;  $P < .001$ ). The radiation dose (CTDI<sub>VOL</sub>) with the low-tube voltage and IR algorithm was 32% lower than that with the low-tube voltage with FBP algorithm, and 65% lower than the standard protocol ( $P < .001$ ). Low CM concentrations improve images. Clinically low-dose CT with an IR algorithm is superior to the conventional protocol in phantom image contrast and exposure dose and is feasible for CTA.

**Keywords:** Clinically low-dose, Image contrast, Iterative reconstruction algorithm, Phantom, Contrast media.

## INTRODUCTION

In computed tomography (CT) angiography (CTA), the concentration of iodine contrast media (CM) in the blood vessel is a crucial factor for increasing image contrast<sup>1-3</sup>. The amount of intravenous iodine CM is a major factor determining the degree of vascular decay in low-tube voltage imaging<sup>4,5</sup>. The current injection protocol for CTA uses low-tube voltage imaging<sup>6</sup>, as this has been reported to increase the required image contrast and reduce the exposure dose<sup>7,8</sup>. However, a low-tube voltage reduces X-ray penetration and energy, and may increase image noise and induce beam hardening artefacts<sup>9</sup>. Recently, a noise reduction method (GE Healthcare, Milwaukee, WI, USA) was introduced that uses an adaptive iterative reconstruction (IR) or model-based approach. This advanced algorithm reduces image

noise by combining the filtered back-projection (FBP) image and the image of the raw data, repeatedly<sup>10,11</sup>. An IR algorithm can improve image quality more than an FBP algorithm, by reducing image noise<sup>12</sup>. Hence, an IR algorithm is used in CT in order to reduce the noise caused by reduced X-ray penetration<sup>13</sup>. According to a recent study, low-tube voltage with an IR algorithm can reduce image noise and radiation dose; furthermore, the use of a low concentration of CM prevents contrast-induced nephropathy (CIN), as the viscosity and injection pressure of the CM is low<sup>14</sup>. A low intravascular concentration of CM leads to a reduction in the CT value in the target area. Therefore, IR algorithms are used to increase the CT value with low-tube voltage and to reduce noise<sup>15</sup>. For iodinated contrast-enhanced examinations, it has been demonstrated that lower kV values result in higher contrast enhancement. Accordingly, the combination of

low-dose CT and progressive reconstruction technology is gaining much interest, as it can reduce exposure dose and improve image contrast, without compromising quantitative evaluation<sup>16,17</sup>.

Therefore, this study evaluated the degree of attenuation of iodine CM in phantoms, using varying concentrations of iodine CM at low-tube voltage and employing an IR algorithm.

## MATERIALS AND METHOD

**Contrast medium and phantom study:** An acrylic phantom (76-710 DSA Phantom, Fluke Biomedical, Cleveland, OH, USA) was used for radiological evaluation of blood vessels. Five 5-mm diameter tubes filled with CM were accurately positioned at each location of the phantom (the centre, and at 3, 6, 9, and 12 o'clock). The five tubes were filled with non-ionic monomeric CM with low osmotic pressure at concentrations of 270, 300, and 350 mg iodine/ml iohexol (Iobrix, Taejoon Pharma, Seoul, Korea) in a 0.9% sodium chloride solution (JW Pharma, Seoul, Korea). CM and normal saline were mixed in a 1:10 or 1:20 ratio, considering the degree of intravascular dilution of the CM injected in a patient, and preheated at 37°C. Radiological evaluation of the phantoms containing various CM concentrations was performed using varying tube voltages and reconstruction methods. In the first part of this phantom study, 120 kV tube voltage and conventional FBP algorithm (standard protocol), were used. In the second part of the study, 80 kV tube voltage and FBP algorithm were used. In the third part of the study, 80 kV tube voltage and an IR algorithm (30% ASIR, and Veo algorithm; ASIR-V) were used to obtain and reconstruct images.

**Scan protocol:** In all protocols, exposure dose modulation was achieved automatically by using state-of-the-art equipment (Smart mA, GE Healthcare) for obtaining images. We used a 200–300 mA range for 120 kV tube voltage, and a 500–600 mA range for 80 kV tube voltage. The equipment for image acquisition was a 128-channel CT (Revolution EVO; GE Healthcare), and images were obtained using a spiral scanning tube impregnated with diluted CM within a phantom. The exposure parameters were as follows: beam pitch 0.98; 0.5 s tube rotation time; and 64×0.625 mm beam collimation. Each exposure protocol was repeated three times to achieve reproducibility and accuracy. All phantom images were

analyzed at a standard slice thickness (5-mm). In the two standard reconstruction methods, an FBP algorithm was used. In the second study, we used an IR algorithm (ASIR-V, GE Healthcare) in order to eliminate noise caused by the 80 kV tube voltage. The performance at 80 kV with an FBP algorithm and 80 kV with an IR algorithm was compared using standard protocol.

**Quantitative analysis:** All analyses were performed on the Siemens Medical Workstation (MMWP; Erlangen, Germany). Mean attenuation (SI1) and noise (SD1) were analysed on all sequentially obtained images by describing a circular region of interest (ROI; 9 mm<sup>2</sup>) outlining the tubes inserted into the phantoms (the centre, and at 3, 6, 9, and 12 o'clock). Mean attenuation (SI2) and noise (SD2) were measured by setting an ROI of the same size near a tube inserted into a phantom [Figure 1]. Mean CT values of three measurements were analysed to ensure data accuracy. The signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were analysed as shown below, and were compared using average measured values from each phantom study. The average of three repeated measurements was used to obtain the mean CT value for each phantom study

$$\text{SNR} = \text{SI} / \text{SD1}$$

$$\text{CNR} = (\text{SI1} - \text{SI2}) / \text{SD2}$$

The clinical exposure dose was analysed as the CT dose index volume (CTDI<sub>vol</sub>) calculated using the phantom study protocol.



**Figure 1: Region of interest (ROI) placement in the phantom (ROI: 9 mm<sup>2</sup>)**

**Statistical analysis:** Attenuation value, noise, SNR, and CNR of each phantom study were compared with the paired samples *t*-test using the Statistical Package for the Social Sciences version 21.0 (SPSS, Inc, Chicago, IL, USA). In addition, attenuation values for all CM concentrations, according to the degree of dilution, were compared individually by means of paired samples *t*-tests. The nonparametric Wilcoxon test was used for

related intra-individual comparisons. A *P*-value < .05 was considered statistically significant for all tests.

### RESULTS AND DISCUSSION

In all phantom studies, CT values were higher at higher CM concentrations. The CT value of the low-kV study was the highest at all CM concentrations according to the position of the tube in the phantom (*P* < .001) [Table 1].

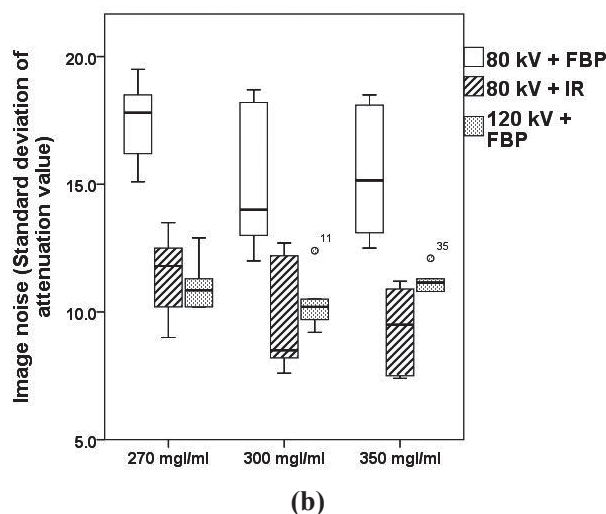
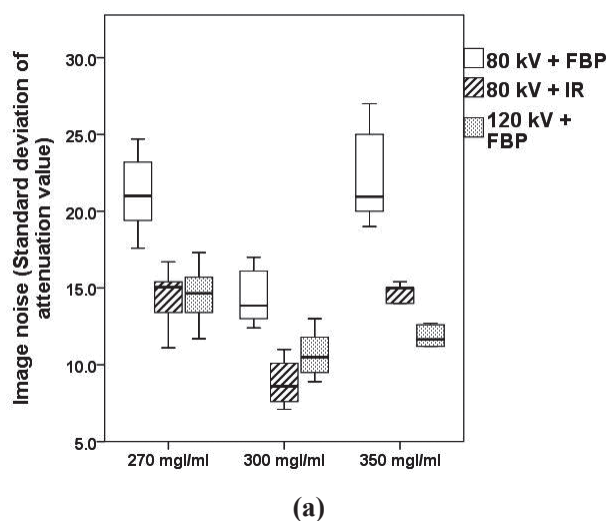
**Table 1: Mean computed tomography image value based on contrast media concentration**

Mixing ratio of contrast media and normal saline	Contrast media concentration (mg iodine/ml)	Tube voltage with reconstruction algorithm		
		80 kV with IR algorithm	80 kV with FBP algorithm	120 kV with FBP algorithm
1:10	270	629.9 ± 9.1	630.6 ± 8.2	379.6 ± 2.9
	300	856.9 ± 5.2	859.1 ± 6.0	521.9 ± 3.6
	350	943.1 ± 51.5	945.2 ± 52.7	582.2 ± 35.5
1:20	270	453.7 ± 3.7	453.5 ± 4.3	276.5 ± 2.6
	300	602.2 ± 6.1	598.8 ± 7.5	364.3 ± 3.5
	350	676.0 ± 3.9	676.9 ± 2.4	410.7 ± 3.8

Data are mean ± standard deviation

FBP = filtered back-projection; IR = Iterative reconstruction (30% ASIR and Veo)

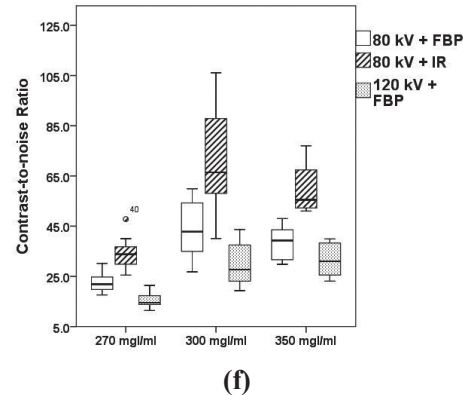
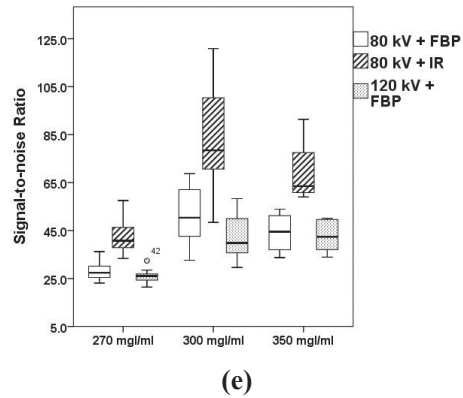
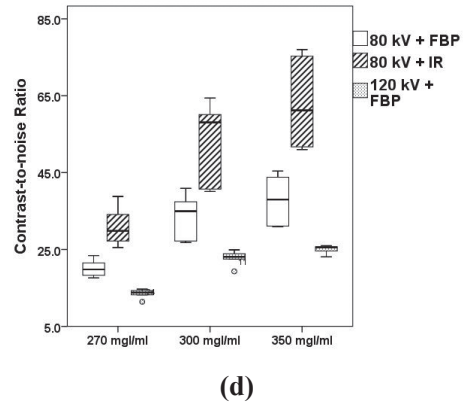
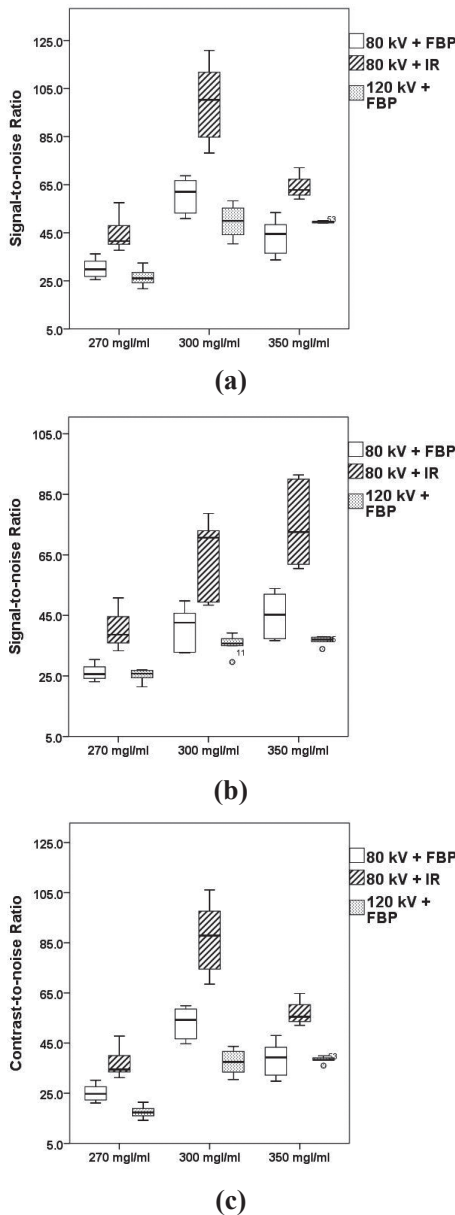
Compared to the standard study, the noise generated with the protocol using 80 kV tube voltage and an FBP algorithm was significantly increased at all CM concentrations (*P* < .001). The phantom study using a low-tube voltage with an IR algorithm yielded lower noise than 80 kV tube voltage with an FBP algorithm (*P* < .001). Compared to the standard study, the noise using 80 kV tube voltage with an IR algorithm was significantly increased at a CM of 350 mg iodine/ml, mixed at a ratio of 1:10 with normal saline ( $14.7 \pm 0.6$  vs.  $11.8 \pm 0.7$ , *P* < .001) [Figure 2].



**Figure 2: Box and whisker plots showing quantitatively measured values. The noise generated when using a mixture of contrast media and normal saline at a ratio of (a) 1:10, (b) 1:20.**

The measurements for all image evaluation were significantly higher for the low-tube voltage with an IR algorithm protocol, for all CM concentrations (*P* < .001) [Figure 3], while CM at 300 mg iodine/ml concentration yielded significantly increased SNR and CNR at 80 kV tube voltage with an IR algorithm protocol, as compared to those generated with CM at 270 mg iodine/ml (SNR:  $82 \pm 22$  and  $42 \pm 6$ , CNR:  $70 \pm 21$  and  $34$

$\pm 6$ , respectively;  $P < .001$ ). There was no significant difference when compared to a CM of 350 mg iodine/ml (SNR:  $82 \pm 22$  and  $70 \pm 12$ , CNR:  $70 \pm 21$  and  $60 \pm 9$ , respectively;  $P = .426$ ) [Figure 3]. Compared to the standard protocol and using a CM of 350 mg iodine/ml, the SNR and CNR of the protocol using a 80 kV tube voltage and an IR algorithm at a CM of 300 mg iodine/ml was significantly increased (SNR:  $82 \pm 22$  and  $43 \pm 7$ , CNR:  $70 \pm 21$  and  $32 \pm 7$ , respectively;  $P < .001$ ). Compared to the standard protocol using CM of 270 mg iodine/ml, the SNR and CNR of the protocol using a 80 kV tube voltage with an FBP algorithm at a CM of 300 mg iodine/ml was significantly increased ( $P < .001$ ) [Figure 3]. The radiation dose ( $CTDI_{vol}$ ) related to the protocol using a low-kV with an IR algorithm was 32% lower than that of the low-kV with an FBP protocol, and 65% lower than that of the standard protocol.



**Figure 3: Box and whisker plots showing quantitatively measured value. The signal-to-noise ratio (SNR) obtained when using a mixture of contrast media and normal saline at a ratio of (a) 1:10, (b) 1:20. The contrast-to-noise ratio (CNR) obtained when using a mixture of contrast media and normal saline at a ratio of (c) 1:10, (d) 1:20. The SNR (e) and CNR (f) of the mixed contrast media as a whole.**

The present study assessed the feasibility and resultant image quality of CTA involving a low-kV tube voltage and the currently most advanced IR algorithm (ASIR-V); we showed that this protocol can be used to decrease the CT CM usage and the radiation dose. The low-tube voltage with IR algorithm protocol yielded a higher SNR and CNR for all CM concentrations. Iodine CM increases the contrast of the image by artificially

increasing the differential absorption of X-rays into each target organ, allowing better visualization of tissues and blood vessels in radiological tests. Sufficient intravascular contrast enhancement is important for the diagnosis of vascular disease, especially disease involving small vessels, such as cardiac arteries<sup>1</sup>. To achieve optimal intravenous attenuation, perfect timing and fast intravenous bolus injection is important<sup>3,18</sup>. The crucial factors related to these conditions are the amount of iodine injected into the patient per second (iodine delivery rate; IDR) and the iodine CM concentration<sup>19</sup>. A previous study on intravascular contrast attenuation was performed using a high-iodine CM, with a CM concentration varying from 300 to 400 mg iodine/ml<sup>20</sup>. The use of various CM concentrations and IDRs are currently under investigation, but intergroup comparisons tend to show heterogeneous results, because of the various factors that determine the intravascular decaying factor<sup>21</sup>.

Previous studies using phantoms showed no significant difference in vessel attenuation in images obtained with a fixed amount of iodine injected per second, according to different CM concentrations<sup>22</sup>. Other studies found that, for chest and abdominal contrast-enhancement scans, lowering the tube voltage could reduce the CM usage without compromising image quality<sup>23,24</sup>. Our study measured the attenuation value and noise using various scan protocols and reconstruction algorithms along with different CM concentrations (diluted in normal saline) in order to maintain a CM concentration similar to the intravascular concentration. In our phantom study, the attenuation value was found to correlate directly with the CM concentration.

Furthermore, compared to the standard study, the noise of the protocol using low-tube voltage and an FBP algorithm was significantly increased at all CM concentrations. The disadvantage of the low-tube voltage technique is the increase in image noise, which is generally considered to be the most crucial image quality parameter in CT scans with lower contrast clinical protocols<sup>9,25</sup>. Various literature reviews have reported that low-tube voltage imaging affects the diagnostic value through image noise that occurs due to the decrease in permeating photons<sup>26-28</sup>. It has also been reported that a 14–17% reduction in the tube voltage reduced the noise by 16–29% with a considerable increase in radiation dose (32%–38%)<sup>25</sup>.

Despite these results, combining low-kV with high-mAs in CTA yielded similar or improved image noise as compared to that obtained with the standard clinical study<sup>29,30</sup>. In our phantom study, the SNR and CNR of the low-kV with FBP algorithm protocol (80 kV, 500–600 mA) were not significantly different from those of the standard study (120 kV, 300–400 mA) at all CM concentrations (270, 300, and 350 mg iodine/ml), due to the increase in noise level, despite the high attenuation value ( $P > .05$ ). However, the application of an IR algorithm in low-tube voltage CT scan significantly reduces image noise, without causing a reduction in spatial resolution<sup>31-33</sup>. The FBP algorithm is the main approach used for analytic reconstruction, and allows for fast reconstruction, but it has a marked effect on the wave of the X-ray and is sensitive to artefacts and image noise. The resultant reduction in projection data and radiation dose causes a decrease in image quality and makes it unsuitable for diagnostic use. Therefore, the FBP algorithm is limited by its radiation dose-reducing ability<sup>28</sup>. ASIR-V, recently introduced by GE Healthcare, is an IR algorithm that outperforms other reconstruction algorithms in terms of image quality improvement, by minimizing noise at low-dose levels. ASIR-V adjusts the variation of projection measurement caused by limited electronic noise and photon statistics, and at the same time considers statistical modelling of the reconstructed objects, thereby adjusting the actual variation of individual image voxels<sup>34-36</sup>.

A phantom study cannot replace a clinical study, as it cannot consider the biochemical complexity and variability of the human body. However, it does allow for repeated measurements by applying a broad-spectrum factor and quantifying the range of measurement error, making it useful for bridging between clinical studies and non-clinical studies. More specifically, phantom experiments provide a unique opportunity to scan the same subject repeatedly, while adjusting parameters, such as making changes in CM concentration and scanning protocol. Therefore, further research using phantom studies to investigate various factors that affect image quality is necessary.

In our phantom study, SNR and CNR were significantly higher with 80 kV tube voltage with an IR algorithm study than with the standard study ( $P < .001$ ). A previous study of CT urography, performed at 80 kV with an IR algorithm, revealed that CM of 300

mg iodine/ml is the most optimal CM concentration<sup>37</sup>. However, another study using CT urography showed that a clinically low-tube voltage (80 kV) combined with an IR algorithm had a higher decay factor and SNR at a CM concentration of 240 mg iodine/ml<sup>38</sup>. Low-tube voltage with an IR algorithm can thus reduce the concentration of CM, but there is no agreement about the appropriate CM concentration. However, as observed in our study, 80 kV tube voltage with IR algorithm protocol showed the highest image quality at all CM concentrations and reduced the radiation dose by 65% as compared to the standard protocol (120 kV, FBP algorithm). Image acquisition at low-tube voltage with an IR algorithm has been extensively investigated for reducing radiation exposure to different body regions<sup>39-46</sup>. It has been reported that thoracoabdominal CT using low-tube voltage with an IR algorithm resulted in an average reduction in the radiation dose by 34.9% as compared to the standard protocol, but significantly increased SNR and CNR<sup>47</sup>. The combination of low-tube voltage imaging and high concentration CM results in an overall higher image quality and lower radiation dose. Nevertheless, using a low-tube voltage with a higher CM concentration can lead to increased image noise. It is interesting to note that, in our study, the SNR and CNR of low-tube voltage with IR algorithm protocol at a CM of 300 mg iodine/ml was significantly increased as compared to those of the standard protocol at a CM of 350 mg iodine/ml (SNR:  $82 \pm 22$  vs.  $43 \pm 7$ , CNR:  $70 \pm 21$  vs.  $32 \pm 7$ ,  $P < .001$ ). Therefore, the combination of a lower CM concentration and low-tube voltage requires further research, using various CM concentrations, in order to improve image noise.

There were several limitations to our study. First, the range of tube voltage in MDCT was narrow, and thus, we could not conduct this study with a tube voltage below 80 kV. Second, as this was a phantom study, we did not consider other influencing factors, such as body mass index (BMI) and body size. However, all scans were applied with a wide range of tube current (200–600 mA) in order to adjust for BMI; nevertheless, this was not the focus of our study.

### CONCLUSION

The purpose of this study was to determine the feasibility and image quality of a CTA protocol using low-tube voltage (80 kV) and an IR algorithm. The low-

tube voltage with IR algorithm protocol yielded a higher SNR and CNR in this phantom study. Furthermore, the radiation dose (CTDI<sub>VOL</sub>) was markedly lower in the protocol using a low-tube voltage and an IR algorithm. Previous studies have suggested that use of a low-tube voltage can lead to a decrease in projected photons, which can increase image noise and reduce image quality. However, we found that SNR and CNR are highly measured by an IR algorithm, which could reduce the noise in a low-tube voltage study. Additionally, using this protocol, improved images could be obtained with a low concentration of CM. Reduction of the concentration of CM used can be beneficial to patients at risk of CIN, as a high concentration of iodine CM is considered a risk factor for CIN. We propose that CTA using 80 kV tube voltage with an IR algorithm may have clinical application, allowing a reduction in exposure dose and improving image quality.

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**Conflict of Interest:** NA

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# Effect of Kinesthetic Imagery Training and Visual Imagery Training on Balance and Foot Pressure in Adults with Functional Ankle Instability

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## ABSTRACT

Imagery training has similar effects to those of actual exercise therapy. In this study, two types of imagery training were administered to adults with functional ankle instability (FAI). Kinesthetic imagery training involves imagery around the self, while visual imagery training involves imagery around someone else. Eight-week imagery training intervention comprising four 30-minute sessions a week was administered to two randomly divided groups. The Biorescue program was used to measure foot pressure and stability limits before and after the intervention. The statistical analysis was performed using the SPSS statistical software package (version 23.0; SPSS). In the kinesthetic imagery training group, there was a significant difference on the left side before versus after foot print pressure. In the visual imagery training group, there was a significant difference on the left and right sides before versus after foot print pressure. In both groups, there was a significant difference in left back and right front before versus after foot pressure. There was no significant difference before versus after the limit of stability program. This study found that adults with FAI experience a balance effect through either approach but there was no significant difference between them.

The two imagery training approaches are economical alternatives to balance rehabilitation for FAI.

**Keywords:** Kinesthetic imagery training, Visual imagery training, Functional ankle instability, Balance, Foot pressure

## INTRODUCTION

Ankle injuries result from sudden and excessive exercise and occur frequently in daily life.<sup>1</sup> Most ankle injuries are ankle sprains, specifically lateral sprains, in which the lateral ligament is repeatedly injured.<sup>2</sup> Ankle injury leads to functional ankle instability (FAI), which elevates the re-injury rate to  $\geq 70\%$ .<sup>3</sup> FAI refers to one's feeling of the ankle giving away after an ankle injury.<sup>4</sup> FAI features reduced sensation and proprioception of ankle movement and ultimately adversely effects balance.<sup>5</sup>

Balance refers to one's ability to maintain the center of mass and continuously maintain postural alignment against a basal plane.<sup>6</sup> Balance is an essential component of all functional activities of daily living, such as sitting, standing up, and walking.<sup>7</sup> Vestibular, auditory, and proprioceptive senses are important players in balance

control,<sup>8</sup> of which proprioception is dependent on the somatosensory information from the feet touching the surface.<sup>9</sup> Pressure is inflicted on the overall foot as well as specific areas of the foot when a person engages in various daily living movements and functional activities while maintaining balance, which is called foot pressure. Thus, foot pressure can be used as an index of balance quality.<sup>10</sup>

To improve ankle stability with regard to balance problems caused by FAI, balance training, proprioception stimulation, and muscular training to strengthen the weakened muscles are crucial.<sup>11</sup> Various muscle strengthening and proprioception exercises are administered in physical therapy centers in hospitals, sports medicine clinics, and sports centers for balance recovery after an ankle injury.<sup>12</sup> However, people today have little time and space for treatment, and such therapies are highly costly, rendering them financially inefficient as well.

In this context, imagery training has been gaining traction as an alternative therapy.<sup>13</sup> Imagery training is an active training process in which working memory is reproduced within one's mind while the individual maintains a particular motion without actually engaging in the actual activity.<sup>14</sup>

Prior studies have objectively confirmed that functional imagery training activates muscles and improves exercise performance and muscle strength similarly to actual exercises<sup>15</sup> and that repeatedly imagining the process of exercise movements improves learning and acquisition.<sup>16</sup> Imagery training methods involve the use of various sensations such as vision, hearing, touch, motor, smell, and taste to allow the subject to feel the senses without external stimuli.<sup>17</sup> The most widely used types of imagery training are broadly categorized into kinesthetic imagery training and visual imagery training. Several studies are currently investigating the differences in the efficacy of these two types of imagery interventions,<sup>18</sup> but not many studies have examined the differences in the effects of the two imagery training methods on foot pressure and balance in adults with FAI. Thus, this study aimed to investigate the effects of imagery training on the foot pressure of adults with FAI and determine which of the two imagery training methods (kinesthetic and visual) is more effective at improving balance.

## MATERIALS AND METHODS

**Participants:** This study included male and female adults in their 20s with FAI. The inclusion criteria were those who have had at least one ankle sprain within the prior 3 months with a feeling of instability where the ankle seems to be giving away and those who are capable of completely supporting their body weight. People with lower limb edema, a history of ankle surgery, and a history of ankle fracture were excluded, resulting in a total of 30 participants enrolled in the study. The participants were randomly assigned to the kinesthetic imagery training group (n = 15) or the visual imagery training group (n = 15). Informed consent was obtained from each participant.

### Methods

**Procedure:** The study period was conducted over 8 weeks from March 1 to April 30, 2017, and the interventions were administered four times a week. Prior to the therapeutic

intervention, the participants' general characteristics, foot pressures, and limit of stability (LOS) were measured. The two types of interventions were administered to the two randomly and equally assigned groups. The pre- and post-test measurements were performed by one physical therapist, and the experiment was conducted by one physical therapist using an auditory recording of imagery training recorded in the same environment to maintain interventional consistency. To maximize the effects of the imagery training, the interventions were administered in an environment with minimal noise and light and the participants were instructed to maintain an upright posture.

**Imagery training protocol:** The imagery training program used in this study was structured to be suitable for use in adults with FAI, the imagery training used by Dunsky et al. was modified and adapted.<sup>19</sup> The imagery training program comprises four stages: first, the warm-up stage where the participants are relaxed (5 minutes); second, the pre-training stage involving an input of sensation into the ankles (5 minutes); third, the intervention stage in which the imagery training is performed to improve ankle balance (15 minutes); and fourth, the cool-down stage in which the participants are relaxed (5 minutes). The entire program lasts 30 minutes.

We used kinesthetic image training and visual image training as defined by the classification suggested by Mahoney and Avenier.<sup>20</sup>

**Kinesthetic image training:** The kinesthetic image training used in this study was designed to be performed around the participants themselves. The participants were instructed to imagine the proprioception of a particular body part. In this case, the participants imagined maintaining ankle balance against an unstable surface. While performing the kinesthetic imagery training, the participants imagined feeling the position of the muscles that are involved in the stability of the ankle joints and soles of the feet to maintain their balance.

**Visual image training:** Photographs, which are visual stimuli, were used for the visual imagery training. The photos show a person trying to maintain ankle balance. That is, the participants imagine someone else trying to maintain balance. The imagination of proprioception was excluded in this visual imagery training. The participants were instructed to imagine someone else trying to maintain their ankle balance against an unstable surface.

**Measurement tools:** We used a Biorescue (RM Ingenierie, Rodez, France) to measure balance and LOS. This equipment can be moved and comprises a square force plate that measures the displacement of center of pressure and a monitor that shows the displacement of center of pressure. The Biorescue measures static and dynamic balance in patients, the general population, and athletes, and the data can be used for their treatment. In this study, the foot print and LOS programs of the Biorescue (RM Ingenierie) equipment were used twice, once before and once after the imagery training.

**Foot print:** Foot pressure was measured with the participants standing upright. Using the foot platform of the Biorescue, the average pressure and percent of body weight support were measured. Measurements were taken with the participant standing on the foot platform with the legs spread and body relaxed in a comfortable posture for 10 seconds.

**Limit of stability:** The LOS of dynamic balance is measured based on the center of pressure on the foot. Starting from an upright standing position on the foot platform, the participant moves his or her body weight in eight directions as instructed on the monitor. The displacement of the center of pressure displayed on the

monitor was measured. All measurements were taken three times and the average measurement was used.

**Analysis:** Statistical analyses were performed using the SPSS 23.0 for Windows program. The participants' general characteristics were analyzed using descriptive statistics, and intragroup changes of foot pressure and LOS in relation to the intervention were compared using paired t-tests. Statistical significance was set at  $p = 0.05$ .

## RESULTS AND DISCUSSION

The changes of foot pressure and LOS in relation to kinesthetic and visual imagery training in adults with FAI are as follows.

In the kinesthetic imagery training group, there were significant changes in left back and right front foot pressure area and in left foot pressure after the intervention.

In the visual imagery training group, there were significant changes in the left back and front foot pressure area and in left and right foot pressure after the intervention. Neither group showed any significant changes in LOS after the intervention as shown in table1,2.

**Table 1: Changes of foot pressure and limit of stability after kinesthetic imagery training**

Test			KITG (n = 15)		P-value
			Pre	Post	
FP	Area(%)	Lt. front	26.12 ± 5.78	27.31 ± 6.78	.378
		Lt. back	28.79 ± 5.41	25.14 ± 5.24	.017*
		Rt. front	22.27 ± 4.36	24.86 ± 5.06	.047*
		Rt. back	22.82 ± 6.23	22.67 ± 5.96	.863
	Pressure(%)	Lt.	54.91 ± 3.87	52.45 ± 4.51	.019*
		Rt.	45.09 ± 3.87	46.19 ± 6.56	.540
		FB	48.07 ± 9.26	51.73 ± 10.25	.069
LOS	Surface area per sides (cm <sup>2</sup> )	Left	8.45 ± 2.68	8.31 ± 3.01	.848

**Table 2: Changes of foot pressure and limit of stability after visual imagery training**

Test			VG (n = 15)		P-value
			Pre	Post	
FP	Area(%)	Lt. front	26.72 ± 5.89	26.32 ± 6.93	.770
		Lt. back	29.15 ± 6.10	25.67 ± 5.30	.023*
		Rt. front	20.77 ± 3.52	24.52 ± 4.23	.002*
		Rt. back	23.36 ± 5.81	23.47 ± 6.18	.929
	Pressure(%)	Lt.	55.88 ± 4.08	51.99 ± 4.65	.002*
		Rt.	44.12 ± 4.08	48.01 ± 4.65	.002*
		FB	47.00 ± 9.07	50.46 ± 10.01	.065

Conted...

LOS	Surface area per sides (cm <sup>2</sup> )	Left	8.73 ± 2.87	8.89 ± 3.34	.830
		Right	9.36 ± 3.01	9.29 ± 2.87	.918
		Front	10.93 ± 3.64	11.48 ± 4.16	.519
		Back	7.17 ± 2.89	6.70 ± 2.46	.586
		Total	18.10 ± 5.65	18.18 ± 6.11	.953
Area ratio	Area ratio	Left/Right	0.95 ± 0.17	0.97 ± 0.15	.607
		Front/Back	1.63 ± 0.59	1.77 ± 0.60	.523

Values are expressed as mean±SD.

VITG, Visual imagery training group; FP, Foot print; LOS, Limited of stability

FAI as a result of recurrent ankle sprain induces the loss of ankle muscle strength and impairment of proprioception, which ultimately compromises ankle balance. The ankle joint supports the body weight and provides flexibility and stability during movement, and a change in foot pressure is a useful index of ankle balance<sup>21</sup>. Ankle balance is the primary function that maintains the body's balance and is a critical factor that serves as the basis of an upright posture<sup>22</sup>. For these reasons, people with FAI require balance training and rehabilitation. Imagery training has recently gained traction as an alternative therapy. There are two broad categories of imagery training: kinesthetic and visual imagery training. Although the two methods have not been differentiated in most cases, they feature an important difference, that is, the former is an imagery training involving the self while the latter involves a third person.

Therefore, this study aimed to investigate the differences in the effects of the two imagery training methods on ankle balance in adults with FAI. More specifically, this study verified the effects of imagery interventions by measuring foot pressure and LOS, a measurement that reflects the changes in center of pressure, in an ultimate attempt to provide a spatiotemporally efficient and economical imagery training method for busy modern people.

Dowling et al. stated that foot pressure can be used as an index of balance quality during various daily living and functional activities. When the area of pressure of both feet is 100%, the ideal distribution of foot pressure is 25% in the front and back of each foot. In the present study, we found significant changes in left back and right front foot pressure area after both types of interventions, suggesting that both imagery training methods improve ankle balance.

Further, the kinesthetic imagery training group showed changes in the left foot pressure, while the visual imagery

training group showed changes in the right and left foot pressure. These findings suggest that imagery training has greater effects on the left and right directions than on the anterior and posterior directions of foot pressure. This is attributable to the fact that ankle sprain, particularly lateral ankle sprain, is the most common cause of FAI, so imagery training would have had a greater effect on the left and right direction foot pressures.

Prior studies have reported that imagery training is effective at improving balance among patients with brain tumors. Vasundhra et al. stated that imagery training is effective at improving muscle strength and balance among basketball players and that it would be useful for basketball athletes when they are physically incapable of exercise. Our findings were in line with these prior findings.

In our study, there were no significant changes in LOS after the intervention in either group, but the area and proportion of LOS increased. This is speculated to be due to ankle strategies being used more frequently in postural control because the participants were standing upright during imagery training; thus, the imagery training would have led to an increase in the total area (left, right, front, back) in the test of LOS and of the proportion of left and right as well as front and back. The findings of this study verified that any type of imagery training has significant effects on adults with FAI. Frey argued that kinesthetic imagery training improves timing and coordination while visual imagery training aids in learning new tasks. Based on these findings, the choice of imagery training should be made based on the focus of the effects of balance training.

## CONCLUSION

This study showed that both kinesthetic imagery training and visual imagery training led to improvements in ankle balance, suggesting that imagery training is a potentially useful alternative therapy with spatiotemporal

and financial advantages for patients in need of ankle balance training and rehabilitation.

This study had a relatively short study period and small sample size, which hinders the generalization of our findings. Thus, future studies should investigate effective imagery training methods that may improve ankle balance of adults with FAI using a more systematic and generalizable study design.

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**Source of Funding:** Self

**Conflict of Interest:** NA

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# A Nationwide Survey on Perception and Demands on Palliative Care in the Republic of Korea

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## ABSTRACT

Palliative care is a type of care to enhance the quality of life of the patients who have life-threatening diseases. The purpose of this study was to navigate public awareness of Palliative care in Korea. 1,500 Korean adults nationwide who were selected by quota sampling strategy according to sex, age, and region participated in this survey. Data collection was performed from 19th August to 30th September in 2014. Participants of this study completed self-reported surveys via online. Data were analyzed using descriptive statistics and X<sup>2</sup> tests to find the differences in perception and demands on palliative care according to the participants' features. 60.5% of the participants replied having no knowledge about palliative care. 85.8% of the participants replied that palliative care was required. 73.9% of the participants replied that they have intentions to utilize the services of palliative care. Size of residence, level of education, monthly income, religion, health status, private insurance and family history were associated with knowledge of palliative care. Age, level of education, marital status, monthly income, religion, private insurance, present illness, and family history were associated with intentions to utilize palliative services. The people who know about palliative services tended to have intentions to utilize palliative services. It is necessary to improve public perception on palliative care by emphasizing that it could enhance the quality of life of the terminally ill patients and help the dying patients to die dignified.

**Keywords:** hospice, palliative care, end-of-life, public perception, usage intention, nationwide survey

## INTRODUCTION

Palliative care is a type of care provided to enhance the quality of life for patients who have life-threatening diseases<sup>1,2</sup>. A recent meta-analysis research revealed that interventions of palliative care were related to less symptom burden and better quality of life, but not to improved survival<sup>3</sup>. Palliative care may involve pain and symptom management, psychological and spiritual care, and social support instead of curative treatment options<sup>4</sup>. Palliative care may be applied for not only cancer patients, but also all patients with any incurable diseases<sup>5</sup>. However, in Korea, meaningless life-sustaining treatments are still common, despite benefits from the treatments are not expected anymore for terminally ill patients<sup>6</sup>. Also, the number of patients who are dying in hospitals is increasing more than those dying at home<sup>6</sup>.

Meanwhile, the Hospice, Palliative Care and Life-sustaining Treatment Decision-making Act, called 'well-

dying' law, will take effect in the Republic of Korea from February 2018<sup>7,8</sup>. According to the new law, terminally ill patients will be able to receive services of palliative care legitimately<sup>8</sup>. Prior to the enforcement of the new law, changes in public perception are required for the universal application of palliative care to terminally ill patients. Public perception and demands for palliative care should be assessed, before changing perception on it. However, there has been little research on public perception about palliative care in the Republic of Korea. Therefore, this study was conducted to explore perception and demands for palliative care nationwide and ultimately to utilize as a basic data to facilitate the development of activation plans for palliative care.

## MATERIALS AND METHOD

**Design and sample:** We used cross-sectional data to examine public perception and demands for palliative care. 1,500 people participated in this study, selected



by quota sampling strategy according to sex, age, and region among the general population in the Republic of Korea.

**Data collection:** We used the raw data of the “Activation Plans for Palliative Care (2014)”<sup>9</sup>, which was conducted by the Health Insurance Research Center of National Health Insurance Service in the Republic of Korea. A Survey was conducted to 1,500 people, who were male and female adults, aged 20 and over. Data collection was done from 19th August to 30th September in 2014. Participants completed a self-reported survey via online.

**Measurements:** The survey questionnaire was comprised of three domains, sociodemographic characteristics, perception on palliative care, and demands for them. Sociodemographic characteristics included gender, age, gender, city size of residence, level of education, marital status, monthly income, religion, health status, private insurance, current disease, and family history. Public perception on palliative care consisted of questions asking self-assessed knowledge, information source, and perception on hospices and palliative care. Demands for palliative care consisted of the questions asking necessity for palliative care and willingness to utilize those services.

**Statistical Analysis:** Data analysis was done using descriptive statistics and X<sup>2</sup> tests with the SPSS 23.0 program. All questions were described using frequencies and percentages. The level of significance was set at .05 for all tests.

## RESULTS AND DISCUSSION

### Results

#### Sociodemographic Characteristics of the Participants:

As shown in Table 1, among the 1,500 participants, 50.8% (762) were men and 49.2% (738) were women. In regards to age groups, 18.3% (275) were in their 20’s, 22.1% (331) were in their 30’s, 24.9% (374) were in their 40’s, 22.6% (339) were in their 50’s, and 12.1% (181) were in their 60’s and over. 50.6% (759) lived in small cities. 67.3% (1,009) were university graduates. 69.5% (1,042) were unmarried. 36.1% (541) earned 3 million (won) per month. 51.5% (773) had no religion. 45.8% (687) perceived their health ‘average’. 67.5% (1,012) had a private insurance. 73.3% (1,100) had present illnesses and 53.5% (803) had family histories.

**Table 1: Sociodemographic characteristics of the Participants (N = 1,500)**

Characteristics	Categories	n (%)
Gender	Male	762 (50.8)
	Female	738 (49.2)
Age (years)	20’s	275 (18.3)
	30’s	331 (22.1)
	40’s	374 (24.9)
	50’s	339 (22.6)
	≥60	181 (12.1)
City size of residence	Large city	712 (47.5)
	Small city	759 (50.6)
	Others	29 (1.9)
Level of education	≤Middle school	85(5.8)
	High school	311(20.7)
	University	1,009(67.3)
	Graduate school	95(6.3)
Marital status	Married	458(30.5)
	Unmarried	1,042(69.5)
Monthly income (1,000 won)	<3,000	541 (36.1)
	3,000~≤5,000	529 (35.3)
	≥5,000	430 (28.7)
Religion	Buddhism	236 (15.7)
	Catholic	157 (10.5)
	Protestantism	328 (21.9)
	None	773 (51.5)
	Others	6 (0.4)
Health status	Unhealthy	208 (13.9)
	Average	687 (45.8)
	Healthy	605 (40.3)
Private insurance	Yes	1,012 (67.5)
	No	488 (32.5)
Present illness	Yes	400 (26.7)
	No	1,100 (73.3)
Family history	Yes	803 (53.5)
	No	697 (46.5)

**Public perception on Palliative Care:** As shown in Table 2, 4.4% (66) of the participants replied that they knew very well about palliative care, 35.1% (527) replied that they knew a little about it, 44.3% (660) replied that they had heard about it, but didn’t know about it’, and 16.5% (274) replied that they had no idea about it. 47.8% (599) obtained the information about palliative care via television or newspaper and 20.0% (251) got it via

internet. 76.6% (1,147) of the participants perceived palliative care as helping the patients live in fullness for the rest of their lives and had comfortable deaths.

**Table 2: Public perception on Palliative Care (N = 1,500)**

Items	n (%)
<b>Self-assessed knowledge on palliative care</b>	
I know very well about it.	66(4.4)
I know a little about it.	527(35.1)
I have heard about it, but I don't know about it.	660(44.0)
I have no idea about it.	274(16.5)
<b>Information Sources</b>	
Television/newspaper	599(47.8)
Internet	251(20.0)
Family/friend	203(16.2)
Health care provider	58(4.6)
Religious organization	50(4.0)
Promotional material	40(3.2)
Book	38(3.0)
School lesson	14(0.5)
Movies/TV drama/documentary	5(0.4)
I can't remember	3(0.2)
<b>Perception on palliative care</b>	
Helping the patients live in fullness for the rest of their lives and get comfortable deaths	1,147(76.5)
Prolonging the lives of terminally ill patients	91(6.1)
Efforts to overcome human death	73(4.9)
Passive euthanasia	53(3.5)
All applicable	1(0.1)
No idea	135(9.0)

**Demands for Palliative Care:** As shown in Table 3, 85.8% of the participants replied that palliative care was necessary and 73.9% of the participants replied that they were willing to use the services of palliative care.

**Table 3: Demands for Palliative Care (N = 1,500)**

Items	n (%)
<b>Necessity for Palliative Care</b>	
Absolutely necessary	375(25.0)
Necessary	912(60.8)
Unnecessary	60(4.0)
Not necessary at all	18(1.2)
No idea	135(9.0)
<b>Intentions to use the services of palliative care</b>	
I will definitely use it	233(15.5)
I will use it	876(58.4)
I will not use it	85(5.7)
I will never use it	25(1.7)
I don't know	281(18.7)

**Differences in Perception and Demands for Palliative care by the Sociodemographic Characteristics of the Participants:** As shown in Table 4, the people who lived in large cities, who graduated from the university or graduate school, who had monthly incomes of over 5million, had any religions, who perceived their health as healthy, who had a private insurance, or who had family history tended to have had knowledge about palliative care.

The people who were in their 40's and 50's, who graduate university or graduate school, who had monthly income of over 3million, had a religion, who had private insurances, who had present illnesses, or who had family history were more likely to have willingness to use the service of palliative care. Additionally, the people who had knowledge about palliative care were more apt to have intentions to utilize those services.

**Table 4: Differences in Perception and Demands for Palliative care according to the Sociodemographic Characteristics of the Participants (N = 1,500)**

Characteristics	Categories	Knowledge			Intentions to use		
		Yes	No	X <sup>2</sup> (p)	Yes	No	X <sup>2</sup> (p)
Gender	Male	309(40.6)	453(59.4)	0.67 (.418)	554(72.7)	208(27.3)	1.22 (.270)
	Female	284(38.5)	454(61.5)		555(75.2)	183(24.8)	
Age (years)	20's	115(41.8)	160(58.2)	3.96 (.411)	171(62.2)	104(33.2)	53.7 (<.001)
	30's	116(35.0)	215(65.0)		221(66.8)	110(33.2)	
	40's	153(40.9)	221(59.1)		307(82.1)	67(17.9)	
	50's	134(39.5)	205(60.5)		279(82.3)	60(17.7)	
	≥60	75(41.4)	106(58.6)		131(72.4)	50(27.6)	

Conted...

City size of residence	Large city	304(42.7)	408(57.3)	6.51 (.039)	526(73.9)	186(26.1)	1.32 (.971)
	Small city	276(36.4)	483(63.6)		560(73.8)	199(26.2)	
	Others	13(44.8)	16(55.2)		23(79.3)	6(20.7)	
Level of education	≤Middle school	24(28.2)	61(71.8)	24.12 ( $<.001$ )	54(63.5)	31(36.5)	8.45 (.038)
	High school	99(31.8)	212(68.2)		226(72.7)	85(27.3)	
	University	417(41.3)	592(58.7)		751(74.4)	258(25.6)	
	Graduate school	53(55.8)	42(44.2)		78(82.1)	17(17.9)	
Marital status	Married	177(38.6)	281(61.4)	0.22 (.641)	294(64.2)	164(35.8)	32.46 ( $<.001$ )
	Unmarried	416(39.9)	626(80.1)		815(78.2)	227(21.8)	
Monthly income (1,000 won)	<3,000	182(33.6)	359(66.4)	19.86 ( $<.001$ )	367(67.8)	174(32.2)	20.79 ( $<.001$ )
	3,000~≤5,000	206(38.9)	323(61.1)		395(74.7)	134(25.3)	
	≥5,000	205(47.7)	225(60.5)		347(80.7)	83(19.3)	
Religion	Buddhism	101(42.8)	135(57.2)	23.89 ( $<.001$ )	187(79.2)	49(20.8)	12.85 (.012)
	Catholic	74(47.1)	83(52.9)		120(76.4)	37(23.6)	
	Protestantism	155(47.3)	173(52.7)		256(78.0)	72(22.0)	
	None	261(33.8)	512(66.2)		542(70.1)	231(29.9)	
	Others	2(33.3)	4(66.7)		4(66.7)	2(33.3)	
Health status	Unhealthy	73(35.1)	135(64.9)	6.44 (.040)	158(76.0)	50(24.0)	2.03 (.363)
	Average	258(37.6)	429(62.4)		496(72.2)	191(27.8)	
	Healthy	262(43.3)	343(56.7)		455(75.2)	150(24.8)	
Private insurance	Yes	418(41.3)	594(58.7)	4.08 (.043)	795(78.6)	217(21.4)	34.51 ( $<.001$ )
	No	175(35.9)	313(64.1)		314(64.3)	174(35.7)	
Present illness	Yes	170(42.5)	230(57.5)	2.01 (.156)	326(81.5)	74(18.5)	16.21 ( $<.001$ )
	No	423(38.5)	677(61.5)		783(71.2)	317(28.8)	
Family history	Yes	342(42.6)	461(57.4)	6.76 (.009)	630(78.5)	173(21.5)	18.34 ( $<.001$ )
	No	251(36.0)	446(64.0)		479(68.7)	218(31.3)	
Knowledge of palliative care	Yes				500(84.3)	93(15.7)	54.87 ( $<.001$ )
	No				609(67.1)	298(32.9)	

## DISCUSSION

This study showed that 40% of the participants knew about palliative care. The rate of the people having knowledge about palliative care in this study was relatively low than those in the nationwide surveys for many countries, although it varied from 23% to 76% depending on country<sup>10-13</sup>. On the other hand, in this study, 86% of them recognized services of palliative care as requisite and 74% of them had intentions to utilize those services. It was shown that while perception on the service of palliative care was not enough, demands for those services were high. Furthermore, knowledge about palliative care was related to the intention to utilize those services. Therefore, public education and policy

advertising are required to get to know about it better and promote 'well-dying'.

## CONCLUSION

This study was performed to explore perception about palliative care and demands for those services nationwide. In this study, we found that more than half of the people did not know about palliative care. However, approximately 80% of people recognized that the palliative care was required and 70% of people had intentions to utilize those services in the future. It is necessary to improve public awareness on palliative care by emphasizing that it could enhance the quality of life of terminally ill patients and help the patients to die dignified.

**Ethical Clearance:** Taken from Daegu Health College

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Evaluating Lead Thickness for Shielding during Computed Tomography Using Monte Carlo Simulation

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## ABSTRACT

The objective of this study was to determine the appropriate thickness of lead shielding for computerized tomography (CT) and mock estimate the transmission spectrum according to changes in lead thickness based on computational simulation of CT apparatus. Based on the technical manual of the CT equipment company, CT device configuration was simulated with Monte Carlo simulation code. As shielding material for CT, lead, the most used one, was selected. Lead thickness was simulated by setting it from 0 (absence of shielding material) to 1.25 mm. With increasing lead thickness, the probability of photon absorption was increased while transmittance was estimated to be reduced. In addition, photon permeability was estimated to be 50% or less with lead thickness of 0.05 mm. However, photon absorption probability was estimated to be 90% or more with lead thickness of 0.375 mm with 10%. In computational simulation transmittance experiment of computed tomography using Monte Carlo simulated code, the appropriate lead thickness of the shield was found to be 0.5 mm.

**Keywords:** Monte Carlo Simulation, Lead Thickness, Computed Tomography, Shielding Rate, Transmittance

## INTRODUCTION

X-ray was first discovered in 1895. It is now used in many fields, including the medical field. In the early days of radiation discovery, many radiation workers did not recognize the danger of radiation. They were recklessly exposed to radiation<sup>1</sup>. After realizing the risk of radiation exposure, International Commission on Radiological Protection (ICRP) was established to prevent radiation exposure. The ICRP has recommended the principle of radiation protection which is now the basis of international standards. To reduce radiation exposure, ICRP recommendation has two basic concepts: 1) all unnecessary exposures should be avoided; and 2) all doses should be kept as low as possible<sup>2</sup>. Based on these basic concepts, three principles of defense against external exposure are considered important in hospitals responsible for public health.

In modern medicine, medical imaging tests such as radiography play a very important role. Currently, radiological examinations, especially computed tomography (CT) examinations, are widely used in the

medical field to identify abnormal lesions, accurately locate lesions, differentiate lesions, determine treatment methods, and determine therapeutic effect. Since 2000, the use of multi-detector computed tomography (MDCT) has become commonplace and the number of CT examinations has increased sharply. In 2006, the total number of CT examinations in the United States was 62 million, a 3.4-fold increase from 18.3 million in 1993. In 2007, the total number of CT examinations in the UK was about 3 million, which was three times higher than that (one million) in 1996. The number of CT examinations in Korea is increased about 20% per year. It is increasing rapidly<sup>3</sup>. To reduce medical exposure, awareness and attitude toward radiation exposure of CT scanners are very important. They have great effect on minimizing patient exposure through radiation shielding<sup>4</sup>.

Efforts to shield unnecessary radiation in the medical field that use radiation are very important. Shielding radiation exposure is an act so that the dose of exposure can be reduced by artificial effort. The basic goal of radiation protection is to prevent the decisive effect

from occurring in the exposed person in the context of expected benefit from radiation exposure to reduce the probability of a probabilistic impact to acceptable level<sup>5</sup>.

There have been many studies on shielding of medical radiation. There is a direct correlation between shielding and reduced radiation exposure in patients and workers. Lead is the most used material for radiation shields. The main reason why lead is widely used as radiation shielding is due to its excellent ability to shield medical radiation and its workability<sup>6</sup>. Currently, the most commonly used shielding material in medical institutions is also lead. It has good enough processability to be made into thin sheets.

In computed tomography, it is a burden to use expensive equipment other than lead. For diagnostic purpose, a shield is made to protect parts other than the test site. Simulation techniques are widely used to examine the interaction between radiation and matter. Recently, the Monte-Carlo method has been widely used as an analytical technique for various radiation transport codes using a computer. It can be applied to radiation particle transportation to accurately predict various values such as flux, fluence, energy spectra, and energy deposition<sup>7</sup>.

The purpose of this study was to compare shielding rate and transmittance according to lead thickness

by using Monte Carlo simulation code in order to find the appropriate thickness of shielding material during computed tomography. This will provide basic data for radiation shielding in medical examination environments.

## MATERIALS AND METHOD

**Program selection:** A Monte Carlo calculation, also known as a Monte Carlo method or Monte Carlo transport, is a statistical calculation of all known micro-interactions to obtain a macroscopic measurement. The Monte Carlo application requires a lot of iterations. Therefore, it must be done using computerized code<sup>8</sup>. The Monte Carlo method is very useful for medical physics such as nuclear medicine, radiotherapy, diagnostic X-ray, and radiation protection due to the stochastic nature of radiation release, transport, and detection processes.

Monte Carlo Neutron and Photon code version X (MCNPX) is a representative program for calculating the interaction of radiation and matter. It provides results similar to actual results. Many researches have been conducted using MCNPX both domestically and externally<sup>9</sup>.

The Monte Carlo simulation program used in this study was MCNPX ver. 2.6 developed by Los Alamos National Laboratory (LAN) [Figure 1].

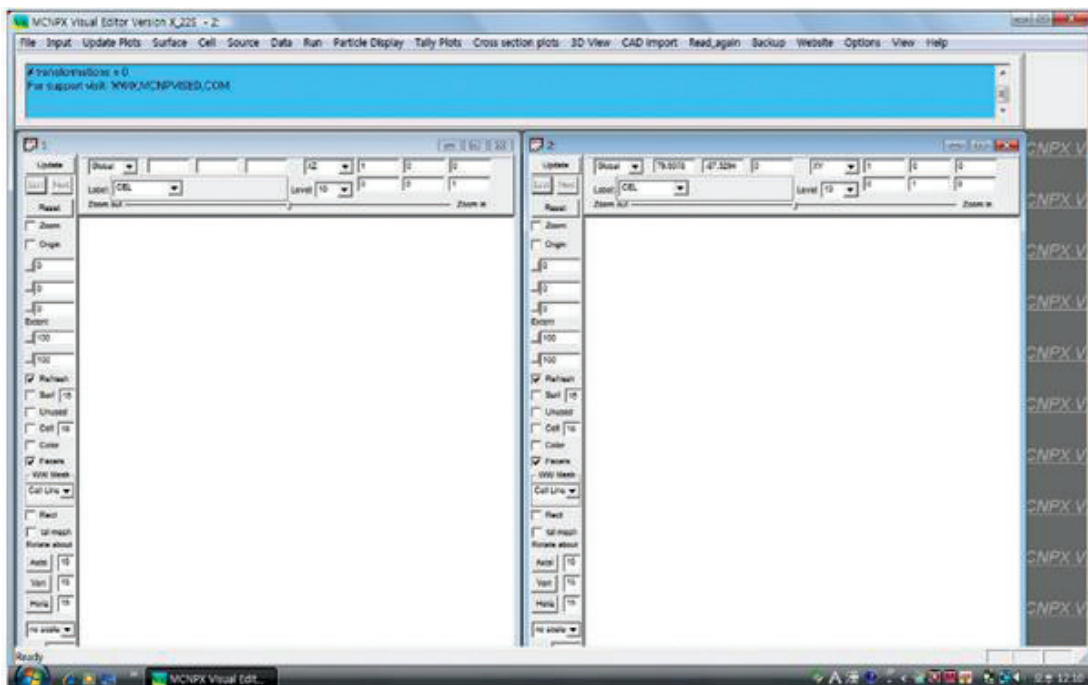


Figure 1: MCNPX Program

**Composition of simulation using MCNPX Code:** For simulation of CT device configuration, the technical manual of the equipment company was used as reference. For G company tube, the anode had a tungsten (W) and rhenium (Re) alloy. The angle between the anode and the electron beam was  $7^\circ$ . In SRS-78 program, when tungsten (W), molybdenum (Mo), and rhodium (Rh) were used as anode material, spectra corresponding to changes of the angle of the anode and the applied voltage were semi-empirically calculated to provide an X-ray spectrum at an energy interval of 0.5 keV<sup>10</sup>. Although it does not provide energy spectrum information for a tungsten-rhenium alloy used as an actual anode, as a result of comparing energy intensity obtained by calculating the energy spectrum assuming that the material of the anode is 100% of tungsten, similar CTDI results are reported<sup>11</sup>.

At the time of CT examination, X-rays generated in the X-ray tube were not directly used. Instead, X-rays attenuated through the filter were used. When CT examination was performed using X-rays that had not passed through the filter, most of these X-rays were absorbed by the human body without passing through the human body because the proportion of low energy X-rays was high. When the inspection was performed using X-rays that had not passed through the filter, the ratio of X-rays unnecessary for the medical image implementation was increased, resulting in an increased dose in unnecessary radiation exposure to the patient in order to obtain a medical image of the same image quality. The role of the filter is to attenuate low-energy X-rays not helpful in imaging and increase the proportion of X-rays that contributes to medical imaging. The

damping effect of low energy X-rays using such a filter is called beam hardening effect.

Because other medical radiology scanners including CT scans are subjected to different inspection conditions, different types of filters may be used depending on the purpose of different inspection. Aluminum and copper are mainly used as filters while aluminum is widely used as a reference material for comparing the effect of the filter when using a filter made of various materials. In MCNPX, there are two ways to implement filters on CT scans. One is to simulate a filter like an actual CT scanner. The second way is to use the energy spectrum which is calculated when a filter is input in an X-ray energy spectrum calculation program such as SRS-78<sup>12</sup>. With this method, it is possible to obtain high-quality results in a shorter time than when the direct filter is input. It is advantageous to intuitively recognize beam-cured energy spectrum necessary for calculation.

According to the report of the National Radiological Protection Board (NRPB) in the UK, the difference in radiation dose between implementation of energy spectrum change at each angle and no such implementation is 1% due to difference in beam curing effect by angle<sup>13</sup>.

In this study, as a simulation to find appropriate shielding materials and shielded lead equivalents of shielding parts in areas other than the target site for CT examination referring to Korean Industrial Standard for lead equivalent test method of X-ray protection products (KS A 4025: 1990), geometric conditions in the CT environment were implemented [Figure 2].

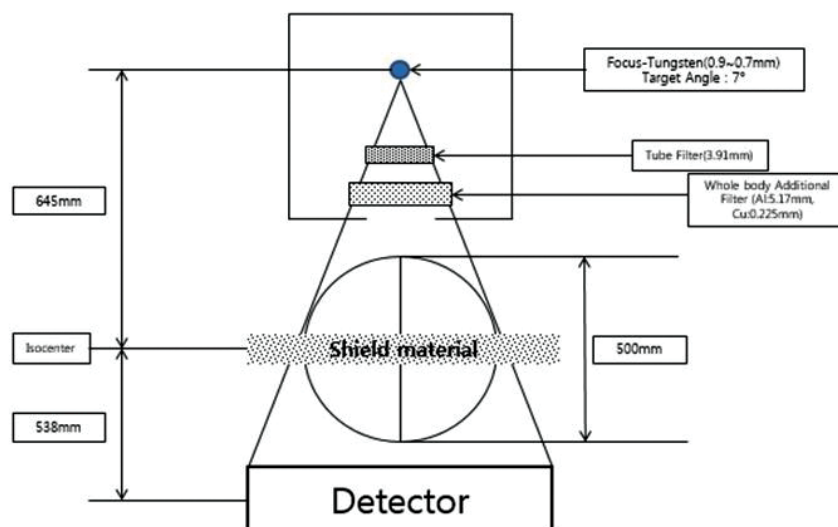
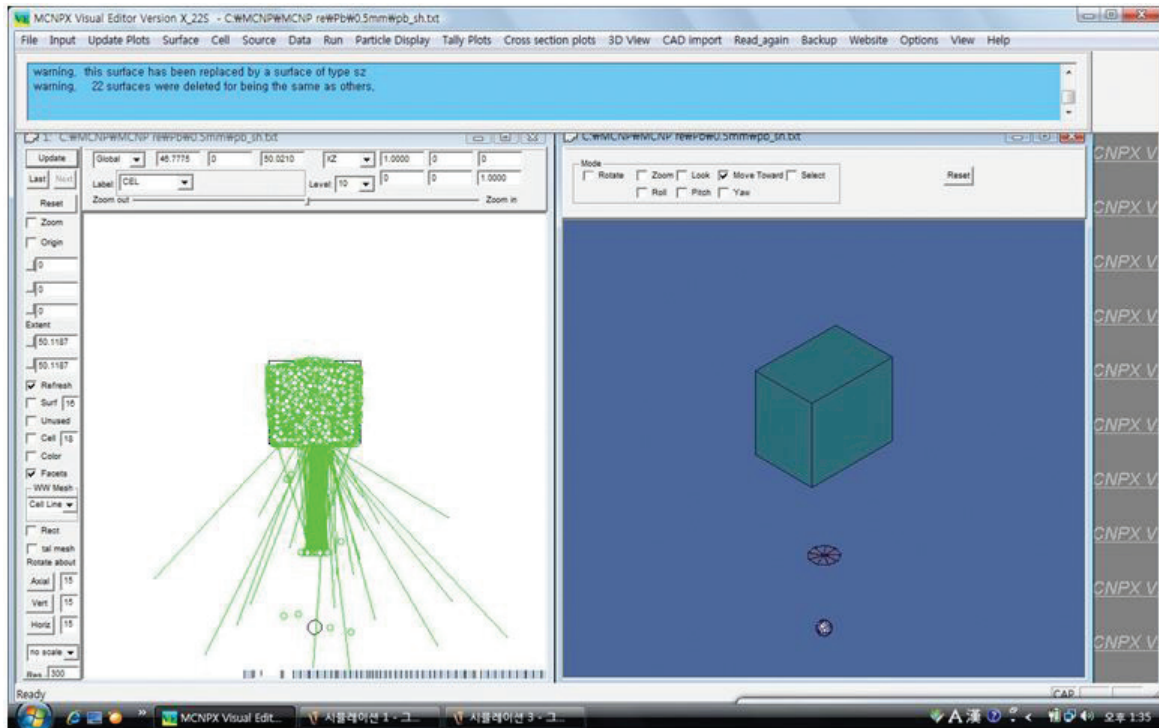


Figure 2: Geometry of simulated CT

**Computer simulation using MCNP:** In this study, computer simulations were performed in the order of Housing, Second collimator, First collimator, Upper filter (Al), Lower filter (Cu), and ion chamber in c cell card. The c surface card determines the shape of the geometry. The first number is the number of the card to be assigned. The second number determines the shape of the geometry. Finally, the value needed to determine the size of the

geometry is listed. In c surface card, computer simulation is done so that the thickness of the shielding material can be adjusted. After that, c data card is simulated. It defines the ray source, records results of tallies, and determines materials. In c data card, the transport of photons is simulated using p. To reduce statistical uncertainty of the calculation to less than 3%, the number of iterations was estimated to be  $1 \times 10^8$  [Figure 3].



**Figure 3: Graphical illustration of MCNPX simulation**

**RESULTS AND DISCUSSION**

Regarding transmittance according to lead thickness, transmittance was 100% when open, 52.87% at 0.025 mm, 49.05% at 0.05 mm, 36.02% at 0.1 mm, 31.08% at 0.125 mm, 17.01% at 0.25 mm, 9.38% at 0.375 mm, 6.08% at 0.5 mm, 3.72% at 0.625 mm, 2.44% at 0.75 mm, 1.62 mm at 0.875 mm, 1.18% at 1 mm, and 0.69% at 1.25 mm.

For shielding rate according to lead thickness, it was 0% at 0 mm, 42.13% at 0.025 mm, 50.95% at 0.05 mm, 63.98% at 0.1 mm, 68.92% at 0.125 mm, 82.99% at 0.25mm, 90.62% at 0.375mm, 93.92% at 0.5 mm, 96.28% at 0.625 mm, 97.56% at 0.75mm, 98.38mm at 0.875mm, 98.82% at 1 mm, and 99.31% at 1.25 mm. Through Monte Carlo simulation, interaction probabilities and transmission spectrum were used to estimate the absorption spectrum.

To estimate the absorption spectrum in the transmission spectrum by thickness, the difference between the transmission spectrum and spectra before transmission of general energy spectrum was calculated. After estimating the spectrum of arbitrary thickness through simulation using MCNPX, results were compared (Equation 1).

$$\Delta I = I_0 - I, I = I_0 e^{-\mu x} \dots(1)$$

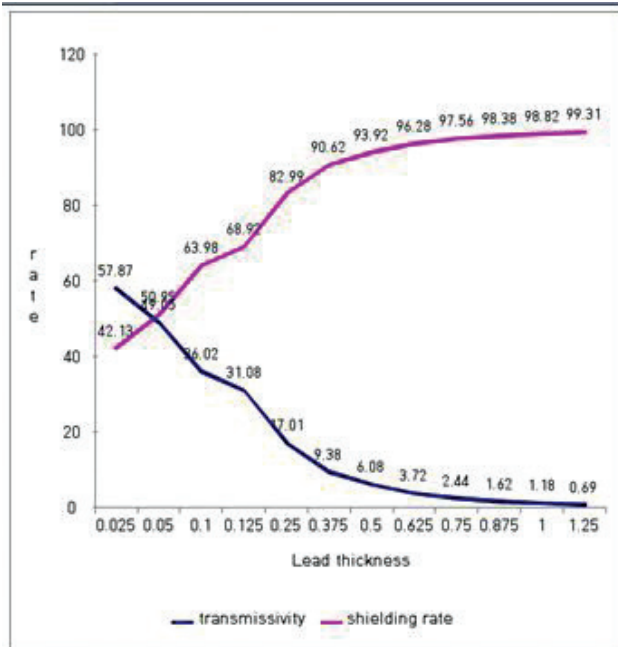
Where  $I_0$  represents X-ray intensity,  $I$  represents transmitted X-ray intensity,  $\mu$  is the linear attenuation coefficient,  $x$  is the thickness of shielding material, and  $\Delta I$  represents the intensity of absorbed X-ray.

Through simulation, the transmission spectrum according to lead thickness was simulated. Based on this, shielding rate was derived by integrating the absorption probability of energy photon by lead thickness. Simulated results are shown in [Table 1] [Figure 4].



**Table 1: Change value of lead thickness by using MCNPX**

Lead Thickness (mm)	Cell 64 value	Transmissivity (%)	Shielding rate (%)
Open	3.76250E-08	100.00	0.00
0.025	2.17772E-08	57.87	42.13
0.050	1.84563E-08	49.05	50.95
0.100	1.35555E-08	36.02	63.98
0.125	1.16966E-08	31.08	68.92
0.250	6.40040E-09	17.01	82.99
0.375	3.52981E-09	9.38	90.62
0.500	2.29005E-09	6.08	93.92
0.625	1.40106E-09	3.72	96.28
0.750	9.20349E-10	2.44	97.56
0.875	6.10544E-10	1.62	98.38
1.000	4.46366E-10	1.18	98.82
1.250	2.62820E-10	0.69	99.31



**Figure 4: Transmissivity and shielding rate by thickness change of lead**

**CONCLUSION**

Based on results of this study, the probability of photon absorption is increased with increasing lead thickness while the transmittance is estimated to be reduced. In addition, photon permeability is 50% or less when lead thickness is 0.05 mm or more. Photon absorption probability is estimated to be 90% or more

when lead thickness is 0.375 mm or more with 10%. Shielding rates were estimated to be 82.99% and 93.29% while photon transmission were 17.01% and 6.08% for lead equivalent of 0.25 and 0.5 mmPb, respectively, according to Korea Industrial Standard (KS P 6023) regulations. The probability of photon absorption was decreased when lead thickness was 0.5 mm or more while the probability of shielding was estimated to be largely unchanged.

In summary, based on computer simulation transmittance experiment using Monte Carlo simulation code, the appropriate lead thickness of the shield is 0.5 mm. This can be used as the standard to make shielding protection in the future.

**Ethical Clearance:** Taken from Konkuk University

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Evaluation of Contrast Media Concentration in Aneurysm According to Change of Condition in Digital Subtraction Angiography

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## ABSTRACT

The purpose of study is to suggest an optimization method to improve the risk perception of the contrast media and to acquire the appropriate image by comparing and evaluating contrast media concentration with objective values. Aneurysm Blood Flow Simulator was set equal to the blood flow velocity of the cerebral blood vessels. DSA was performed using catheters and automatic injector, and the ROI(mm<sup>2</sup>) in the aneurysm was set so as not to include surrounding structures. The concentrations of contrast media and dilution of normal saline were measured according to flow rate and volume by dividing into 4 kinds according to the main component and kinds of contrast media. This study examined the significant difference using statistics program SPSS ver. 23. The mean concentration of contrast media without dilution of normal saline was the highest at 774.70 at 4ml/s-8ml, and the lowest at 3ml/s-6ml at 1479.50. There was no significant difference in the concentration of contrast media depending on catheter type (p-value > 0.05), and there was a significant difference (p-value < 0.05) between contrast media injection rate and volume. There was no significant difference Visipaque 320 and Pamiray 300, Visipaque 270 and Pamiray 250 without dilution of normal saline, respectively (p-value > 0.05). It's expected that this study could be used as fundamental data to minimize the risk by providing optimized image in describing cerebral aneurysm in clinical, and choosing proper contrast media to patient.

**Keywords:** contrast media, concentration, Digital Subtraction Angiography, cerebral aneurysm, Aneurysm Blood Flow Simulator

## INTRODUCTION

The shape of the vascular structure is a long, thin structure. It is more important to diagnose abnormally shaped vessels such as aneurysms, stenosis, and occlusion rather than the diagnosis of these normal vascular structures, considering the clinical purpose to be used for actual diagnosis<sup>1,2</sup>. CT, MRI, DSA, and the like are being actively performed to diagnose or treat abnormal structures of these blood vessels. The use of contrast media is inevitable for obtaining excellent images of these tests, and the clinical application of contrast media is an important factor in developing radiologic imaging<sup>3</sup>. Especially, proper use of contrast media not only reduces the risk of drug side effects of patients<sup>4</sup>, but also can provide excellent images by controlling the concentration of images. This study aims to obtain DSA of the aneurysm using Aneurysm Blood Flow Simulator. The purpose of this study is to suggest an optimization method to improve the risk perception of the contrast media and to acquire

the appropriate image by comparing and evaluating the concentration of the contrast media in the cerebral aneurysm with objective values.

## MATERIALS AND METHOD

**Materials:** The equipment used was Axiom Artis dBA (SIEMENS, Germany) and Angiomat Illu-mena (Liebel-Farsheim, USA) [figure 1].



**Figure 1: Axiom Artis dBA**

**Method:** Aneurysm Blood Flow Simulator FlowTek™ A201E (DIALACT Corporation, USA) was set equal to the blood flow velocity of the cerebral blood vessels. Digital subtraction angiography (DSA) was performed using a catheter and contrast media automatic injector, and the ROI (mm<sup>2</sup>) in the aneurysm was set so as not to include surrounding structures. The concentrations of the contrast media and dilution of normal saline were measured according to flow rate and volume. The total amount and the injection rate of the contrast media were set to 6 ml and 8 ml, and the injection rates were set to 3 ml / s and 4 ml / s, respectively. Images were acquired according to the dilution amount of normal saline by dividing into 4 kinds according to the main component (iodicanol, inopamidol) and kinds (Visipaque, Pamiray) of water-soluble nonionic contrast media. The mean values were measured 10 times for each type of catheter and contrast media [figure 2, figure 3].

**Statistical analysis:** This study examined the significant difference using independent sample t-test of statistics program SPSS ver. 23. The significance level was smaller than 0.05 (P<0.05)



Figure 1: Axiom Artis dBA

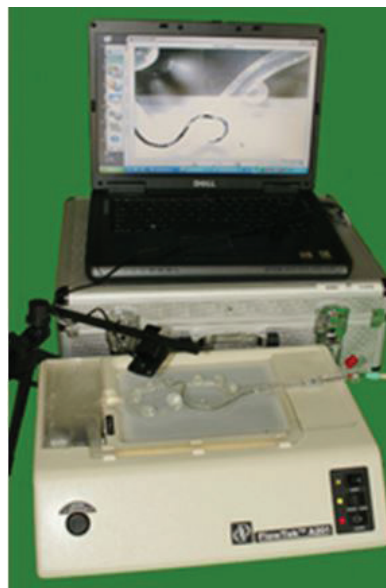


Figure 2: Flow Tek™ A201E Figure



Figure 3: Contrast Media

## RESULTS

The range of concentration values was 0 for the minimum value and 3000 for the maximum value. It was the lower concentration values of contrast media, the higher the concentration [figure 4].

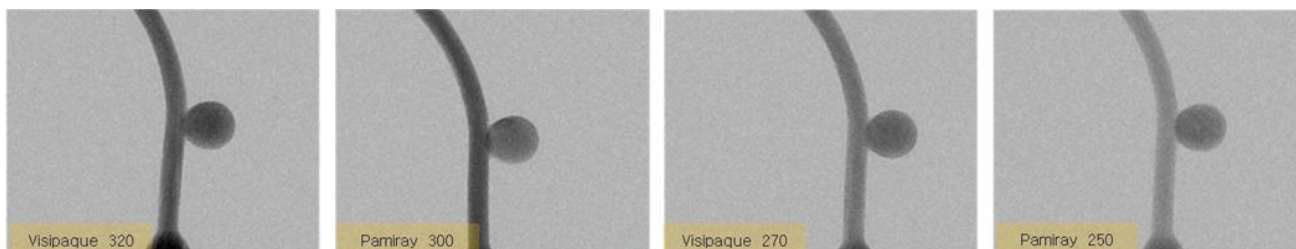


Figure 4: Concentration of Contrast Media

**Means of concentration (Head hunter catheter, 3ml/sec-6ml):** In Head hunter catheter, Injection rates: 3ml/sec, Total volume: 6ml, Visipaque 320 diluted with 40ml normal saline, Visipaque 270 undiluted with normal

saline, Pamiray 300 diluted with 40 ml normal saline, and Pamiray 250 undiluted with normal saline were similar respectively [Table 1].

**Table 1: Means of concentration (Head hunter catheter, 3ml/sec-6ml)**

CM: NS*	V 320 <sup>†1</sup>	V 270 <sup>†2</sup>	P 300 <sup>†3</sup>	P 250 <sup>†4</sup>
	mean ± SD	mean ± SD	mean ± SD	mean ± SD
150:0	912.20 ± 3.88	1473.02 ± 4.21	918.66 ± 3.89	1479.50 ± 4.07
140:10	1057.15 ± 3.76	1615.23 ± 4.31	1060.56 ± 3.68	1619.32 ± 4.05
130:20	1195.56 ± 4.01	1761.12 ± 4.01	1201.24 ± 4.17	1769.04 ± 4.14
120:30	1342.39 ± 3.69	1902.63 ± 3.97	1345.78 ± 4.33	1910.22 ± 4.22
110:40	1477.89 ± 4.18	2045.12 ± 4.13	1481.34 ± 4.05	2049.87 ± 3.96

\*CM: NS: contrast media(ml): normal saline(ml)

<sup>†1</sup>V 320: Visipaque 320, <sup>†2</sup>V 270: Visipaque 270, <sup>†3</sup>P 300: Pamiray 300, <sup>†4</sup>P 250: Pamiray 250

**Means of concentration(Head hunter catheter, 4ml/sec-8ml):** In Head hunter catheter, Injection rates: 4ml/sec, Total volume: 8ml, Visipaque 320 diluted with 30ml normal saline, Visipaque 270 undiluted with normal saline, Pamiray 300 diluted with 30 ml normal saline, and Pamiray 250 undiluted with normal saline were similar respectively[Table 2].

**Table 2: Means of concentration (Head hunter catheter, 4ml/sec-8ml)**

CM: NS*	V 320 <sup>†1</sup>	V 270 <sup>†2</sup>	P 300 <sup>†3</sup>	P 250 <sup>†4</sup>
	mean ± SD	mean ± SD	mean ± SD	mean ± SD
150:0	774.70 ± 3.88	1248.14 ± 4.01	778.42 ± 3.63	1250.22 ± 3.80
140:10	934.21 ± 3.77	1402.85 ± 4.13	939.22 ± 3.69	1406.74 ± 3.92
130:20	1089.74 ± 3.96	1560.24 ± 3.99	1093.21 ± 3.71	1561.62 ± 4.04
120:30	1244.86 ± 3.95	1711.34 ± 3.47	1245.18 ± 3.84	1713.68 ± 3.86
110:40	1401.96 ± 4.04	1866.45 ± 3.66	1404.72 ± 3.82	1868.52 ± 3.85

\*CM: NS: contrast media(ml): normal saline(ml)

<sup>†1</sup>V 320: Visipaque 320, <sup>†2</sup>V 270: Visipaque 270, <sup>†3</sup>P 300: Pamiray 300, <sup>†4</sup>P 250: Pamiray 250

**Means of concentration(Davis catheter, 3ml/sec-6ml):** In Davis catheter, Injection rates: 3ml/sec, Total volume: 6ml, Visipaque 320 diluted with 40ml normal saline, Visipaque 270 undiluted with normal saline, Pamiray 300 diluted with 40 ml normal saline, and Pamiray 250 undiluted with normal saline were similar respectively[Table 3].

**Table 3: Means of concentration (Davis catheter, 3ml/sec-6ml)**

CM: NS*	V 320 <sup>†1</sup>	V 270 <sup>†2</sup>	P 300 <sup>†3</sup>	P 250 <sup>†4</sup>
	mean ± SD	mean ± SD	mean ± SD	mean ± SD
150:0	913.66 ± 3.56	1475.04 ± 4.12	920.23 ± 3.78	1478.16 ± 3.74
140:10	1058.64 ± 3.68	1614.22 ± 3.76	1061.81 ± 3.87	1621.38 ± 3.81
130:20	1194.22 ± 3.88	1762.56 ± 3.85	1202.34 ± 3.91	1772.68 ± 3.64
120:30	1343.87 ± 4.01	1901.22 ± 3.92	1343.27 ± 3.92	1909.20 ± 3.74
110:40	1478.65 ± 4.11	2046.19 ± 3.65	1482.33 ± 3.76	2049.12 ± 3.86

\*CM: NS: contrast media(ml): normal saline(ml)

<sup>†1</sup>V 320: Visipaque 320, <sup>†2</sup>V 270: Visipaque 270, <sup>†3</sup>P 300: Pamiray 300, <sup>†4</sup>P 250: Pamiray 250

**Means of concentration(Davis catheter, 4ml/sec-8ml):** In Davis catheter, Injection rates: 4ml/sec, Total volume: 8ml, Visipaque 320 diluted with 30ml normal saline, Visipaque 270 undiluted with normal saline, Pamiray 300 diluted with 30 ml normal saline, and Pamiray 250 undiluted with normal saline were similar respectively[Table 4].

**Table 4: Means of concentration (Davis catheter, 4ml/sec-8ml)**

CM: NS*	V 320 <sup>†1</sup>	V 270 <sup>†2</sup>	P 300 <sup>†3</sup>	P 250 <sup>†4</sup>
	mean ± SD	mean ± SD	mean ± SD	mean ± SD
150:0	775.46 ± 4.10	1250.26 ± 3.89	776.58 ± 4.03	1251.16 ± 3.80
140:10	940.22 ± 3.99	1406.32 ± 4.15	942.06 ± 4.06	1408.38 ± 3.92
130:20	1092.26 ± 3.94	1562.64 ± 4.10	1093.04 ± 3.89	1564.12 ± 3.78
120:30	1247.25 ± 4.09	1710.88 ± 4.06	1248.78 ± 3.88	1713.06 ± 3.75
110:40	1406.29 ± 3.89	1865.48 ± 3.97	1407.46 ± 3.74	1867.20 ± 3.87

\*CM: NS: contrast media(ml): normal saline(ml)

<sup>†1</sup>V 320: Visipaque 320, <sup>†2</sup>V 270: Visipaque 270, <sup>†3</sup>P 300: Pamiray 300, <sup>†4</sup>P 250: Pamiray 250

**Concentration according to Catheter type:** The mean concentration of Head hunter, Davis catheter was 1402.85 ± 347.20 and 1403.94 ± 346.66, respectively. There was no significant difference in the concentration of contrast media depending on catheter type (p-value > 0.05)[Table 5].

**Table 5: Concentration according to Catheter type**

	Head hunter	Davis	P-value
	mean ± SD	mean ± SD	
CCT*	1402.85 ± 347.20	1403.94 ± 346.66	.989

by independent sample t-test

\*CCT: concentration

**Concentration according to injection rate and volume:** Concentration of contrast media according to injection rate and volume was 1481.17 ± 350.39 at 3ml/sec-6ml and 1325.62 ± 324.88 at 4ml/sec-8ml. There was a significant difference between contrast media injection rate and volume (p-value < 0.05) [Table 6].

**Table 6: Concentration according to injection rate and volume**

	3ml/sec-6ml	4ml/sec-8ml	P-value
	mean ± SD	mean ± SD	
CCT*	1481.17 ± 350.39	1325.62 ± 324.88	.043

by independent sample t-test

\*CCT: concentration

**Concentration according to kinds of contrast media:** The mean concentration of Visipaque 320, Pamiray 300 was 1144.06 ± 223.50 and 1147.31 ± 223.00, respectively. Also the mean concentration

of Visipaque 270, Pamiray 250 was 1659.05 ± 239.08 and 1663.16 ± 240.04, respectively. There was no significant difference Visipaque 320 and Pamiray 300, Visipaque 270 and Pamiray 250, respectively (p-value > 0.05) [Table 7].

**Table 7: Concentration according to kinds of contrast media**

	V 320 <sup>†1</sup>	P 300 <sup>†3</sup>	P-value
	mean ± SD	mean ± SD	
CCT*	1144.06 ± 223.50	1147.31 ± 223.00	.963

	V 300 <sup>†2</sup>	P 250 <sup>†4</sup>	P-value
	mean ± SD	mean ± SD	
CCT*	1659.05 ± 239.08	1663.16 ± 240.04	.957

by independent sample t-test

\*CCT: concentration

<sup>†1</sup>V 320: Visipaque 320, <sup>†2</sup>V 270: Visipaque 270, <sup>†3</sup>P 300: Pamiray 300, <sup>†4</sup>P 250: Pamiray 250

## DISCUSSION

In the diagnosis of aneurysms, DSA can be diagnosed as small aneurysms as angiographic equipment develops.

However, the actual size of the aneurysm to be observed is often not accurately described due to the influence of artifacts caused by peripheral structures such as bones or other normal blood vessels or by patient motion<sup>5-6</sup>.

Also if the concentration of the contrast medium is too high or low, the size or shape of the aneurysm is distorted.

Contrast media is a generally used to accurately diagnose the disease by clarifying the form, location and

functional changes of organ, blood vessel by increasing contrast or enhancing concentration difference of the tested part other than normal anatomical information provided each image.

Such use of contrast media is essential in examining cerebral aneurysm in DSA, but it also accompanies risk of side effects. The side effects include minor vomiting, rash, urtication, vomiting, or temporary dyspnea, but in rare cases, it could lead to serious hypersensitive reaction which requires proper treatment<sup>7-10</sup>. Also, it has been reported that the concentration of contrast media affects exposure dose to patient<sup>11</sup>.

Thus, it is important to properly use the media by well grasping the type and characteristics of contrast media.

According to this study results, the concentration of aneurysm was 1481.17 and 1325.62 each when it was 3ml/s-6ml and 4ml/s-8ml, which showed the higher injection rate and larger volume of media led to higher concentration, and it was statistically significant.

Also, in accordance with the types of catheter, the average concentration of Head hunter and Davis was each 1402.85 and 1403.94 which was quiet similar. This refers that the catheter's shape does not affect difference in concentration.

In accordance with the type of contrast media, the average concentration of Visipaque 320, Visipaque 270, Pamiray 300, and Pamiray 250 was each 1144.06, 1659.05, 1147.31 and 1663.16.

This confirmed that the average concentration of Visipaque 320, Pamiray 300 and Visipaque 270, Pamiray 250 was similar.

Thus, it indicates the concentration of image won't have significant difference when using the Pamiray which has comparatively lower content of iodine than Visipaque.

It has been reported that the hyposmotic pressure contrast media has less possibility of side effect than hyperosmotic contrast media<sup>12</sup>. Osmotic pressure is proportional to iodine concentration. Pamiray 300 and Pamiray 250 contains lower iodine contents and have lower osmotic pressure compared to Visipaque 320, Visipaque 270 used in this study. As it could reduce side effects of media, it could reduce the risk of side effects

of patients, and also by using the lower concentrated contrast media, it could reduce exposure dose.

However, as the concentration could vary due to rate or volume of injection, and as the rate and volume are variables that could cause rapid influence to kidney, the patient's blood flow and condition must be considered when applying.

The study is limited as it failed to compare other catheters except for Head hunter and Davis, or that it did not diversified the rate and volume of injected contrast media.

Thus, there is a need for consistent researches to draw up more objective data.

## CONCLUSION

This study used simulator to express the objective numerical value on concentration of contrast media, conducted comparative evaluation. It is expected that this study result could be used as fundamental data to minimize the risk to patients by providing optimized image in describing cerebral aneurysm in clinical, and choosing proper contrast media to patient.

**Ethical Clearance:** Taken from Hanseo University

**Source of Funding:** Self

**Conflict of Interest:** NA

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# Implementation of Emergency Monitoring System Using Biometric Data

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## ABSTRACT

Most emergencies faced by the socially vulnerable class occur in the absence of their protectors or observers. Therefore, unexpected accidents lead to taking their lives. To solve the problem, it is required to establish a system enable to notify a protector or an observer of an emergency in order to prevent and deal with an unexpected accident. An emergency monitoring system using biometric data receives biosignals from wearable devices, detects and judges an emergency with the use of emergency context awareness algorithm, and then gives a notification to a protector or an observer. The monitoring system implemented in this study is able to collect body temperature, heart rate, and work rate to recognize an emergency and to make a judgment on the basis of the received biosignals with the use of emergency context awareness algorithm. The emergency monitoring system using biometric data implemented in this study is expected to bring about better monitoring effects if it is able to monitor an emergency caused by external conditions (falling, fire, and gas leak), and to produce more effective rescue results in emergencies faced by senior people living alone, young children, or patients with serious illnesses.

In the future, it will be necessary to research an image information connection system in the way of associating with CCTV images for better judgment on the conditions before and after an emergency in order to monitor and cope with an emergency more effectively.

**Keyword:** *Emergency, Context Awareness, Wearable, IOT, Health Care*

## INTRODUCTION

Today, more nuclear families and more severe individualism have led to a rise in the population living alone. In particular, there is no emergency context awareness system to immediately recognize and cope with a case where a senior citizen living alone is exposed to a risk or an emergency. As a result, unfortunate accidents that take their precious lives frequently occur. This emerges as a serious social issue.

To address the issue, there have been various social efforts to protect the socially vulnerable class. The effects have yet to be fulfilled. It is urgent to develop a more effective emergency monitoring system. Previous studies and services mainly focused on monitoring the external situations induced risk circumstances (e.g., falling, fire, gas leak) of senior citizens living alone face or their emergency (emergent call), and the monitoring system in connection with a fire station or a local center was developed<sup>[3]</sup>, and A study on the monitoring system

through the remote access web application based on the multi sensor network and the alarm system to prepare for the dangerous situation and the home monitoring system using the wireless sensor network according to the need of the elderly nursing according to the rapid increase of the elderly population And so on<sup>[1],[9]</sup>.

However, to provide safer and more effective services, it is necessary to develop a system that can recognize in real time the risk situations or emergencies caused by not only external situations but internal factors like heart attack, sudden death, and solitary death, to give a notification to a protector or an observer in order to respond to a risk or an emergency immediately, and thereby to quickly protect senior citizens living alone, young children, and disabled persons with severe disabilities against emergencies.

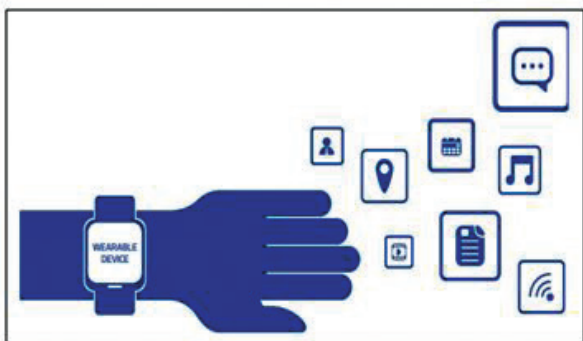
To solve the problems, this study made use of three biosignals from body temperature sensor, work rate sensor, heart beat sensor to judge an emergency

in real time and proposed and implemented the system enable to quickly notify a protector or an observer of an emergency to respond to the emergency immediately.

### RELATED WORK

**Wearable Device:** A wearable device is used to measure and collect biosignals. It is required to be equipped with natural wearing feeling, constancy for seamless communication support, user-friendly interface, safety for the human body, no sense of cultural difference, and privacy protection. A wearable device is forecasted to evolve to a patch or insertion type and furthermore to an eating type from the current wearing type [6]. The types of a wearable device used in previous studies included a ring type, an armband type, a wristband type, breast clothing type, an ankle band type. According to the analysis on their advantages and disadvantages in consideration of users' wearing convenience, data accuracy, and, users' resistance, a wristband typed wearable device had the least resistance and was suitable to obtain multiple biosignals [10].

[Fig. 1.] illustrates the image of a wearable device(<https://twochairs.joins.com/Article.aspx?aType=A&aId=166>)



**Fig. 1: Illustrates the image of a wearable device.**

**Context Awareness:** Context awareness means providing useful information by recognizing and judging the surrounding situation. Since Schilit and Theimer used the words 'context awareness' first in 1994, there has been active research on context awaren[12].

A context awareness system requires four technologies[2].

The first one is context collection technology of collecting context data from sensors.

The second one is context modeling technology of expressing and saving context information.

The third one is context reasoning technology of making meaningful and applicable information with the collected context data.

The fourth one is context distribution technology using the query or subscription based delivery method.

The studies on emergency context awareness system mostly focused on the external factors data, such as a study that uses an accelerator sensor to distinguish the motions of the human body to find an emergency [5], a study using multi modal information [4], and a study on the context awareness system on the basis of the case based reasoning using the detected living patterns [8]. More description is presented in the below [Table 1][11]

**Table 1: Comparative research of emergency context awareness**

Research	Summary
Accelerator sensor based research	A mark is attached to the wrist, the ankle, and the waist in order to measure acceleration of gravity and acceleration of velocity. The information on the motions of the human body is quantitatively measured
Multi modal information based research	Video, audio, and gravity sensor processing modules are used, and the multi-integrated module is applied for information transmission. Multi modal recognizes various signals and finds a context in communication with a user through an audio channel.
Case based context awareness system research	A user's living pattern, biosignals, and surrounding data are collected and analyzed. If a different context is found in the analysis, an abnormal signal is captured and a proper response is offered.

### The proposed system

**Emergency monitoring system:** The following [Fig. 2.] is a schematic diagram of the proposed system.

First, a wearable device receives biosignals from body temperature sensor, work rate sensor, and heart beat sensor, and sends the data to the receiver of the emergency awareness system from its transmission module.

Secondly, on the basis of the received biometric data and standard set data, the system judges whether the current situation is normal or emergent.

Thirdly, in case of emergency, the system sends a real-time text message to a protector or an observer of the situation for monitoring and reporting.

**Wearable device:** A wearable device is comprised of a sensor to measure biosignals, and transmission protocol.

As shown in [Fig. 3.], a wearable device measures biosignals (body temperature, heart beat rate, work rate) of a user (emergent patients, young children, elderly and weak persons, etc.) and sends them to the emergency context awareness system.

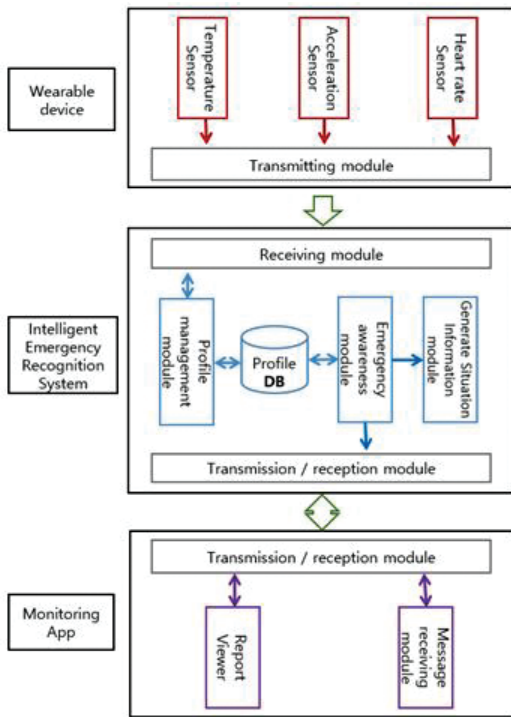


Fig. 2: Emergency monitoring system structure diagram

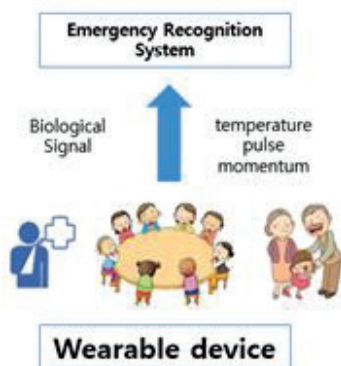


Fig. 3: Configuring wearable device capabilities

As the body temperature measurement method for measuring biosignals, infrared measurement technique that has no direct contact with the skin was applied.

The heart beat sensor was a wristband typed Front End IC and was designed with AFE4404.

This heart beat measurement method uses the method of measuring a blood volume. Basically, it has three detection mechanisms: positive displacement blood volume measurement, impedance blood volume measurement, and photo blood flow measurement. Of the measurement methods, photo blood flow measurement (PhotoPlethysmoGraphy, PPG) needs no accurate identification of position and is performed on the wrist. Therefore, this study selected the PPG.

As the work rate sensor, this study used the 9-axis work rate tracking sensor of MPU-9250 with high performance. This work rate sensor actually has 3-axis gyroscope, 3-axis accelerator sensor, and 3-axis magnetometer (compass) built in so that it has a great deal of compatibility. These days, it is widely applied to smartphones, tablet PCs, and wearable devices and features good functional extension.

The wearing judgment sensor uses a different light amount change depending on the separation distance between the sensor and the skin contact surface.

The gateway uses Android Studio 2.1.2.

[Fig. 4.] illustrates the function implementation logic of the sensor-device integrated main board.

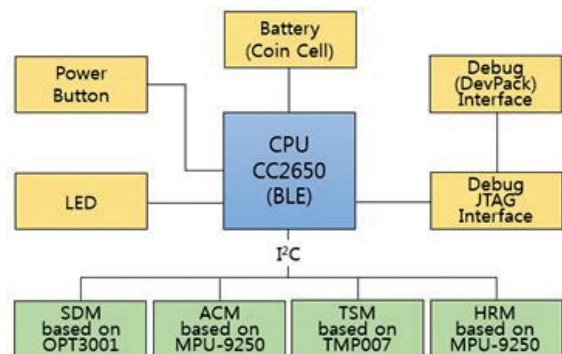
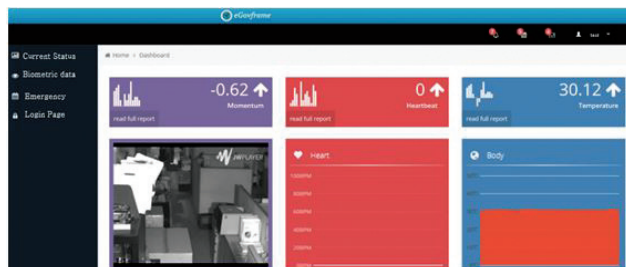


Fig. 4: Sensor Device Integration Mainboard Function Implementation Logic

**Experiments and Discussion:** In connection with the emergency context awareness algorithm<sup>[7]</sup> proposed by previous research, this study implemented the emergency monitoring system using biometric data.

The system receives and saves biometric data from the wearable device sensor to judge an emergency. In case of emergency, the implemented system immediately sends an alarm to a protector or an observer for monitoring.

[Fig. 5.] shows the monitoring screen for observer.



**Fig. 5: Manager monitoring screen**

## CONCLUSION

Today, with the increased ageing population and nuclear families, there has been absence of protectors, which leads the socially vulnerable class (young children, senior citizens living alone, patients with severe illnesses, etc.) to exposure to a risk or an emergency.

The socially vulnerable class has no enough ability to cope with a risk or an emergency. Therefore, the absence of their protector or observer can trigger a big accident.

In this study, the emergency monitoring system using biometric data was implemented to deal with an emergency properly. If the biometric data based emergency monitoring system can also monitor the emergencies caused by external circumstances (falling, fire, and gas leak), it is expected to bring about bigger effects and to produce more effective rescue results for not only senior citizens living alone but young children and patients with severe illnesses.

For better accuracy, it will be necessary to continue to research the system associated with the CCTV image and positioning based service.

**Ethical Clearance:** Taken from Kongju National University

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# The Relationship between Yacht School Participants' Sport Commitment and Exercise Adherence

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## ABSTRACT

To understand the relationship between yacht school participants' sport commitment and exercise adherence and seek measures to encourage them to consistently use yacht school. This study analyzed 268 questionnaires collected from yacht school participants by conducting frequency analysis, factorial analysis, reliability analysis, and multiple regression analysis. The study results can be summarized as below. First, as a result of examining the relationship between yacht school participants' sport commitment and tendency, cognitive commitment ( $\beta=.516$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.116$ ,  $p<.05$ ) had positive (+) effects on tendency. Second, as a result of examining the relationship between yacht school participants' sport commitment and possibility, cognitive commitment ( $\beta=.300$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.314$ ,  $p<.001$ ) had positive (+) effects on possibility. Third, as a result of examining the relationship between yacht school participants' sport commitment and enhancement, cognitive commitment ( $\beta=.372$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.250$ ,  $p<.001$ ) had positive (+) effects on enhancement. Therefore, it may be concluded that yacht school participants' sport commitment has positive effects on exercise adherence. Thus, it is necessary to induce yacht school participants to consistently participate in yacht school by motivating them have a positive perception of sport commitment. To do so, measures should be provided including establishment of facilities, development of easily accessible programs, and provision of opportunities through promotion.

**Keyword:** *Yacht School, Sport Commitment, Tendency, Possibility, Enhancement, Adherence.*

## INTRODUCTION

Since Korea introduced the two-day holiday system in July 2011, it has transitioned to a leisure-centered society. Among leisure activities, interest in sports activities involving nature-friendly and adventurous elements has increased. Based on the relationship between nature and humans in the natural environment, many people are showing much interest in eco-sports such as marine sports<sup>[8]</sup>. Especially, among various marine sports, yachting is the most typical sport to engage in for nature-friendly leisure. The geographical location of Korea provides the best environment for enjoying yachting. As Korea is surrounded by water on three sides and has a rias coast and rich waterfront resources, it has very favorable geological conditions. Korean geological conditions having easy access to the natural environments of the sea provide the opportunity to cruise in a yacht.

Nature-friendly sports focus on harmony and collaboration with nature that has been objectified

and subordinate so far. Actually nature-friendly sports emerged opposing the highly organized and commercialized modern sports. Marine leisure sports have developed continuously owing to the needs to change the recognition of natural environments and keep the harmonious relationship between people and nature. In this sense, for yacht sailing to become a successful leisure sport, it is critical to analyze the relationship between participants' sport commitment and exercise adherence. Participation in exercise has a positive relationship with sport commitment<sup>[13]</sup>, and has a direct causal effect on it<sup>[3]</sup>. Commitment experience in sports plays a significant role in inducing exercise adherence for satisfaction and joy.

Sports commitment appears due to intrinsic motivation. It is a state that participants are deeply immersed in sports activities. It is also a state that participants are willing to constantly participate in sports activities. At last, positive emotional reactions of sports participants have positive effects on sports commitment

and exercise adherence. Sports commitment is the most desirable psychological state that participators can experience when there is a balance between challenges and skills. Thus, it is necessary to raise pleasure and fun in sports situation to experience this commitment.

For sport participants to consistently engage in asport activity, they need to enjoy the sport activity through sport commitment. [2] contend that if participants cannot feel joy out of sports, they are likely to give up the sport. In addition, if participators come to feel pleasure and fun by participating in water sports, they can experience happiness and commitment, which leads to exercise adherence. The successful experience from participation in water sports leads to commitment, and this sports commitment is accompanied by satisfaction and positive emotion. [13] claimed that commitment would be a positive factor for exercise adherence, and that higher commitment would result in higher intention of participation in exercise adherence. [3] argued that higher commitment would lead to higher exercise adherence, and that it would be needed to do healthy sports activities through the optimum state of commitment for constant participation in water sports. However, if the level of commitment is high, the possibility of exercise adherence is also high. In examining previous research on yacht sailing, although there are many studies addressing participation motivation and satisfaction in main activities [8]; [7], those related to yacht school are only targeting elite athletes.

To examine yacht school participants engaging in a sports-for-all activity, it is necessary to specify the relationship between their sport commitment and exercise adherence, with the participants being general people, not elite athletes. Thus, the purpose of this study is to understand the relationship between yacht school participants' sport commitment and exercise adherence, seek measures to encourage them consistently use yacht school, and thereby provide baseline data needed to establish the foundation for people to join in the leisure age of marine sports.

**RESEARCH METHOD**

**Study subjects:** Those that participate in yacht schools in Korea were selected as a population. Three-hundred participants of yacht schools located in Gyeonggi-do, Jeollanam-do, Gangwon-do, and Busan were selected

through a convenience sampling method, and a total of 268 questionnaires excluding 32 containing negligent responses were used for the final analysis. Looking at general characteristics, as for gender, males were 173(64.6%) and females were 95(35.4%). As for age, 133(49.6%) were in 20s, 64(23.9%) in 30s, 44(16.4%) in 40s, and 27(10.1%) in 50s or older. General characteristics of the subjects are like <Table 1>.

**Table 1: General characteristics of subjects**

Variable		Frequency (n)	Percentage (%)
Gender	Male	173	64.6
	Female	95	35.4
Age	20s	133	49.6
	30s	64	23.9
	40s	44	16.4
	Over 50s	27	10.1

**Research Tools:** A questionnaire was used as a research tool in this study. It consisted of two items related to individual characteristics (background variable), eight items to sport commitment (independence variable), and 11 items to exercise adherence (dependent variable). To measure sport commitment, questionnaires reorganized by Kim and Lee (2009), Jeong (2004) considering Korean circumstances were revised and complemented. As for sport commitment, there were four items for cognitive commitment and four items for behavioral commitment. As for exercise adherence, the Korean Exercise Adherence Scale developed by Son and Kim (2012) was revised and complemented for this study. Concerning exercise adherence, there were four items for tendency, three for possibility, and four for enhancement. Likert 5-Point Scale was used for the responses.

**Exploratory Factor Analysis and Reliability Analysis:** Because of a factorial analysis of exercise adherence, Bartlett's unit matrix was 796.392 (Sig=.001), and KMO index was .811. Because of a factorial analysis of 11 questions based on this, three factors were extracted, explaining 59.299% of the total variables. Factor loading was .726-.772 for tendency, .719-.758 for possibility and .501-.771 for enhancement. Reliability value was .687 for tendency, .669 for possibility and .691 for enhancement.

**Data Processing:** SPSS 21.0 was used for the statistical processing of collected data. Frequency analysis was

conducted on participants' demographic characteristics. Factorial analysis was conducted for validity verification, and Cronbach's  $\alpha$  was used for reliability verification. Multiple regression analysis was conducted to examine the relationship between yacht school participants' sport commitment and exercise adherence. The significance level of all data was set at the level of  $p < .05$ .

**Study Results:** Results of an analysis of the correlation between exercise adherence and sport commitment

To examine the correlation between exercise adherence and sport commitment, Pearson's product-moment correlation was calculated. The results of the correlation analysis are like <Table 2>.

**Table 2: Results of an analysis of the correlation between exercise adherence and sport commitment**

Variable	A	B	C	D	E
A	-				
B	.205***	-			
C	.539***	.221***	-		
D	.364***	.375***	.424***	-	
E	.423***	.326***	.299***	.457***	-

\*\*\* $p < .001$

A: Cognitive commitment, B: Behavioral commitment, C: tendency,

D: possibility, E: enhancement

Because of the correlation between variables like <Table 2>, exercise adherence and sport commitment, sub-factors of exercise adherence had statistically significant positive correlation with all sub-factors of commitment.

**Correlation between sport commitment and tendency**

**Table 3: Correlation between sport commitment and tendency**

	B	SE	$\beta$	t
Constant	.969	.273		3.544***
Cognitive commitment	.548	.056	.516	9.846***
Behavioral commitment	.138	.062	.116	2.213*
R <sup>2</sup> =.304, F=57.806***				

\* $p < .05$ , \*\*\* $p < .001$

Like <Table 3>, sport commitment had a significant impact on tendency. The significance of the entire regression equation of this was  $F=57.806$  ( $p < .001$ ), and the explanation power was approximately 30.4% ( $R^2=.304$ ) in total variables. To examine the beta value, the relative impact of sport commitment on tendency, cognitive commitment ( $\beta=.516$ ,  $p < .001$ ) had a more positive impact than in behavioral commitment ( $\beta=.116$ ,  $p < .05$ ).

**Correlation between sport commitment and possibility**

**Table 4: Correlation between sport commitment and possibility**

	B	SE	$\beta$	t
Constant	1.348	.266		5.064***
Cognitive commitment	.294	.054	.300	5.428***
Behavioral commitment	.345	.061	.314	5.684***
R <sup>2</sup> =.227, F=38.831***				

\*\*\* $p < .001$

Like <Table 4>, sport commitment had a significant impact on possibility. The significance of the entire regression equation of this was  $F=38.831$  ( $p < .001$ ), and the explanation power was approximately 22.7% ( $R^2=.227$ ) in total variables. To examine the beta value, the relative impact of sport commitment on possibility, behavioral commitment ( $\beta=.314$ ,  $p < .001$ ) had a more positive impact than in cognitive commitment ( $\beta=.300$ ,  $p < .001$ ).

**Correlation between sport commitment and enhancement**

**Table 5: Correlation between sport commitment and enhancement**

	B	SE	$\beta$	t
Constant	1.549	.224		6.911***
Cognitive commitment	.310	.046	.372	6.789***
Behavioral commitment	.234	.051	.250	4.573***
R <sup>2</sup> =.239, F=41.604***				

\*\*\* $p < .001$



Like <Table 5>, sport commitment had a significant impact on enhancement. The significance of the entire regression equation of this was  $F=41.604$  ( $p<.001$ ), and the explanation power was approximately 23.9% ( $R^2=.239$ ) in total variables. To examine the beta value, the relative impact of sport commitment on enhancement, cognitive commitment ( $\beta =.372$ ,  $p<.001$ ) had a more positive impact than in behavioral commitment ( $\beta =.250$ ,  $p<.001$ ).

## DISCUSSION

Among various water sports, yachting is a representative sport for environment-friendly leisure, and the Korean geological conditions having easy access to the natural environments of the sea provide the best opportunity of yachting. Even in the recent economic recession, people attracted to sailing are constantly enjoying yachting, especially because it is an environment-friendly sport. In this sense, This study was conducted for the purpose of verifying the relationship between sport commitment of participants in yacht schools and sport continuance. The discussion focusing on the results of this is as follows:

This study revealed that sport commitment (cognitive commitment, behavioral commitment) of participants in yacht schools positively affects the entire sport continuance (tendency, possibility, reinforcement). This result reveals that sport commitment of participants in yacht schools is the factor of the properties to continue sports.

sports commitment including cognitive commitment and behavioral commitment would strengthen not only yacht school participators' tendency, possibility, and reinforcement but also exercise adherence. That is, yacht school participators' cognitive and behavioral commitment could strengthen their level of awareness of exercise adherence.<sup>[16]</sup> contended that the moment of experiencing commitment would lead to the best pleasure and trance, eliminating fears, pressures, and weaknesses. In other words, sports commitment enables participators to experience pleasure, satisfaction, and delight from sports behavior. Thus, it can be concluded that yacht school participators' cognitive commitment and behavioral commitment influence exercise adherence.

Advanced studies have stated that sport commitment of participants in aerobics positively affected sport continuance<sup>[12]</sup>. The studies also stated that the sport

commitment level of participants in risk sports significantly affected the speed of participants<sup>[10]</sup>.

Experience of sport commitment according to participation in sports activities is highly correlated to the intention to continue engaging in sports regardless of gender, age, and career. Especially, <sup>[9]</sup> study proved that factors of sport commitment relative to perception and behavior commitment had the effect of reinforcement, by mediating the relationship between tendency, possibility and reinforcement, the factors of sport continuance of participants in swimming, the ability to continue their sports. Also, <sup>[1]</sup> study supports this study by establishing the fact that as the level of sport commitment experience of participants in leisure sports is high, the level of intention to sport continuance is high, and positive commitment experience is a significant factor for enhancing continuance.

<sup>[5]</sup> stated that for participants in sports activities, experience of commitment in sports is more critical than anything else for continuous sport performance, Son and Kim(2012) study stated that commitment in sports positively affected sport continuance as well. Also, <sup>[11]</sup> study that established the relationship between sport commitment and sport-continuance behavior established the fact that the success of sport-continuance behavior is anticipated depending on the level of commitment experience.

As revealed above, sport commitment of participants in yacht schools and sport continuance are interrelated. Positive sport commitment in yacht schools may be the impetus for continuous sport performance by improvement of psychological satisfaction. To use yacht schools continuously, a plan to continue yacht activities is needed by providing sports tasks through systematic and proper program for the level of participants rather than yacht activities with a focus on laymen's lectures and individual practices.

## CONCLUSION

To understand the relationship between yacht school participators' sport commitment and exercise adherence and seek measures to encourage them to consistently use yacht school, this study analyzed 268 questionnaires collected from yacht school participants by conducting frequency analysis, factorial analysis, reliability analysis, and multiple regression analysis.

The study results can be summarized as below. First, as a result of examining the relationship between yacht school participants' sport commitment and tendency, cognitive commitment ( $\beta=.516$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.116$ ,  $p<.05$ ) had positive (+) effects on tendency. Second, as a result of examining the relationship between yacht school participants' sport commitment and possibility, cognitive commitment ( $\beta=.300$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.314$ ,  $p<.001$ ) had positive (+) effects on possibility. Third, as a result of examining the relationship between yacht school participants' sport commitment and enhancement, cognitive commitment ( $\beta=.372$ ,  $p<.001$ ) and behavioral commitment ( $\beta=.250$ ,  $p<.001$ ) had positive (+) effects on enhancement. Therefore, it may be concluded that yacht school participants' sport commitment has positive effects on exercise adherence. Thus, it is necessary to induce yacht school participants to consistently participate in yacht school by motivating them have a positive perception of sport commitment. To do so, measures should be provided including establishment of facilities, development of easily accessible programs, and provision of opportunities through promotion

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**Conflict of Interest:** NA

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# Study on Emergency Patients Care by Korea Coast Guard Center Workers Focused on Drowning, Fall and Isolation

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## ABSTRACT

The purpose of the study was to investigate the first response, rescue, and transport of emergency patients in Korea coast guard center workers. A self-administered questionnaire was carried out by 333 maritime police workers working at Korea coast guard center from March-June, 2016. The questionnaire consisted of 25 question items. Data were analyzed using SPSS WIN 21.0. Majority of the study subjects worked at the Korea Coast Guard Center and of them, 96.7% were composed of staff who did not possess emergency medical technician certificate, followed by 2.7% possessing level 2 emergency medical technician certificate, and 0.6% possessing level 1 emergency medical technician certificate. And in terms of the possession of lifeguard certificate, 60.1% of the staff possessed lifeguard certificate which was higher percentage than the staff who did not possess lifeguard certificate at 39.9%. In the case of lifeguard certificate, staff who possess lifeguard certificate had better knowledge about the usage instructions for Automated External Defibrillator, than the staff who did not possess the certificate, and meaningful difference was seen in accordance with the possession of the lifeguard certificate( $t=4.31$ ,  $p<.001$ ). Paramedics, also referred to as prehospital emergency personnel, must also be recognized as expert manpower and accordingly, there is a need for a system to allow them to receive corresponding reward.

**Keywords:** First response, Rescue, Transport, Emergency patients, Coast guard

## INTRODUCTION

In the case of emergency patients on land, 119 rescue services come to the site to perform emergency medical care. Police substations that belonged to each Coast Guard Stations, have been managing departure and entry of ships into the major ports and harbors in our country in addition to maintaining public order and security, and the name has now changed to Korea Coast Guard Center that belongs to Korea Coast Guard, per the reorganization of government organizations<sup>1</sup>. Korea Coast Guard Center has reduced the public order maintenance work that it has done in the past, and reinforced safety rescue oriented work. With the rise

in the quality of life for the citizens, those seeking for tourism leisure activities related to the ocean<sup>2,3</sup>, have also increased and there has also been an increase in the trend for ocean related accidents as well. And according to the report by the Ministry of Ocean and Fisheries in 2016 on the accident prevention plan for the coastal and offshore fishing vessels, the average number of accidents related to deaths and disappearance in the recent 5 years, from 2011 to 2015, was 97 and maritime shipwreck accidents from the recent three years were reported as 7,963 in 2013, 11,180 in 2014, 18,835 in 2015, showing a continuing increase in the trend<sup>1</sup>. Amid such changes, there is a demand for rescue expertise of the staff at the Korea Coast Guard Centers regarding the emergency patients and thus, there is a need for education and training on initial response on emergency patients as well as systematic patient rescue. This study looks into the reestablishment of the duty and role of Korea Coast Guard Center staff and accordingly. we seek to analyze

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the number of emergency medical technicians assigned to each Korea Coast Guard Centers, initial response of the staff, emergency medical care knowledge, and the possibility of emergency medical care including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered<sup>4,5,6</sup>. We will look into whether the staff recognize the usage instructions for automated external defibrillator, and whether the staff have experience on emergency patient rescue and transport, and seek to propose a need for experience regarding the 3 major accidents(drowning, falling, isolation) indicated by the Korea Coast Guard(KCG), propriety of current rescue workers and equipment as well as expert divers.

**STUDY METHOD**

The subjects of this study were 333 maritime police officers, working at the Sokcho·Donghae(the East Sea)·Pohang Korea Coast Guard Center sites(safety center, local police station, patrol ship), which belong to Donghae(the East Sea) Korea Coast Guard, and the convenience sampling method was used for the subjects. In this study, the completion of the survey was carried out by first providing the subjects with an explanation regarding the study objective and the points of caution in completing the survey, and after obtaining an agreement from them, the completion of the survey was done through the self-administered method.

Two maritime police rescue expert officers, 2 professors from the department of emergency rescue, 1 statistics expert reviewed and verified the contents of the survey. The period during which the survey was carried out was from March-June 2016, and the subjects of survey were Korea Coast Guard Center maritime police officers. To investigate and reveal the study objective, the measuring tool used was structured survey sheet, and this survey sheet was used as the measurement tool in order to find out how the initial action of the staff, rescue, transport, equipment and others of the Korea Coast Guard Centers are carried out. The survey is composed of 8 general characteristics questions, 4 initial action questions, 7 rescue questions, 10 transport questions, 4 equipment and other questions for a total of 33 questions, and the result of investigating the credibility of the measurement tool used in this study, Cronbach  $\alpha$  was 0.83 for initial action, 0.67 for rescue, 0.70 for transport, 0.85 for equipment and others, so all were above 0.60

indicating that it is at a credible level, and the results are as shown in <Table 1>. The collected data in this study were analyzed using the Statistical Package for the Social Science(SPSS) WIN 21.0 program. For the general characteristics of the study subjects, frequency and percentage were used to carry out frequency analysis. In order to find out about the awareness of the staff regarding the initial action and transport of the emergency patients at the Korea Coast Guard Center, t-test(verification) and One way ANOVA(one-way analysis of variance) were carried out.

**Table 1: Reliability in the study**

Classification	Items	Cronbach's $\alpha$
First response	4	0.83
Rescue	7	0.67
Transport	10	0.70
Equipment and others	4	0.85

**RESULTS**

The sample used in this study were a total of 333 maritime police officers and when classified per the place of work, making up the majority at 75.7% were from Korea Coast Guard Center, next was 20.7% from local police stations, followed by 3.6% from patrol ship(in charge of emergency medical care).

Majority of the study subjects worked at the Korea Coast Guard Center and of them, 96.7% were composed of staff who did not possess emergency medical technician certificate, followed by 2.7% possessing level 2 emergency medical technician certificate, and 0.6% possessing level 1 emergency medical technician certificate. And in terms of the possession of lifeguard certificate, 60.1% of the staff possessed lifeguard certificate which was higher percentage than the staff who did not possess lifeguard certificate at 39.9%.

In the case of gender, there were much greater distribution of male at 93.7% with female at 6.3%. In the case of educational background, 39.9% were university graduates making up the highest percentage, followed by 30.3% 2 year college graduates, 29.4% high school graduates, and 0.3% graduate school graduates. For work experience, those with more than 20 years made up the highest percentage with 30.6%, followed by 29.4% possessing between 10~20 years, 24.6%

possessing between 5 ~ 10 years, and 15.3% possessing less than 5 years. On the other hand, there were more staff with Korea Coast Guard Center work experience than those without such experience at 88.6% and 11.4% respectively. In the case of rank, 38.7% were lieutenants, next was corporal at 24.6%, sergeant at 23.4%, constable at 11.4%, higher than inspector at 1.8%. The general characteristics of the subjects are as shown in <Table 2>.

**Table 2: General characteristics of the subjects**

Classification		Number	Percent
Work place	Coast guard center	252	75.7
	Branch office	69	20.7
	Patrol ship	12	3.6
Paramedic certificate	Level 1	2	0.6
	Level 2	9	2.7
	No.	322	96.7
Basic life support certificate	Yes.	200	60.1
	No.	133	39.9
Gender	Male	312	93.7
	Female	21	6.3
Education	High school	98	29.4
	College	101	30.3
	Graduate school	134	40.3
Duration of work	<5years	51	15.3
	5 ~ 10 years	82	24.6
	11 ~ 20 years	98	29.4
	>20 years	102	30.6
Work in coast guard center	Yes.	295	88.6
	No.	38	11.4

Conted...

Rank	Policeman	38	11.4
	Senior policeman	82	24.6
	Police sergeant	78	23.4
	Police lieutenant	129	38.7
	Police inspector	6	1.8
Total		333	100.0

As a result of analyzing the emergency rescue capability among the initial action of the staff, we recognized that the staff working at the local police stations/patrol ships had more satisfactory emergency rescue capability compared to that of the staff working at the Korea Coast Guard Center, however the difference was not significant. In terms of the certificate, the study recognized those with emergency medical technician certificate to have more satisfactory emergency rescue capability than those without the certificate.

Possibility of emergency medical care including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered. The result of examining the awareness regarding the possibility of emergency medical care by maritime police staff, including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered, was a total average of 3.56 on a scale of one to five, allowing us to realize that the staff can carry out emergency medical care, including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered, and it is as shown in <Table 3>.

**Table 3: Possibility of emergency medical care by maritime police staff, including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered**

Classification		Number	Mean	SD	t(F)	p
Work place	Coast guard center	252	3.63	0.82	2.87**	0.004
	Branch office/Patrol ship	81	3.33	0.79		
Paramedic certificate	Yes	11	3.64	0.67	0.32	0.750
	No	322	3.56	0.83		
Basic life support certificate	Yes	200	3.68	0.78	3.36**	0.001
	No	133	3.38	0.85		
Gender	Male	312	3.55	0.83	-0.62	0.534
	Female	21	3.67	0.73		

Conted...

Education	High school	98	3.43	0.90	2.09	0.126
	College	101	3.66	0.74		
	Graduate school	134	3.57	0.82		
Duration of work	<5 years	51	3.78	0.70	3.47*	0.016
	5 ~ 10 years	82	3.67	0.82		
	11 ~ 20 years	98	3.53	0.79		
	>20 years	102	3.38	0.88		
Work in coast guard center	Yes.	295	3.55	0.83	-0.37	0.710
	No.	38	3.61	0.79		
Rank	Policeman	38	3.71	0.69	4.71**	0.003
	Senior policeman	82	3.74	0.80		
	Police sergeant	78	3.63	0.72		
	Police lieutenant	135	3.36	0.89		
Total		333	3.56	0.82		

In the case of place of work, we recognized that the staff working at the Korea Coast Guard Center can perform emergency medical care, including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered, more so than the staff working at the local police station/patrol ship, and meaningful difference was seen in accordance with the current place of work. And in the case of lifeguard certificate, we recognized that the staff who possess lifeguard certificate can perform emergency medical care, including cardiopulmonary resuscitation among others, when cardiac arrest patients are discovered, more so than the staff who do not possess the certificate, and meaningful difference was seen in accordance with the possession of the lifeguard certificate( $t=3.36, p<.01$ ).

Recognition of the usage instructions for Automated External Defibrillator, AED

The result of examining the maritime police staff regarding their knowledge on the usage instructions for Automated External Defibrillator, was a total average of 3.80 on a scale of one to five, indicating that the staff had good knowledge of the usage instructions for Automated External Defibrillator, as shown in <Table 4>.

In the case of place of work, staff working at the Korea Coast Guard Center had deeper understanding of the usage instructions for Automated External Defibrillator, than the staff working at the local police station/patrol ship, and it showed a significant difference in accordance with the current place of work( $t=4.31, p<.001$ ).

**Table 4: Recognition by the maritime police staff on the usage instructions for AED**

Classification		Number	Mean	SD	t(F)	p
Work place	Coast guard center	252	3.91	0.80	4.31***	0.000
	Branch office/Patrol ship	81	3.46	0.84		
Paramedic certificate	Yes	11	3.82	0.60	0.07	0.947
	No	322	3.80	0.84		
Basic life support certificate	Yes	200	3.97	0.72	4.31***	0.000
	No	133	3.56	0.92		
Gender	Male	312	3.79	0.84	-0.86	0.391
	Female	21	3.95	0.74		
Education	High school	98	3.66	0.95	1.95	0.144
	College	101	3.85	0.70		
	Graduate school	134	3.87	0.82		

Conted...

Duration of work	<5 years	51	4.20	0.57	8.28***	0.000
	5 ~ 10 years	82	3.91	0.77		
	11 ~ 20 years	98	3.78	0.79		
	>20 years	102	3.54	0.93		
Work in coast guard center	Yes	295	3.79	0.84	-0.73	0.464
	No	38	3.89	0.73		
Rank	Policeman	38	4.08	0.63	9.38***	0.000
	Senior policeman	82	4.05	0.72		
	Police sergeant	78	3.87	0.73		
	Police lieutenant	135	3.53	0.92		
Total		333	3.80	0.83		

In the case of lifeguard certificate, staff who possess lifeguard certificate had better knowledge about the usage instructions for Automated External Defibrillator, than the staff who did not possess the certificate, and meaningful difference was seen in accordance with the possession of the lifeguard certificate ( $t=4.31, p<.001$ ).

In the case of work experience, less the number of years of experience, better they knew about the usage instructions for automated external defibrillator, and meaningful difference was seen in accordance with the work experience ( $F=8.28, p<.001$ ). Staff members had good knowledge and understanding about the usage instructions for automated external defibrillator, and those working at the Korea Coast Guard Center, those

who possessed lifeguard certificate, those with less number of years of work experience, and those with lower rank had better knowledge and understanding about the usage instructions for automated external defibrillator compared to other staff members.

In the case of place of work, the staff members working at the Korea Coast Guard Center felt the need for The result of looking into the recognition of the staff regarding the need for emergency medical technician at the Korea Coast Guard Center, was a total average of 4.12 on a scale of one to five, indicating that the staff members recognized the need for emergency medical technician at Korea Coast Guard Center, and the result is as shown in <Table 5>.

**Table 5: The need to assign emergency medical technician to Korea Coast Guard Center**

Classification		Number	Mean	SD	t(F)	p
Work place	Coast guard center	252	4.13	0.88	0.25	0.801
	Branch office/Patrol ship	81	4.10	0.87		
Paramedic certificate	Yes	11	4.55	0.52	1.64	0.102
	No	322	4.11	0.88		
Basic life support certificate	Yes	200	4.16	0.82	1.02	0.309
	No	133	4.06	0.95		
Gender	Male	312	4.11	0.89	-0.89	0.372
	Female	21	4.29	0.72		
Education	High school	98	4.18	0.88	0.37	0.694
	College	101	4.09	0.92		
	Graduate school	134	4.10	0.85		
Duration of work	<5 years	51	4.08	0.69	0.07	0.977
	5 ~ 10 years	82	4.15	0.85		
	11 ~ 20 years	98	4.11	0.99		
	>20 years	102	4.13	0.88		



Conted...

Work in coast guard center	Yes.	295	4.11	0.90	-0.48	0.633
	No.	38	4.18	0.69		
Rank	Policeman	38	4.13	0.62	2.42	0.066
	Senior policeman	82	4.02	0.86		
	Police sergeant	78	4.35	0.75		
	Police lieutenant	135	4.04	0.99		
Total		333	4.12	0.88		

The emergency medical technician at Korea Coast Guard Center, more so than the staff working at the local police station/patrol ship, however there was no significant difference in accordance with the current place of work. In the case of emergency medical technician certificate, those who possess the emergency medical technician certificate felt the need for the emergency medical technician at Korea Coast Guard Center, more so than those who do not possess the certificate, however there was no significant statistical difference. In the case

of lifeguard certificate, those who possess the lifeguard certificate felt the need for the emergency medical technician at Korea Coast Guard Center, more so than those who do not possess the certificate. As a result of studying the degree of experience on the transport of emergency patient by the maritime police staff, the total average came out to be 2.98 on a scale of one to five, indicating that there was not much experience on transporting emergency patient, as shown in <Table 6>.

**Table 6: Experience on the transport of emergency patient by the maritime police officer**

Classification		Number	Mean	SD	t(F)	p
Work place	Coast guard center	252	2.99	1.23	0.38	0.704
	Branch office/Patrol ship	81	2.94	1.06		
Paramedic certificate	Yes	11	3.45	1.04	1.35	0.177
	No	322	2.96	1.19		
Basic life support certificate	Yes	200	2.96	1.19	-0.36	0.721
	No	133	3.01	1.18		
Gender	Male	312	3.03	1.18	2.79**	0.006
	Female	21	2.29	1.06		
Education	High school	98	2.94	1.16	1.03	0.358
	College	101	3.12	1.16		
	Graduate school	134	2.90	1.23		
Duration of work	<5 years	51	2.49	1.22	3.61*	0.014
	5 ~ 10 years	82	3.00	1.24		
	11 ~ 20 years	98	3.08	1.16		
	>20 years	102	3.11	1.11		
Work in coast guard center	Yes	295	3.03	1.17	2.07*	0.039
	No	38	2.61	1.31		
Rank	Policeman	38	2.50	1.22	4.99**	0.002
	Senior policeman	82	2.83	1.31		
	Police sergeant	78	3.33	1.04		
	Police lieutenant	135	3.00	1.13		
Total		333	2.98	1.19		

**3. Ability of maritime police staff to rescue and transport drowned individuals:** As a result of studying the awareness regarding the ability to rescue and transport a drowned individual in the time of discovery, by the maritime police staff, the total average came out to be 3.15 on a scale of one to five, as shown in <Table 7>. In the case of place of work, we recognized that the staff at the Korea Coast Guard Center had higher ability rescuing and transporting drowned individuals, compared to the staff at local police

stations/patrol ships( $t=2.08$ ,  $p<.05$ ). In the case of work experience, staff with experience between 10~20 years had the highest ability rescuing and transporting drowned individuals, and staff with experience between 5~10 years were recognized as not having high ability in rescuing and transporting drowned individuals, compared to other staff.

Ability of maritime police staff to rescue and transport drowned individuals

**Table 7: Ability of maritime police staff to rescue and transport drowned individual**

Classification		Number	Mean	SD	t(F)	p
Work place	Coast guard center	252	3.20	0.80	2.08*	0.039
	Branch office/Patrol ship	81	2.99	0.77		
Paramedic certificate	Yes	11	2.73	0.79	-1.78	0.076
	No	322	3.16	0.80		
Basic life support certificate	Yes	200	3.21	0.81	1.78	0.077
	No	133	3.05	0.78		
Gender	Male	312	3.16	0.81	1.44	0.151
	Female	21	2.90	0.62		
Education	High school	98	3.14	0.90	0.12	0.887
	College	101	3.18	0.73		
	Graduate school	134	3.13	0.78		
Duration of work	<5 years	51	3.12	0.77	0.70	0.554
	5 ~ 10 years	82	3.10	0.81		
	11 ~ 20 years	98	3.24	0.81		
	>20 years	102	3.11	0.80		
Work in coast guard center	Yes	295	3.15	0.81	-0.09	0.930
	No	38	3.16	0.75		
Rank	Policeman	38	3.00	0.70	0.60	0.615
	Senior policeman	82	3.21	0.81		
	Police sergeant	78	3.17	0.81		
	Police lieutenant	135	3.14	0.81		
Total		333	3.15	0.80		

In the case of work experience at Korea Coast Guard Center, we recognized that the staff without work experience at the Korea Coast Guard Center had higher ability in rescuing and transporting drowned.

## DISCUSSION

It is often that we come across drowning accidents from unskilled swimming, safety accidents from water sport activities, as well as death accidents from scuba diving, from nearby coasts.

Ships can cause many losses of lives from fire, collision, being capsized, sinking and others, and those who perform ocean related works can get involved in safety accidents during work. And when these various accidents occur, maritime police officers have to rush to the site of the accident, and take action in such emergency situation. Unlike on land, emergency medical care has to be carried out on a shaking boat and even in the water. Improvement in the emergency medical care knowledge

and ability to respond to emergency patients of Korea Coast Guard Center staff can be a matter of life and death to people in danger.

The Korea Coast Guard Academy, trains level 2 emergency medical technicians during the new police officer training period and during recruitment, level 1 emergency medical technicians with great amounts of actual work experience are hired via special hiring.

Emergency medical technicians are prehospital emergency personnel, and the position requires high level of ability to judge as well as leadership on site, and are expert workforce needed at the Korea Coast Guard Center. They work at 93 Korea Coast Guard Centers around the country and work 24 hours in 3 shifts, and each Korea Coast Guard Centers need 3 emergency medical technicians, however that is not the case in reality. It is important for this study to become the foundation in creating an environment in which emergency medical technicians can work at all Korea Coast Guard Centers.

### CONCLUSION

The study recognized that staff possessing lifeguard certificate knew very well about the usage instructions for automated external defibrillator, and when staff possessing lifeguard certificate finds patient experiencing cardiac arrest, they can perform emergency medical care.

The Korea Coast Guard Center, considered as the point of contact in preventing coastal accidents for the people of our nation, is in need of level 1 emergency medical technicians and expert divers to be assigned, who can respond in emergency situations. In the case of emergency medical technicians, job rotation between 119 rescue services and Korea Coast Guard Center should be implemented to sustain expertise of the emergency medical technicians. If doctors and nurses possess expertise at hospitals, emergency medical technicians, also referred to as prehospital emergency

personnel, must also be recognized as expert manpower and accordingly, there is a need for a system to allow them to receive corresponding reward.

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# Reliability Enhancement using Opportunistic Routing in Mobile Ad-hoc Networks

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## ABSTRACT

The ultimate goal of this study is to ensure the reliability and route stability in mobile ad-hoc networks. The opportunistic routing scheme is used to provide reliability in the data transmission over mobile ad-hoc network. In this paper, Robustness Enhancement using Opportunistic Routing (RE-OR) in Mobile Ad-hoc networks is proposed. In this scheme, the next forwarder node is chosen dynamically based on the link quality and the distance to the destination. So, the data can reach the destination without delay and in a reliable manner. The proposed routing scheme is evaluated by using the simulation results obtained by Network Simulator-2 simulator.

**Keywords:** MANET, reliability, stability, link quality, Network Simulator-2.

## INTRODUCTION

Mobile Ad-hoc Network (MANET) is a spatially distributed wireless network. In this network, each and every node is free to move in any direction. In wireless networks, generally each and every node has the link with the nodes within its transmission range. As all the nodes in the MANET are mobile nodes, the link between the nodes changes frequently. The most important characteristics on MANET which attracts by many of the application are the autonomous behavior of the mobile nodes. The term autonomous indicates that all the nodes are present as an independent entity. The mobile nodes in MANET are self directed and they don't have any centralized control. The node should play a dual role in MANET environment. So, the cooperative communication plays a vital role in MANET.

Many simple MANET-reactive routing protocols use a single metric like the shortest path, signal strength,

or node battery's residual to construct the route for data transmission. This single-metric route selection is not sufficient to construct a stable route because it may cause frequent route failures that stimulate the routing protocol algorithms to rediscover a new route each time a route is broken. The operations of route discovery consume extra network resources, degrading network performance, minimizing network lifetime, and leading to network partitioning problems. Since the node positions changes dynamically in MANET, the reactive routing protocol is used to route the data packets to the destination in a dynamic environment. The route to reach the destination changes dynamically as the link between the nodes changes dynamically. So, the reliability in the data transmission is not guaranteed in MANET. The reliability can be achieved by the use of opportunistic routing. There are several routing scheme developed for the dynamic environment of MANET.

The rest of this paper is explained as follows: Existing works are explained in next section followed by the proposed work, the simulation analysis and conclusion.

## RELATED WORKS

The geographical routing uses location information to forward the data packets in a hop by hop fashion<sup>1</sup>. Geographic routing protocols are much suitable for

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MANETs. In geographical routing, each and every node should be able to approximate the location of the nodes within its range. Each node should update the position of its immediate neighbor if the node moves to another location. EX-OR chooses the rely nodes to reach the destination in a dynamic manner. The next forwarder node is chosen only when the data reaches the previous forwarder node<sup>2</sup>. Traditional routing schemes avoid the link with high loss rate to participate in the transmission.

Geographic routing scheme uses the greedy forwarding scheme to forward the packets to the destination. The greedy forwarding fails to push the data towards its destination because of communication voids<sup>3</sup>. Greedy perimeter stateless routing is specifically designed for datagram wireless networks. This routing scheme uses the location information of the routers and the destination to make the greedy forwarding decision<sup>4</sup>. It uses only the local information to route the data packets towards its destination.

Location aided opportunistic routing uses only the location information to route the data packets<sup>5</sup>. As this protocol uses only the location information to direct the data packets, it can be useful only for the static wireless networks. Fuzzy-based approach enhances the AODV (FU-AODV) reactive routing protocol's performance by selecting the most trusted nodes to construct the route between the source and destination nodes. The nodes' parameters, residual energy, node mobility, and number of hop counts, are fed through a fuzzy inference system to compute the value of the node trust level, which can be used as a metric to construct an optimal path from source to destination<sup>6</sup>.

Route Stability and Energy Aware Ad hoc On-demand Distance Vector (RSEA-AODV) protocol designs a bi-objective optimization formulation to compute the reliability factor based on stability and residual energy of nodes. The route with the highest reliability factor value is selected for data transmission<sup>7</sup>. During route discovery, signal strength, delay, remaining energy and draining rate of nodes decide whether to add the node in path or not<sup>8</sup>. All these parameters are compared with defined threshold value, if calculated value satisfy the threshold condition then it process the route request packet otherwise it drops the packet.

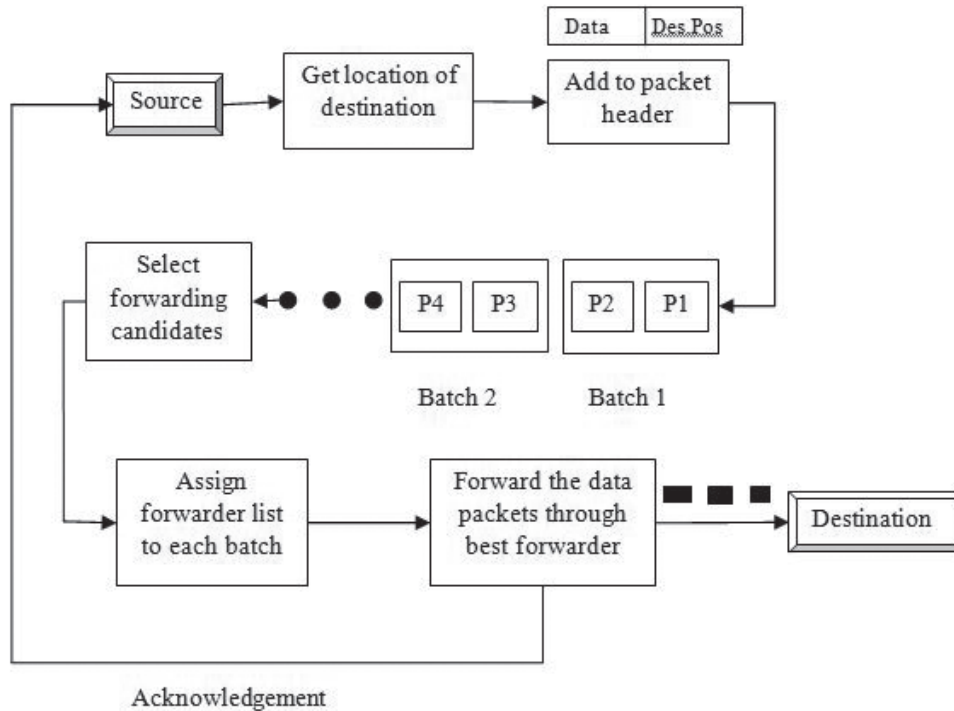
AODV only saves the least hops path to the destination. When the link breaks, it needs to rediscover

the route that increase network overload. MAODV takes route stability into consideration to attempt to establish a more stable path between the source and destination<sup>9</sup>. A trust module is included in the adaptive protocol which gives inputs regarding nodes' trustworthiness so as to keep a path as reliable as possible<sup>10</sup>.

**Robustness enhancement using opportunistic routing scheme:** In this paper a new opportunistic routing scheme Reliable and stable opportunistic routing (RE-OR) is proposed. This scheme uses the destination location information to direct the packet towards the destination. Each and every node maintains the neighbor list to find the next forwarding node. The node selects the next forwarding node based on the parameters link quality and the distance to the destination. The proposed scheme provides the better performance than traditional methods in terms of throughput and delay.

MANET is widely used in many applications regarding critical task such as military, disaster recovery etc. So the reliability of data transfer plays a very important role in MANET. The MANET changes its topology dynamically. So, the link between the nodes may fail at the middle of data transfer. By default the reliability is not guaranteed in MANET. The traditional routing protocols such as DSR, DSDV and AODV predetermine the route before transmitting the data packets. If any route failure occur means it reroute the data packets from source to destination. So, the delay occurs in the network due to route failure. But opportunistic routing never predetermines the route to reach the destination. It provides the choice for the next forwarding node until the data packet reach the destination. So, there is no route failure and it ensures the robustness of the data transmission.

In the proposed scheme, the opportunistic routing is act as base for routing. The route stability is ensured by choosing the next forwarder node based on the link quality. The source and all intermediate nodes chooses the next forwarder node from candidate forwarding list based on the node with high link quality with the node forwards the data. To reduce the delay, the shortest path is selected by estimating the distance between the current node and the destination node. The proposed scheme provides route stability by considering the link quality while selecting next forwarder node. Each and every forwarder node sends the acknowledgement back to the sender after receiving the data packets to ensure the reliability of data transfer.



**Figure 1: Reliability and stable opportunistic routing scheme**

The proposed reliable and stable opportunistic routing scheme is explained in Figure.1. Initially, the source node gets the location of the destination and then attaches it into the end of each and every packet to be transmitted. Then source node estimates its neighbor list. The next forwarding node is selected from the neighbor list. The source node and each and every intermediate node choose best forwarder based on the following algorithm.

```

Forwarding candidate selection algorithm

FL: Forwarding list
NL: Neighbor list
DC: Distance between current node and destination node
DS: Distance between source and destination node
D: Destination node      S: Source node
If D is in the NL(S) then
    Forward data packets directly
Else
    Batches → Grouping data packets
    For each n in NL(S)
        If (DC (n) < DS)
            Add n into FL
        For all batches attach FL at end
    // Next forwarder node
    For all batches {
        Foreach node in NL
            nfwd → node with high link quality
        }
    Repeat until nfwd=D
    End
    
```

The best forwarder is selected by using Forwarding candidate selection algorithm. The best forwarder node repeats the process until the data packet reaches the destination. Before transmission, the data packets to be transmitted are grouped into batches. The node appends the forwarding list at the end of each batch. So, the forwarding list is not required to attach at the end of each packet. The node in the neighbor list is analyzed to select the best behavior. The link quality is estimated by using the equation 1.

$$LQ = PRR \times RSSI \quad \dots(1)$$

Where,

LQ → Link Quality

PRR → Packet Reception Rate

RSSI → Received signal strength

The link quality takes a very important role in the proposed scheme. As the MANET changes its topology dynamically, the link between the nodes is not stable for all the times. If the link failure occurs at the middle of the transmission means it leads to packet delay. So, before forwarding the data to the node, the link quality is analyzed to reduce the delay and ensure the reliability.

**Performance Evaluation:** The performance of the Robustness enhancement using opportunistic routing scheme is examined by using the Network simulator (NS2). It is an open source programming language written in C++ and Object Oriented Tool Command Language. To estimate the proposed scheme we have assumed 65 sensor nodes, a network in an area of 1000x1500 m<sup>2</sup>. The parameters used for the simulation of the proposed scheme are tabulated in Table 1.

**Table 1: Simulation Parameters of RE-OR**

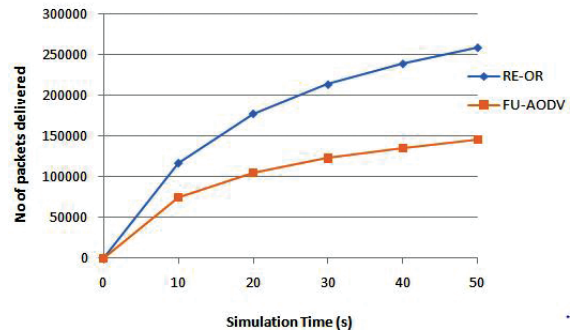
Parameter	Value
Number of nodes	63
Routing scheme	RE-OR and FU-AODV
Traffic model	Constant Bit Rate
Simulation Area	1000x1500 m <sup>2</sup>
Channel	Wireless Channel
Transmission range	250m
Communication Protocol	UDP
Antenna	Omni Antenna

Random waypoint mobility model is used to the sensor node movement. User Datagram Protocol (UDP) is used to node communication. We consider the packet delivery rate, packet loss rate, delay, residual energy are showing the efficiency of the proposed work.

**Packet Delivery Rate:** Packet Delivery Rate (PDR) is the ratio of the total number of packets effectively delivered to the total packets sent. It is received from the equation (2).

$$PDR = \frac{\text{Total Pkts Received}}{\text{Total Pkts Send}} \quad \dots(2)$$

Figure 2 shows the PDR of the proposed scheme RE-OR is higher than the PDR of the existing method FU-AODV. The greater value of PDR means better performance of the protocol.

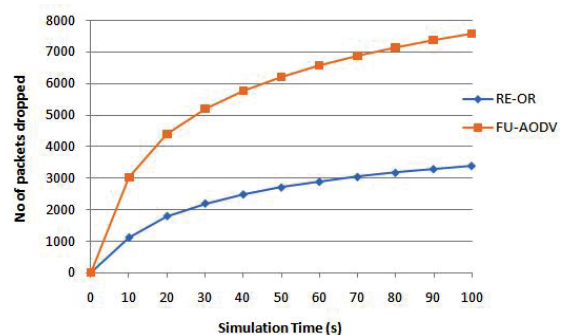


**Figure 2: Packet Delivery Rate of RE-OR and FU-AODV**

**Packet Loss Rate:** Packet Loss Rate (PLR) is the ratio of the packets lost to the total packets sent, estimated by the equation 3.

$$PLR = \frac{\text{Total Pkts Dropped}}{\text{Total Pkts Send}} \quad \dots(3)$$

The PLR of the proposed scheme RE-OR is lower than the existing scheme FU-AODV in figure 3. Lower the PLR indicates the higher performance of the network.

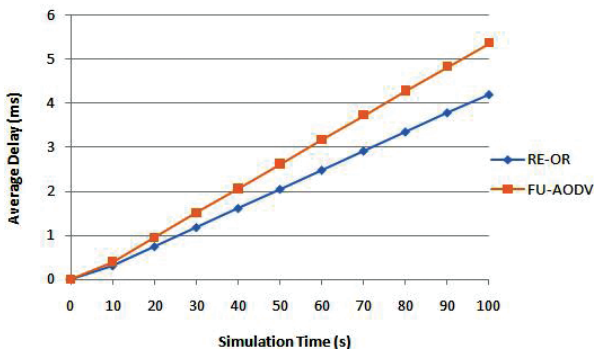


**Figure 3: Packet Loss Rate of RE-OR and FU-AODV**

**Average Delay:** Delay is defined as the time difference between the current packets received and the previous packet received and is shown in equation 4, where n is the number of nodes.

$$\text{Delay} = \frac{\sum_0^n \text{Pkt received time} - \text{Pkt send time}}{n} \dots(4)$$

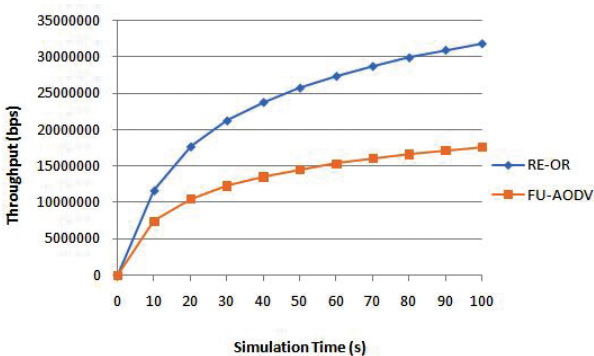
Figure 4 demonstrates that the delay value is low for the proposed scheme RE-OR than the existing scheme FU-AODV. The minimum value of delay is improves the network performance.



**Figure 4: Average Delay of RE-OR and FU-AODV**

**Throughput:** Throughput is defined as the rate at data is successfully transmitted for every packet sent and is shown in equation 5.

$$\text{Throughput} = \frac{\sum_0^n \text{Pkt received time} (n) * \text{Pkt size}}{1000} \dots(5)$$

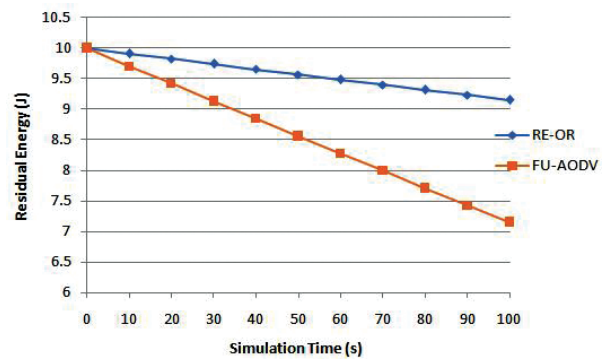


**Figure 5: Throughput of RE-OR and FU-AODV**

Figure 5 show that the proposed scheme RE-OR has greater average throughput when compared to the existing scheme FU-AODV.

**Residual Energy:** The amount of energy remaining in a node at the current instance of time is called as residual

energy. A measure of the residual energy gives the rate at which energy is consumed by the network operations.



**Figure 6: Residual Energy of RE-OR and FU-AODV**

Figure 6 shows that the residual energy of the network is better for the proposed scheme RE-OR when compared with the existing scheme FU-AODV.

### CONCLUSION

This paper proposed a novel routing scheme is called reliable and stable routing scheme. This routing scheme gives the choice of next forwarding node until the routed data packet reach the destination. The route to reach the destinations is not even known by the source itself. To ensure reliability, the route is constructed dynamically in the MANET environment. Thus proposed RS-OR ensures reliability and stability. This has been evaluated by using the simulation results obtained by network simulator.

**Ethical Clearance:** St Peter’s Institute of Higher Education and Research

**Source of Funding:** Self

**Conflict of Interest:** NA

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# International Trade Importance Trends and Approaches

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## ABSTRACT

Though international trade has history from time immemorial, China and India were the torch bearers of international trade. Briton played a crucial role in promoting international trade after industrial revolution with its strong economy. The colonial policy of Briton further promoted global trade. After World War-II, the aggressive economic measures required for recovery of many economies further encouraged trade among nations. In the process of emerging global trade, different growth poles emerged as potential forces. Belatedly, the developing economies emerged as vital growth pole with higher economic growth rate. It is anticipated that the emerging economies are going to play a more important role in the international trade compared to other economic blocks by 2025. Conversion of GATT into WTO and emergence of other world bodies like World Bank and IMF with more effective policies and programmes provided an effective platform for international trade among nations. It helped to reduce the protectionist policies and trade barriers and encouraged more and more free trade across borders. The increasing global trade is the emerging trend in world economy.

**Keywords:** Globalisation, International Trade, Growth Poles, ulti polarity, debt crisis, protectionism, trade bariiers, multilateral approach.

## INTRODUCTION

This is an era of globalization. 1980 onwards many economies in the world have started liberalizing their trade and economic policies with a conviction that enhanced international trade is key for socio economic development of a country. It is also seen that countries with more open economic and trade policies and more share in international trade have grown faster compared to other countries. More pro active and effective roles played by world bodies like World Bank, IMF and World Trade Organization have further helped world economies to frame effective policies condusive to promote world trade. These world bodies have also provided an effective mechanism for carrying out international trade and addressing trade related disputes which enhanced the confidence of economies.

**Historical Perspective of Global Trade:** Historically, China and India were the flag bearers of International Trade. Until the first half of second millennium, China and India were seen as growth poles. From 1500 A.D. onwards Western Europe started aggressive international trade registering a higher share in the total global output (Maddison 2007).

Though the history of trade among communities traces back to time immemorial, definite trade between two nations dates back to 11<sup>th</sup> century due to the long distance trading between Venice and Netherlands. Over the centuries, commercial activities grew considerably weakening the feudal system and thereby seeds of capitalism gradually sown. Growing industrialization and urbanization further weakened the feudal system in the West. Innovations in the field of sailing also promoted long distance trading between different communities and nations [1]. The socio economic developments like concept of private property, banking deposits, contract system, craft guilds, merchant groups, formation of companies, cross country markets, finance system, government support for open market system etc. promoted capitalism. Protestant Reformation which promoted a work culture of hard work, frugality and efficiency helped the growth of capitalism in the West. Though capitalism as a socio economic system initially originated in Europe, gradually it spread to North America and Australia. However, Japan remained a closed society mainly due to the deep rooted feudal structures and caste system until Meiji Restoration in 1968. In order to compete with the development of western countries,

Japan had to resort to large scale borrowing of western technologies for industrial development.

During the 19<sup>th</sup> Century, Britain played a crucial role in the world economy propelled by its Industrial Revolution. British economy was very strong due to current account surpluses and higher valuation of Pound. By the end of the century, British industry and investment spread to other European countries and North America. At the beginning of the 20<sup>th</sup> Century witnessed turmoil in many parts of the world economy. The protective industrial policies and tariff measures stifled the trade. The First World War has crippled many economies in Europe. In the post World War-I scenario, the economic resurgence was lead by United States. Germany suffered badly mainly due to the huge payments owed to the Allied powers. 1929 witnessed Great Depression and crash of stock market in United States and repercussions were spread to Europe. The resurgent Germany witnessed political turmoil in 1933 due to the rise of National Socialist Party headed by Adolf Hitler. Further development of Germany was characterized by re-industrialization, expansion of military capacity, construction of highway system and production of economy cars especially Volkswagen.

**Post World War-II:** After World War-II, Western Allied Forces attempted to control the global economy. The proposed creation of three organizations played key roles in the smooth functioning of world economy.

1. International Bank for Reconstruction and Development (I&RD) with an intention of rebuilding the war affected economies of Europe and Asia.
2. International Monetary Fund (IMF) with a view to maintain fixed exchange rate system, known as Bretton Woods System (BWS). The BWS was dissolved in 1970 and IMF has become a stronger body overseeing the international financial system.
3. International Trade Organization (ITO), though it did not become a full-fledged reality, the goal of liberalizing the world trade was entrusted with General Agreement on Tariffs and Trade (GATT). Various Round negotiations resulted in drastic reduction of world tariff and the Uruguay Round in 1994 reduced barriers to trading services, protection of intellectual property and liberalization in agriculture. The main

achievement of Uruguay Round is the decision to transform GATT into World Trade Organization (WTO).

The post World War-II witnessed two major geo political events viz. the cold war and decolonization which have significant impact on economic development and world trade.

The global scenario witnessed emergence of three groups of nations i.e. (1) consisted western democratic industrial nations, (2) Communist nations and (3) developing nations.

The post World War-II also witnessed withdrawal of European countries from colonized countries resulting birth of new nations like India, Pakistan, Portugal, etc. The newly liberated countries had a tough time in formulating its own socio economic policies. Many countries followed a socialist pattern with a view to cater to the essential needs of the people of the country. Economic policies were highly regulatory in nature with a view to reduce import and promote indigenous industrialization. This was necessitated mainly due to the colonial exploitative practices of importing raw material and thereafter exporting high valued manufactured goods to colonial countries. Further, the new industries required higher levels of protection and incentives from imports for its sustainability.

Developed economies were following economic policies with the belief that they are self reliant and protected from economies of other nations. But, the oil price shocks of 1970s and subsequent recession and inflation realized the US economy that it is not independent from the rest of the world.

Another major development in the emergence of global economy is the exorbitant earnings of oil exporting countries more than what they could spend. The dollar denominated surplus earnings resulted participation of these economies in the global economy and the deposits were mainly made in the banks of US and Europe.

The international debt crisis of 1982 also had great impact in the world economy. This crisis was resulted mainly because of very tight monetary policy introduced by the then Chairman of Federal Reserve System to fight double digit inflation in US. The reduction in money supply caused increase in interest rates and higher

interest payment by developing countries to service their international borrowings. Ronald Reagan's supply-side economic policy caused further damage to the economy which was facing worst recession. This has caused low demand for products from developing countries. The developing countries had severe adverse impact due to higher interest rate for servicing the international borrowings on the one hand and poor demand for exports on the other hand. This has resulted in stringent austerity measures in many developing countries like Mexico, Argentina and Brazil. These developments acted like an eye opener for many developing countries and realized the need for having an open and more integrated economy with other developed economies. This idea has resulted in the policy changes of countries like Korea, Honkong, Taiwan and Singapore which helped them to become developing economies on a fast track and hence they are known as Asian Tigers. This change in the developing economies led to further opening up of markets including stock market which facilitated investment of industrial nations in the Capital Markets of developing economies like Argentina, Chile, Thailand, Malaysia and so on. This has helped developing nations to have sufficient financial capital for investing in infrastructure development and other related activities. The fall of Soviet Union also seen as a lesson that closed economies are not going to survive for long. The end of cold war resulted in more movement of products and interactions between different economies and highlighted the interdependence and need for more vibrant global economy.

**Emerging Global Trends:** As the economic growth has diffused to many countries, the concept of growth poles has been gradually changed to multi polarity in the global economy. The strength of G7 countries as growth drivers has been shared among the developing economies. Since the beginning of the 21<sup>st</sup> century, the global economy has become increasingly multi polar mainly due to the expansion of the process of globalization (Findlay and O'Rourke 2007).

In the period 2004-2008, the US, Euro area and China were the main growth poles. Within a decade, it was expected that developing economies along with advanced economies like Japan and U.K are likely to join these growth poles. Among the developing economies, China emerged as a distinct economy and positioned itself as a growth pole (Arora and Vamvakidis 2010a).

The East Asian growth poles such as China and Korea heavily depend upon exports to drive their growth whereas the Latin American growth poles such as Brazil and Mexico concentrate more on domestic consumption. The strength of developing East Asian economies was the strong domestic consumption base which provided market potential for advanced nations and promotion of global trade. The economic growth of a country also depends upon the policy framework and political stability (Felsenthal and Machover 1998; Masfield 1993). Technological inventions and development also drive sustainable economic growth in the long run (Romer 1990; Solow 1956). For example, the economic policies of the China and US have resulted in Foreign Direct Investment and setting up of manufacturing basis in China by US which also resulted transfer of technology (Acemoglu, Johnson and Robinson 2005; Rodrik, Subramanian and Trebbi 2004). Such policies and investment activities have caused technology diffusion and development which helped all the nations involved in the process (Grossman and Helpman 1991a). As far as investing countries are concerned, they could produce intermediate goods at a cheaper cost (Eaton and Kortum 2002; Grossman and Helpman 1991b; Rivera-Batiz and Romer 1991). Though the developing economies like East Asian economies witnessed more import than export, the open economic policy has resulted in adoption of more technology and productivity which helped higher growth in the economy (Krugman 1979; Melitz 2003). This also helped transfer of technological knowledge, higher labour turnover and exchange of high quality goods and services (Du, Harrison, and Jefferson 2011; Etheir 1986; Fosfuri, Motta, and Ronde 2001; Markusen 2004; Rodriguez-Clare 1996). This trend has witnessed that the financial openness can promote growth when the liberalization process is combined with structural reforms (Beck and Levine 2005; Quinn and Toyoda 2008). During the progress, international labour mobility was also promoted which helped knowledge transfer which is critical for growth (Hovhannisyan and Keller 2010; Kim, Lee and Marschke 2009; Oettl and Agrawal 2008, Kerr 2008; Kerr and Lincoln 2010; Rauch 2001). The mobility of labour has helped the recipient nations as technical talents are made available at reasonable labour cost and the lending countries also benefitted out of the Foreign Exchange remittances which are critical for economic growth (McCraw 2010; Hatton 2010).

During the global financial crisis of 2008-09, these developing economies showed their resilience and strength and even challenged the might of G7 countries by registering increasing trend of global trade and finance (O'Neill 2001). When developed economies registered a negative growth of about 3.5%, these BRIICKS economies registered a 1.5% growth during the year 2009. Among these developing economies, China and India were the flag bearers. China overtook Japan and emerged as the second largest economy in 2010. These developments have further strengthened the interdependence of their economies and promoted world trade.

The developing economies were registering a higher growth rate compared to industrial nations of the West. It is expected that emerging economies will account for 45% of global output by 2025 compared to about 39% at present which means that these countries will account for greater volume of international trade and investment flow. Among the developing economies, China and India are going to register higher growth rate compared to others. As such, these economies will hold greater proportion of global wealth and 21<sup>st</sup> century is likely to be driven by sustained and higher growth of developing economies especially China and India. It is expected that the combined real output of BRIICKS nations (Brazil, Russia, India, Indonesia, China and South Korea) will match the output of Euro area by 2025. The growing economies are expected to register an average growth of 4.7% whereas the world's average growth is expected to be about 2.3%. In short, the global trade is going to be accounted about half each between developing economies and advanced nations and a more integrated global trade is the emerging scenario.

**Recent trends in the World Trade:** 1970s witnessed a lot of upheavals in world economy. The economic collapse of 1971 necessitated realignment of world many currencies. The food crisis which was experienced during 1970-74 also created adverse impact in many economies<sup>[2]</sup>. The oil prices increased about 4 times during 1973-74. Oil prices doubled during 1979-80 also. All these developments has caused economic depression during 1970s, accelerated inflation and experienced volatility in the exchange and interest rates. The impact of the recession prevailed for a longer period. The developed countries were affected more severely than the developing countries. During 1970s average annual

growth of developing countries fell from 5.8% to 4.6% whereas the industrial nations growth has fell from 5.1% to 2.5%. The developing countries faced the situation more effectively compared to the industrial nations mainly by cutting demands for exports, additional production for export purposes and to substitute imports and effecting economic structural adjustments (World Development Report, 1981).

During the early 1990s a slowdown in growth was experienced in all economies but developing economies performed better compared to industrial nations, and some oil exporting countries were substantially benefitted due to raise in the oil prices. But the growth was declined in the case of middle income oil importing economies. Latin America was adversely affected with negative growth in Brazil and slowdown in many other countries. African countries experienced decade long sluggish growth whereas East Asian countries performed better by penetrating into many markets of the industrial nations.

The economic difficulties in different economies have its impact on the world trade. The international trade registered an upward trend more than the growth of output. Industrialized countries resorted to increased import of merchandize since 1970s. Import of manufactures has doubled in industrialized countries during 1970s. Countries like Cyprus, Indonesia, Jordan, Malta, Mauritius and Morocco expanded manufactured exports and registered an increase of 20% during 1970s. Increased exports and raising investments helped the growing economies to recover from the recessionary trends. These countries have constantly improved their manufacturing sector and gradually moved into higher quality goods including heavy engineering products for exports. The availability of cheaper and skilled labour has an advantage for these countries. Certain countries like Republic of Korea pursued these economic practices vigorously and could even compete with industries in Japan and US. Thus, the developing countries raised their share in the manufactured goods exports to industrial countries to 13% during 1980s compared to less than 7% during 1970s. Due to protectionist policies, the European Economic Community became self sufficient in agricultural commodities very fast and could resort to large scale export to oil exporting countries and many developing economies. It is evident that even during economic difficulties in different world economies, the world trade coupled with economic structural changes

was the catalyst for improving growth and engine propelling to tide over the economic recession.

Industrialization in many countries especially the developed nations also promoted world trade and sustained economic growth. Therefore, they have resorted to changes in the policies and structural changes that ensured current account surpluses. Developing countries also effected changes in domestic policies for industrialization and growth in economy. Trade Policy Reforms were effected to enhance the competitiveness in the world market, income growth, export growth, employment and savings. Quantitative restrictions were relaxed to promote imports. The historical Uruguay Round negotiations gave emphasis on the areas of interest to developing countries, namely trade and agriculture, tropical products and textile and clothing. It also highlighted the need for enhanced access of developing countries to markets in the industrial countries.

The second decade of 21<sup>st</sup> century witnessed recovery from financial crisis of 2008-09 and emergence of a world economy with an increase in the multi polar in nature. The emerging economies became a powerful force in international production, trade and finance. Its international trade flows has enhanced from 26% in 1995 to about 42% in 2002. The enhanced trade volume and foreign direct investment amongst developing countries also helped to achieve this goal. The risk factor for investment in developing countries also reduced which helped enhanced investment flow from industrialized nations.

It is envisaged that the coming decades, by 2025, will see a global economic order generated predominantly by the emerging economies. The recovery from the recession in developing economies has been faster. China was one of the first economies recovered from the crisis registering nearly 10% growth; followed by India. India has formulated a new and aggressive five year plan to maintain a higher growth rate. Latin America also rebounded in the year 2010 after contracting sharply in the year 2009. Sub Saharan economies are expected to regain the higher growth trajectory. By 2025, 6 major emerging economies viz. Brazil, China, India, Indonesia, South Korea and Russian Federation, are expected to collectively account for more than half of the global growth (Global Development Horizons, 2011).

From the above developments, world has witnessed a convergence of international trade between emerging

and developed economies and shift of more share of global wealth and assets towards emerging economies. By 2025, emerging economies as a group are likely to experience significant increase in their international trade flows. For example, in the case of Indonesia, it is envisaged that the value of exports is likely to double between 2010 and 2025 and value of its imports is expected to be more than one and half times by 2025.

**Global Trade and Foreign Exchange:** Foreign Exchange of a Country refers to foreign exchange reserve which means the sum total of foreign currencies held by Central Bank of a country. Foreign Exchange rate is the rate at which currency of a country can be exchanged with currency of another country at given point of time. Foreign exchange is the largest financial segment in the economic world with approximately 5 trillion dollars worth transactions daily. Foreign exchange rates are decided by the market forces of demand and supply. Before 1944 countries were doing trade on gold standard. Their govts agreed to redeem their currencies equivalent to the value of gold on demand. A global currency is one that is accepted for trade throughout the world. Some of the world's currencies are accepted for most international transactions. The most popular are the U.S. dollar, the euro, and the yen.

In the year 1944, Bretton Woods agreement kick started the dollar into its current position. 64 percent of all known central bank foreign exchange reserves is in US dollars. World has 185 currencies according to the International Standards Organization List.

Euro constituet only 19.9 percent of known central bank foreign currency reserves were in euros as of the second quarter 2017. Most of these bills are in the former Soviet Union countries and in Latin America. In the foreign exchange market, the dollar rules; more than 85 percent of forex trading involves the U.S. dollar. Furthermore, 39 percent of the world's debt is issued in dollars. As a result, foreign banks require a lot of dollars to conduct business.

Another indication of the dollar's strength is how willing governments are to hold the dollar in their foreign exchange reserves. Governments acquire currencies from their international transactions and trade. They also receive them from domestic businesses and travelers who redeem them for local currencies.

In addition, some governments invest their reserves in foreign currencies. Others, such as China and Japan, deliberately buy the currencies of their main export partners and try to keep their currencies cheaper in comparison so their exports are competitively priced.

In March 2009, China and Russia called for a new global currency. They want the world to create a reserve currency that is disconnected from individual nations and is able to remain stable in the long run, thus removing the inherent deficiencies caused by using credit-based national currencies

China was concerned that the trillions it holds in dollars will be worth less if dollar inflation sets in. This could happen as a result of increased U.S. deficit spending and printing of U.S. Treasuries to support U.S. debt. China called the International Monetary Fund to develop a currency to replace the dollar.

In the fourth quarter 2016, the Chinese renminbi became another one of the world's reserve currencies. As of Q3 2017, the world's central banks held \$108 billion worth. That's a small start, but it will continue to grow in the future. That's because China wants its currency to be fully traded on the global foreign exchange markets. In order to protect the exim industry and to safeguard the balance of payment strength of the country, Countries frame trade and monetary policies with view to maintain the value of their currency especially against dollar being most accepted world currency. As the volume of international trade is increasing at faster rate in this era of globalization, it has direct connection and effect on the foreign exchange reserve of a country.

**Trade Policies and Globalization:** There has been dramatic change in the trends of global trade during the past 50 years, more so, from 1980s with the advent of the concept of globalization. The important reason behind this development is the fact that the economies which promoted global trade have registered a faster growth rate. Hence, since 1980s developing countries also resorted to more open trade policies which promoted foreign trade and investment as part of its development programmes. These changes have resulted in increased share of manufactures in their exports and by late 1990s many developing nations registered around 80% of their exports with manufactured goods. 1994 witnessed a landmark event at Marrakech i.e. Uruguay Round Agreement in which 124 economies signed the Agreement to effect

trade disciplines to agriculture and service sectors. In the same year, Asian Pacific countries which represent half of the world economy met at Bogor, Indonesia and set a target of achieving complete free trade in the Pacific region by 2010 for industrial countries and 2020 for developing countries. These developments have further triggered the globalization process and have become unstoppable (Wolf 2001). Though counter points were raised at different Roudns of Negotiations in places like Seattle, Washington and Prague, one school of thought emphasized that globalization will be sustainable only if the process is accompanied by concrete policies which ensure its benefit to common people (Rodrik 1997). It also highlights the concern of problems arose in some developing countries due to the changes in the economic policies.

**Relevance of Trade Polices in International Trade:** Normally, the trade policies are decided by the respective government with a view to maximize welfare of the people. These policies are framed as far as possible in a realistic manner in order to achieve the set goals and maximize the national welfare keeping in view of the constraints (Rodrik 2001).

One approach in policy formulation regarding global trade is unilateral approach by Central Government without relying much on outside interference from organizations like World Bank and IMF and this approach was followed by developing countries during the past two decades. With this approach, China and India have effected drastic global trade reforms which have proved effective.

Protectionist policies and trade barriers followed by many countries as part of its policy created hurdles in the increasing trend of international trade and international trade negotiations and agreements have helped to address these issues addressing the concerns of both developed and developing economies in a balancing manner. This approach has resulted in international treaties under WTO so that commitments are reinforced through a well developed mechanism. The existing multi lateral system provides for most-favoured-nation (MFN) principle which prevents one country from unilaterally imposing higher tariff on any particular country. Such system under WTO has helped many countries including large developing countries like China and India (Ianchovichina and Martin, 2001; Martin 2001, Martin and Ianchovichina 2001). This trend of strengthening

of multilateral trade is the result of Uruguay Round Negotiations (Whalley 1996).

Another approach noticed is the regional negotiations as it is easier for many developing countries compared to large number of Member countries under WTO. This kind of preferential trade agreement between limited number of countries has helped them to have mutual trade with lower tariff and restrictions. It was also reported that the trade with liberalized tariff between MFN countries within the ASEAN was a success story (Martin 2001).

**Importance of World Trade:** It has been established that increasing trade between economies is key to ending poverty and to share wealth for mutual prosperity. Countries having open policies to international trade are more prone to faster growth and more opportunities. Due to this fact, various world forums on trade and economy deliberated on the need of trade liberalization policies since 1990. Many countries are gradually adopted a policy of lower import tariffs. This was a challenge for developing economies and less developed economies as most of them followed restrictive and protective practices like anti competition business practices, higher tariff on imports, rigid regulatory practices etc. Such policies have blocked the access of goods produced in developing economies to the advanced nations (Roberta Piermartini, WTO). In spite of adopting open policies, many developing economies find it difficult to move phase with the international trade trends and agencies/programmes like Aid for Trade and Trade and hence, Competitiveness Global Practices of World Bank have extended technical support to such economies to tide over the problems. Liberalization also witnessed a scenario that wage inequalities arise but gradually it is normalized over a period of time (Matthieu Bellor, IMF). But preferential trade agreements were proved to be a boon for enhancing cross border trade between countries (Swarnali Hanna, IMF). Further, it is seen that there were also some deep trade agreements between countries which included the policy areas like investment, competition policy and intellectual property right protection have helped promotion of more trade compared to normal trade agreements (AlenMulabdic, World Bank).

The importance of global trade across the world has helped to develop institutional mechanisms to address the issues connected with the global trade under the

auspices world organizations like World Bank, IMF and WTO. Functioning of these organizations has influenced the trade policies of different economies and the globalization process.

**Multilateral approaches:** In the process of emergence of multilateral approach in global trade, the Bretton Woods negotiations gave rise to International Monetary Fund (IMF) and World Bank. Though there were many proposals for wide ranging International Trade Organization (ITO), it could not be taken forward as US Congress did not ratify it and only a small portion survived as General Agreement on Tariffs and Trade (GATT). This included the mechanism of MFN which was proved a success (Hoekman 2000). As GATT had only few members from industrialized nations, the benefit was limited to global trade of manufactures from developed countries. The Uruguay Round negotiation was the turning point as many developing countries were engaged in the process of negotiations for global trade under WTO. The developing nations could ensure inclusion of agriculture, services and intellectual property also to the ambit of GATT. Hence, the WTO emerged as a much stronger body with a strong system for dispute resolution<sup>[3]</sup>. The Membership of the WTO increased substantially in short period of time and multilateral system gained prominence without much changes. Consensus was the principle generally followed to address the issues. However, there were differences of opinion between the developing countries and industrialized nations mainly on issues like agriculture, trade and labour standards. The industrialized countries with surplus agricultural products faced concerns in respect of protection policies and agricultural subsidies in developing nations. The concerns of developing countries were the slow pace of removal of quotas from textile and clothing, absence of open agricultural market and anti dumping measures of industrial nations (Anderson et al 2001). In order to make the WTO more effective, it requires reforms in its governance with an effective dispute settlement mechanism. As many potential countries like China has become members of WTO, there is great potential for WTO to facilitate global trade to a substantially greater extent.

**International Organizations Facilitating Global Trade:** After Second World War, in order to regulate International Monetary and Financial order, a gathering of 730 delegates from 44 Allied Nations was convened from July 1 to 22, 1944 at Breton Woods, New Hampshire,



United States which is known as Breton Woods Conference or United Nations Monetary and Financial Conference<sup>[4]</sup>. This conference made Agreements to establish International Bank for Reconstruction and Development (IBRD) and International Monetary Fund (IMF). Subsequently, World Bank structure was created with two Institutions viz. IBRD and International Development Association (IDA).

**World Bank:** IBRD and IDA are components of World Bank. The prime goal of the World Bank is reduction of poverty and promotion of foreign investment and international trade. World Bank has joint agreement with IMF and World Trade Organization (WTO) to deepen cooperation on trade related issues. World Bank has 189 member countries which are represented by Board of Governors, the ultimate policy makers of WB.

World Bank also has specific trade programmes which include the following:

- a. Promotion of multilateral trading to support economic development
- b. Promote trade competitiveness as development strategy of countries and
- c. Support trade and related reforms through “Aid for Trade Scheme”

In order to achieve these goals, World Bank has evolved a new trade strategy in the year 2011 for “Leveraging Trade for Development and Inclusive Growth”. This strategy aims to promote trade competitiveness and diversification, trade facilitation through logistics and finance, support market access and international cooperation and manage shocks from unanticipated issues.

World Bank assist developing countries to formulate proper trade policies with a view to promote international trade and thereby alleviate poverty and promote development.

**IMF:** Under IMF, 189 countries are working for global monetary cooperation, financial stability and to facilitate international trade and development<sup>[5]</sup>. The goals of IMF are

- To promote international monetary cooperation
- To facilitate the expansion and balanced growth of international trade

- To promote exchange stability
- To assist in the establishment of a multilateral system of payments
- To give confidence to members by making the general resources of the Fund temporarily available to them under adequate safeguards
- To shorten the duration and lessen the degree of disequilibrium in the international balances of payments of members

**WTO:** WTO was formed based on Marrakesh Agreement signed by 123 nations on April, 1994 replacing GATT. WTO officially commenced its function from 1<sup>st</sup> January, 1995. WTO deals with regulation of trade in goods, services and intellectual property among participating countries. It also provides a frame work for negotiating trade agreements and dispute resolution. The WTO gained more relevance and importance when it amended WTO accords on January 23, 2017, the Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement which provided more security to developing countries and legal remedies under the WTO rules.

WTO primarily deals with global rules of trade between nations. WTO facilitates negotiated and signed agreements between trading nations. These documents provide legal ground rules for international commerce. These documents are bound by contracting governments to keep their trade policies within the agreed limits. Though, agreements are signed by governments keeping in view of social and environmental commitments, it also helps producers, exporters and importers to conduct their business in a related environment. It ensures that trade flows as smoothly and freely as possible.

**World Bank Group:** World Bank Group (different from World Bank) is an extended group of five international organizations viz.

1. International Bank for Reconstruction and Development (IBRD), which is an IMF lending arm, providing financial assistance.
2. International Development Association (IDA), which provides loans and grants to poor countries
3. International Finance Cooperation (IFC), which focuses on loan and advises to private sector entities
4. Multilateral Investment Guarantee Agency (MIGA), which encourages FDI in developing nations, and

5. International Center for Settlement of Investment Disputes, which provides expertise to resolve disputes

World Bank Group has set two goals to be achieved by 2030;

- End extreme poverty by decreasing the percentage of people living on less than \$1.90 a day to no more than 3%
- Promote shared prosperity by fostering the income growth of the bottom 40% for every country.

World Bank Group has very closer ties with European Union in the area of development and cooperation. European Commission is the third largest contributor to the WBGs Trust Funds. The important goals of WBG trade strategy are:

- Trade Competitiveness and diversification
- Trade facilitation, transport logistics and trade finance
- Support for market access and international trade cooperation
- Manage shocks by promoting greater inclusion

WBG also strongly supports creation of a sound multilateral trade system and offer expertise to least developed countries and developing economies. WBG has formulated Trade and Competitiveness Global Practice for promoting economic integration among different countries. WBG advocates trade liberalization as a means of achieving higher economic growth and sustainable development<sup>[6]</sup>. In order to achieve this goal, WBG has created many analytical tools and instruments with the aim of identifying restraints on free trade and to reform economies through a more open markets.

### **17. Impact of World Organizations on International Trade:**

It is seen that World Organizations have addressed many concerns and issues affecting international trade and built confidence among countries. The WTO was able to address protections to a great extent (Reivid and Sherlock, 2011). The grey areas of investment and intellectual property rights issues, which have direct impact on international trade, were successfully addressed under WTO (Schaffer, Agusti and Earle, 2008). WTO also had great influence in regulating tariffs, import duties and other trade barriers in many

countries (Wyndham-White, 1961). These organizations especially the World Bank and IMF have influenced to a great extent in the policy formulation process of many countries especially in the field of trade and investment.

**Cooperation among the Global Bodies:** The recent trend of globalization and global integration has increased the need for closer cooperation between IMF, World Bank and WTO in order to help member countries in formulation and implementation of conducive economic policies. In order to ensure greater cooperation in formulating global economic policy making, a cooperation agreement has been signed between IMF and WTO. IIMF has observer status in many WTO bodies. WTO Secretariat also attends meetings of IMF Executive Board. Joint Trade Workshops are conducted periodically with a view to promote trade diversification, policy formulation, promote trade research and address trade shocks. All these global bodies work together to help least developing countries (LDC) to improve their ability for global trade through Enhanced Integrated Frame Work. The synergy of mutual cooperation among these global bodies helps them to formulate and implement effective policy formulation and implementation that promote global trade.

WTO has established a panel on defining the future of trade in April, 2012 to examine challenges to global trade in the 21<sup>st</sup> Century. It held consultations and discussions with representatives of other global bodies with a view to meet challenges being faced in the process of integration of world economy<sup>[7]</sup>. WTO also has created Trade Profiles 2016 in order to share a series of key indicators in goods and services to 195 countries with the details of global trade like merchandise trade, major imports and exports, agricultural and non-agricultural products trade, major origin details etc.

## **CONCLUSION**

The faster phase of globalization has influenced international trade. IT Technology helped the process of faster international trade due to its ability to transfer documents and payments on finger point. It also helped economies to grow substantially with an approach of economies of scale. For example, manufactured goods alone have grown about 100 times from 95 billion dollars to 12 trillion dollars in 50 years since 1995. This trend has also boosted flow of foreign investments in many countries. But, patents, intellectual property

rights and over standardization of certain products for branding are hindrances in the process of smooth progress of international trade. For example, majority of the computers in the world are on Microsoft's Windows Operating System which results in lack of product diversity. However, the momentum of globalization and international trade is unstoppable as it integrates markets of global economy leading to interconnectedness among people across the borders leading emergence of a concept called Global Village.

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# Technological Advancement in Assisting Adaptive Learning Measures to Increase Productivity and Retention of French as a Foreign Language for Post-Modern Learners in Post-Colonial Context

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## ABSTRACT

In the post-globalisation era of post-modern condition, Artificial intelligence is used as an instrument in the foreign language education, the advent of the age of internet. French language learning can be both highly fulfilling and utterly disappointing. Certain innovative and reciprocal approaches of learning French are vital to learn effectively. Development in technologies has won the attention of teaching community and post-modern learners Application of Artificial Intelligence (AI) in French language learning and teaching in post-globalization India; then, the new concept of Robot-Assisted Language Learning (RALL) defined both theoretically and applied to show the new trends in the educational purposes of AI. This study notes the contributions of Artificial Intelligence in the development of reading, writing and speaking skills.

**Keywords:** *Artificial Intelligence, Machine learning, Approaches, algorithms, CLIL.*

## INTRODUCTION

In today's globalized world, multilingualism has become imperative than it was a few years ago. Having a thorough knowledge of a language other than your native language has proved out to be an extremely laudable weapon which might help you to portrait yourself on an upper hand in several scenarios. Whether viewed from the financial or social aspect, being able to converse in some other language always helps to make a genuine connection with people around the world. Knowledge of French language among other foreign languages opens career <sup>[1]</sup>. The concrete reason behind learning French as a foreign language is that it enhances a person's cognitive and analytical abilities. It often increases your sense of self-worth. So, it is important to find certain innovative and reciprocal methods of learning French as a foreign language. Language learning in cyberspace is a virtual collaboration on language learning between a variety of schools in Europe, Canada and Africa. The conversation between pupils ranges from the abstract level to the very practical when they have the ability to read and write letters to French newspapers, exchange views and ask questions to an author whose book they just read, or discuss violence, racism in Africa. Cyberspace offers

language teachers a better opportunity to prepare for hours not only focusing on grammar, but for example also on the intercultural dimension. This method gives students a valuable opportunity to meet real French in class. Through this exchange teachers and students work, questions and comment on the movies, novels and other items which are examined in parallel in teaching. Ultimate focal point of this study is the optimization and personalization of learning French as a foreign language using digital technologies.

## DEMAND

Research on the use of modern technology in learning languages has been taking place since the last decade with the introduction of interactive and user-friendly applications and inclusion of E-learning as a significant component in most major educational institutions around the globe. In spite of the various advantages modern technology has to offer, there are always mixed opinions regarding the effectiveness of technology in the field of language learning such French. French as a foreign language is very popular among the students as well as the professional community. With rapid globalisation, many people wish to expand their

skill set by learning a foreign language and French being the official language in 29 countries, is a very popular choice. But not all can afford the time and money to enrol into French learning course at a centre and so, many opt for enrolling in online courses.

In today's modern age of cyberspace, world is shrinking day by day and necessity of communication skills hold extreme importance because we are inevitably cursed to be criticized everywhere, hence our way of presenting ourselves is also important. As we know Lingual skills are obvious part of communication hence we are supposed to enhance our lingual skill in order to achieve what we want to achieve. Cyberspace has connected the world so vividly that learning any language now holds some amount of importance and is easy to connect to the people of that society French is one of the most worldwide accepted languages o if we invest our time to learn French than it's almost impossible that it won't be worth it.

Teaching, Research, Management, Print and electronic Media, All India Radio (Foreign Languages Services), the Indian Armed Forces, Raw, Parliament, embassy , call centres, multinational companies, export-import agencies, tourism, hospitality, schools at various places in the Foreign there is great demand for professionals, Foreign Language Teacher, Translator, Research Associate, interpreter, tourist guide, Air hostess, Flight Steward, Hotel Resource Associate, writer, public relations officer, settle in jobs such as Language Specialist. In Current cities all corporate schools teach students a foreign language.

Top universities that integrate cyberspace in language learning: Following universities teach language using cyberspace through communicating with people and celebrities using video and audio conversations <sup>[2]</sup>

- Southern New Hampshire University
- Grand Canyon University
- Colorado State University Global
- Indiana Wesleyan university
- Duke University
- University of Pennsylvania
- Walden University
- University of Notre dame

- Stanford University
- Georgetown University

**Types in teaching via cyberspace:**

- Internet reference
- Email and discussion groups
- Media-based learning tools (video, audio, chatting, eBooks etc.)
- Broadband connections
- Pod-casting
- Teleconferencing
- Webcasting

In additional we have other language teaching methods, an insight of these is highlighted in the following sections.

**STUDY OF THIRD-PARTY LITERATURE**

The review of recent research on technology-supported language learning reveals a number of interesting points. For example, Zhao (2013) conducted a study to assess the potential of technology for improving language education. The review found that existing literature on the effectiveness of technology use in language education is very limited in four aspects:

- a. The number of systematic, well-designed empirical evaluative studies of the effects of technology uses in language learning is very small;
- b. The settings of instruction where the studies were conducted were limited to higher education and adult learners;
- c. The languages studied were limited to common foreign languages and English as a foreign or second language; and
- d. The experiments were often short-term and focused on one or two aspects of language learning (e.g., vocabulary or grammar).

Nevertheless, the limited number of studies indicates a pattern of positive effects. Most studies found technology-supported language learning is at least as effective as human teachers, if not more so. Hennessy (2005) noted the introduction of ICTs could

act as a catalyst in stimulating teachers and pupils to work in new ways. Warschauer (2000) described two distinct perspectives about how to integrate technology into the classroom. First, in the cognitive approach learners get the opportunity to maximize their exposure to language in a meaningful context and construct their own individual knowledge. Examples of these types of technologies include text-reconstruction software and multimedia simulation software. Multimedia simulation software allows learners to enter into computerized micro worlds with exposure to language and culture in a meaningful audio-visual context. The best of these programs allow learners a good deal of control and interactivity so they can better manipulate their linguistic input. Second, the social approach emphasizes the social aspect of language acquisition where learning a language is viewed as a process of socialization. From this perspective, students need to be given opportunities for authentic social interactions to practice real life skills. This can be achieved through student collaboration on authentic tasks and projects.

**Learning on one's own pre-rogative:** The first foreign language is always the toughest to learn. Many people even quit before getting started. It is very important to feel a language with all the senses. Never be obsessed with the timeframe. So here are pedagogical practices followed in learning a new language.

**Walk and practice loudly:** Best method to learn while walking. While walking, look at the things around and practice the language out loud. Practicing verbs, conjunctions, simple phrases are the basics to learn any language. Say out loud anything you can see or imagine<sup>[3]</sup>. This involves all the senses. As you see the objects, you say out loud and listen to your voice and all this happens while moving.

**Learning through association:** Try to associate with things you already know - Leaving anything unassociated in a corner somewhere in your memory will never be remembered. So, while learning a new word, try to find and learn its synonyms, antonyms, words that sound like or similar. Creating mind maps is a good way to learn<sup>[4]</sup>. Connect words together based on meaning, grammar, or anything you imagine by making patterns.

**Learning through socialization:** If you see anyone speaking the target language, start communicating and develop the interaction in the target language<sup>[5]</sup>. Fluency

in the target language will strengthen. Language brings people together.

**Watch films/movies with subtitles with Google translate:** Using a Google translate while watching a movie can help you learn a language very fast. Any word you have any confusion can easily be resolved using Google translate. Repeat out loud. Also write down the same in a notebook which can help you later. Learning another language is a long-term undertaking and requires quite a high level of self-discipline to achieve certain level of proficiency<sup>[6]</sup>.

## INNOVATIVE TEACHING METHOD

Teaching a foreign language has been historically linked with the mundane task of forcing students to mug up complex grammar structures. This makes them adept at conjugation of verbs but mute when it comes to making even simple conversations. Due to the ineffective nature of current teaching methods, researchers have indicated towards the fostering of environments that leads to impressive language learning<sup>[7]</sup>. Most European countries have adopted a new teaching method called "content and language integrated learning" (CLIL). In such a teaching methodologies, language learning is used to teach other non-language related subjects<sup>[8]</sup>. For instance using a French language in sports class or learning French music will allow students to look beyond the boundary of grammar rules and actually use the language in common conversations. Such a method enforces the actual usage of the language over its correctness<sup>[9]</sup>. Also teachers can play a vital role in keeping new learners motivated. They can guide their students by taking them to plays and dramas conducted in that language, helping them understand its usage and the tone of speaking. By helping in translating written or spoken content they help the students understand the cultural usage of phrases and words.

## MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

Technological advancement leading to emerging fields like Artificial Intelligence and Machine Learning can give us better tools in assisting adaptive learning measures to increase productivity and retention of a new language. Machine Learning is a study of pattern recognition and computational learning theory in

artificial intelligence<sup>[10]</sup>. Currently the problem is that we have age old teaching material and resources through which we learn or teach French as a foreign language. What works for the population of USA or any other country does not necessarily mean that it would work for the population of India. Machine Learning can therefore help the existing curriculum by studying the patterns associated with the use of the existing material and then provide crucial data analytics to solve the issues pertained by the users. Artificial Intelligence can also come into play by making lectures adaptive based on the needs of the population<sup>[11]</sup>.

### How Machine Learning can play a vital role in making language learning a productive one

**Supervised learning:** The system is fed with example inputs such as data points which comprise of people's errors and successes and their desired outputs, fed into the system by a validator, and the goal is to make the machine learn a pattern. After data analytics, the machine will then start recommending. For example: Figuring out which sentences will help you best practice your weakest words/skills. The system shouldn't make you practice nouns you know with sentences where verbs are in past tense if one has not yet learned that tense<sup>[12]</sup>. It helps the system learn to adapt to the learner's needs and enables it to teach in a way that satisfies each individual's needs and requirements rather than giving every learner the same content and materials.

After getting feedback on the above, your word strength becomes one data point in the set of the data which we get from a population. Based on the feedback from the entire population, word strength can be taken into account and the core syllabus can be improved. For example: A certain area in Delhi does badly in sentence construction, but retention rates are high. A certain area in Bangalore does good in sentence construction using tenses but poor in translating. Predictive course can interchange the content between the two communities, shaping up a better tailored course. All the above would require data science producers, algorithms dealing with Natural Language Processing.

Some examples include Duolingo which is language-learning platform. The company is a mobile first company involving the concept of learning through gamification, whereas a user goes through levels of a game to learn a particular course<sup>[13]</sup>. How does Duolingo use Machine

Language? - It uses Machine Language algorithms to predict your difficulty level. For example : As you start clearing levels, sentences can get harder in terms of translations. How does it happen ? - Predicting Dynamic Difficulty: The algorithm works to find the specific difficulty that is neither 'too easy' meaning it's a piece of cake, and not too hard which discourages the user.

**TEAM:** Team-Oriented Evolutionary Adaptability Mechanism<sup>[14]</sup>. It simply means that the algorithm should adapt using multiple data points i.e., multiple users and not based on a single data point i.e a single user. For example some terms are not easy even if you learn to translate. If the algorithm were to take you into consideration, then it would make the course easy resulting in a much easier course for the other people. Therefore the algorithm should adapt based on team feedback.

**Correction systems:** For example: Every time you get stuck at a particular level and ask the system for translation, it considers this to as a data point. Every data point has a risk assessment value attached it. Simply put, a magnitude. So the system learns to not repeat similar translations which have the risk assessment values.

**Advanced peer review:** The major problem in developing such software is the challenge of having a machine, which is in evident, validate a human translation. No human thinks in the same way and therefore could argue that his/her translation is correct in his/her perspective. Therefore complex algorithms are needed to determine whether human input is acceptable or not. Therefore the translations need to be crowd sourced instead of relying completely on a machine.

**Video Lectures:** A large chunk of the world population would be left without an affordable education if they had to quit their jobs to attend schooling or if they did not have skilled teachers in their area with whom they could take lessons or classes<sup>[15]</sup>. Taking a voice lesson at home sure cuts down the travel time and it gives you access to top teachers who may live in distant locales or who travel too often to be able to offer weekly lessons from a single location. Video lessons prove to be one of the best methods of alternative learning in today's time. The possibility of using Verbal, Visual, and Non-verbal cues in communication. This increases the overall flexibility in terms of communication. Each one of the 3 brings unique benefits to the education process and experience<sup>[16]</sup>.

Demonstrations and clarifications are also vital. Doubts can be comprehended and clarified more efficiently in online lessons as the interaction is real time. They possess the precision & clarity that text doesn't have. Moreover, the video lessons are theoretically more engaging. The sessions are interactive, especially for language learning. A student can work on pronunciation and accents involved in a specific language learning program. One might even feel better about the finished product partly because one learns freely and not under the constraints of time table, be it of learners or the instructor's. Another major advantage is the extremely diverse catalogue. You can find more topics in more areas than anywhere else. Besides the high-demand, business and computer science courses, they also have many arts, humanities, psychology, self-developments courses.

There are some challenges in this mode of learning, but they can be avoided via multiple options. Firstly, the time allotted in each session/lecture should be enough to produce a result and the learning should be significant [17]. The duration of each lesson can be appropriately altered (or divided, according to the total course length) by the teacher. Secondly, price is also a factor. The learning packages should be affordable and reasonable for the mass. Internet ventures like CoursEra, Academic Earth and Big Think are a game changer in this mode of education, providing reasonable and efficient video lesson packages [18]. Hence, the perspective of 'productivity' is fulfilled in the best of ways.

Even though the cyberspace helps us a lot in educating but certainly there are some demerits but let's start with merits then go for demerits.

- Freedom from Time and Space Restrictions
- Promotion of Independent Learning
- Possibilities for Greater Interaction and Expression
- Connection and Collaboration with Others
- Increased Comfort and Participation for Introverted Students

These might be problems when we go through cyberspace:

It is a new and different learning environment.

"A whole new set of physical, emotional, and psychological issues along with the educational issues".

- Physical Problems (ergonomics).
- Psychological Factors (addiction, attention).
- Motivation—strongly motivated, good 'learners', tend to do better.
- The Digital Divide.
- Personality Factors- not an environment for every student/teacher.

For a post-modern learner, the notion of learning a language means learning of digital technologies, tools and application of acquired knowledge. The content varies as per the needs and the demands of the corporate world. There comes the two conceptions of learning technology-based learning and classroom-learning. Firstly, learn knows what to learn in the acquisition, secondly the emphasis would be on acquiring knowledge about learning. Of course, it is a well-known fact that teaching consists mainly on how to learn and there are post-modern learners who are self-taught without resorting to teaching or learning, they acquire knowledge on integrating technologies in their learning.

"Teaching from the perspective of Artificial Intelligence" written by Schank (1983) remarks about the problems of learning to read that what your computers do to read (understanding) a text is quite applicable to the teaching of reading to children. He speaks of learning to read rather than acquisition of language. This distinction is due to the fact that Chomsky claims, we can even speak of learning about language acquisition, it begins well before schooling. Schank and Abelson's approach explains the notions Reading, writing and speaking and their role in the learning of French as a foreign language through AI.

## CONCLUSION

As the world develops faster, the need of the knowledge in the foreign countries language is also increased. With knowledge of the French, one can travel to any French speaking countries and can fulfil the needs without facing any problem. According to the current generation there are many sources of the technology are available to learn. Making the foreign languages as the one of the necessary subjects in the educational institutions will encourage the individual to learn. The main motivation of the learning process is to take the necessary steps and the use of the available resources to



learn through AI. By this we can improve the learning productivity of French as a foreign language. The use of computer mediated communications combined with a sound implementation of teaching theory makes cyberspace an excellent environment to provide educational opportunities to a wide student audience. The tools afforded to instructors on the Internet and in Internet based courseware packages provide for the development of diverse and stimulating learning environments.

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# To Detect Drowsy & Eye State Analysis of Driver's Behaviour for the Intelligent Transport System

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## ABSTRACT

In recent days the accidents mostly occur, because of very fast driving. so we are losing our valuable life by making a small mistake of drivers. Driver fatigue resulting from sleep disorders is an important factor in the increasing number of accidents. The scope our system is used to monitor and control the vehicle when the driver consumes alcohol. In our methodology is used to monitor the alcohol level in the breath of the driver. Eye blink and Tilt sensor is used to detect the drowsiness of the driver. Alcohol sensor is used to detect whether driver is drunken or not. If they attend drowsiness for three times or consumed alcohol, buzzer will be on for alerting the driver. Still if he went to drowsiness message will be transmitted to authorized person and the car will be stopped. The car will be started after getting a message from that authorized person. The total systems will restarted with in the 20 or 30 minutes for driver compatibility.

**Keywords:** Driver fatigue, orientation sensors, passenger comfort, Drowsy Detects, Tilt and eye blink sensor.

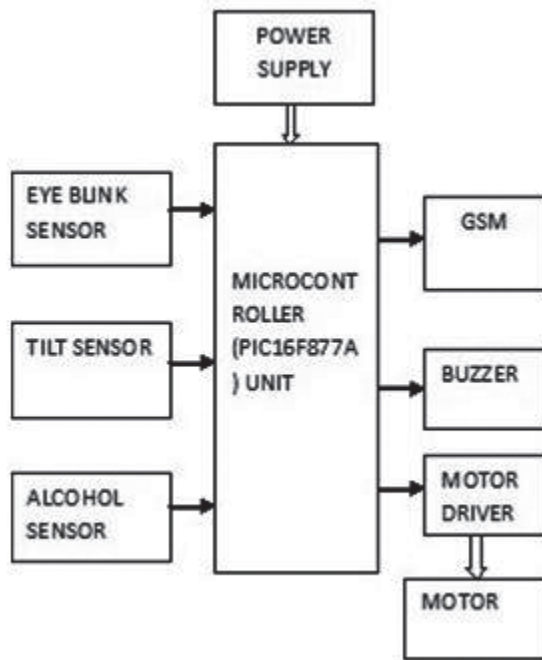
## INTRODUCTION

Drowsiness is defined as a decreased level of awareness portrayed by sleepiness and trouble in staying alarm but the person awakes with simple excitement by stimuli. It might be caused by an absence of rest, medicine, substance misuse, or a cerebral issue [1]. It is mostly the result of fatigue which can be both mental and physical. Physical fatigue, or muscle weariness, is the temporary physical failure of a muscle to perform ideally. Mental fatigue is a temporary failure to keep up ideal psychological execution [2]. In the past years according to available data driver sleepiness has gotten to be one of the real reasons for street mishaps prompting demise and extreme physical injuries and loss of economy. A driver who falls asleep is in an edge of losing control over the vehicle prompting crash with other vehicle or stationary bodies<sup>[3][4]</sup>. Keeping in mind to stop or reduce the number of accidents to a great extent the condition of sleepiness of the driver should be observed continuously. The drivers fatigue should be detected by the driving experiences, emotions, driving preferences. The driver becomes the weakest part vehicle-road closed loop system. The different driver's behaviors recorded and displayed level [5]. The various tasks can be performed by

different drivers and it is believed that on the completion of the identification of driver behavior characteristics [6]. The vehicle should follow the current driver's operation; trigger the appropriate driving assistant device, in order to achieve smooth transition of the simultaneous human-machine control modes, and to realize coordination of driver's operation and automatic control<sup>[7][8]</sup>. It is widely accepted that the driving behaviors vary between driver's ages, genders, driving experiences, emotions, and so etc. Even for the same driver, driving behavior may vary from situation to situation. Many articles are investigating the uniqueness of driving behaviors in vehicles and the possibility to use it for identifying the driver characteristics, to detect driver's abnormal operation and to realize integration between the driver and the electronic control systems [9]. Drowsiness is a complex phenomenon which states that there is a decrease in alerts and conscious levels of the driver. Though there is no direct measure to detect the drowsiness but several indirect methods can be used for this purpose [10]. In initial sections different types of methods for measuring the drowsiness of the driver are mentioned which includes Vehicle based measures, Physiological measures, Behavioral measures [11][12]. Using those methods an intelligence system can be developed which would alert the driver in case drowsy

condition and prevent accidents. If a face is detected then then next task is to locate the eyes<sup>[13][14]</sup>. After the positive result of detecting eye the amount of closure of eye is determined and compared with the reference values for the drowsy state eye. If drowsy condition is found out then driver is alarmed else repeatedly the loop of finding face and detecting drowsy condition is carried out<sup>[15]</sup>.

**Proposed Methodology:** The proposed methodology explains the block diagram with systematic workflow in Figure 1 details.



**Figure 1: Block diagram for proposed methodology**

**Alcohol & Tilt Sensor:** This Alcohol sensor can be used to measure the blood alcohol content in a person by measuring the amount of alcohol is on their breath. This sensor is suitable for detecting alcohol concentration on our breath, just like our common breathalyzer. It has a high sensitivity and fast response time. The tilt sensor is a component that can detect the tilting of an object. However it is only the equivalent to a pushbutton activated through a different physical mechanism. These sensors allow you to detect orientation or inclination. They are small, inexpensive, low-power and easy-to-use.

**Eye Blink Sensor:** This Eye Blink sensor is IR based. The Variation Across the eye will vary as per eye blink. If the eye is closed means the output is high otherwise output is low. This to know the eye is closing or opening position. This output is give to logic circuit to indicate the alarm. This can be used for project involves controlling

accident due to unconscious through Eye blink. Eye blink data is being frequently analyzed and processed for different application fields such as wearable technologies, intelligent driver warning systems

**Buzzer and DC Motor:** These buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Peizo electric sounders. A buzzer device gives an audible, visual or form of alarm signals about a problem or condition it will be interfaced with the Eye-Blink Sensor to alert the driver when he starts feeling sleepy. A DC motor is mechanically commutated electric motor powered from the direct current (DC). The stator is stationary in space and the current in the rotor is switched by the commutated. The motor driver is attached the motor.when the command got from the microcontroller, the vehicle speed control by motor driver, if the driver get drowsy level. The motor speed also reduced and message sent to the authorized person through mobile.

**GSM Modem:** After the driver getting drowsy level, the various sensor detect the fatigue of the driver’s behaviour, and sent to the microcontroller. if controller control the speed of the vehicle motor and sent the SMS through mobile the authorized person, control room, and hospital by using GSM modem. The vehicle motor speed will reduced rapidly. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving information one place to another place.

**Microcontroller:** The PIC microcontroller received the signal after detect the driver’s drowsy behaviour in various sensors and control the dc motor through the motor driven ckt. The vehicle speed slowly reduced The PIC microcontroller PIC16F877A is one of the most renowned microcontrollers in the industry. this controller is very convenient to use, the coding or programming is also easier.one of the main advantages is that it can be write erase as many time as possible because it use FLASH memory technology. it has a total number of 40 pins and there are 33 pins for input and output. A PIC16F877A is used many application of electronics circuit.

**Driver Unit (L292 Driver Unit):** We can interface two DC motors which can be controlled in either clock wise and counter clock wise rotation. A schematic example for interfacing a DC motor using L293D is provided here in. The L293D works on the concept of typical

H-bridge, a circuit which allows the high voltage to be flown in either direction. In a single L293D IC there are two H-bridge circuits which can rotate two DC motors independently. Due to its size and voltage requirement, it is frequently used in robotics applications for controlling DC motors, including in Arduino projects.

### RESULT ANALYSIS

**Eye Blink and Motion Interface:** The eye blinking is easy to achieve by arranging the detector that is near the eyelid, mounting the detector to the rubber eyecup. The movement of eye can be analyzed. The up-down movement and left right movement also detected by the eye blink sensor are given Figure 2. Detection of saccadic eye motion is more difficult but is still easier than detection of absolute position,



Figure 2: Module for eye blinks detection

Due to the characteristically rapid change in the light reflected from the eye surface during the saccadic jumps. For saccadic detection the phototransistor and IR source are best separated, so that the corneal reflection is the main source of detected light in Figure 3.

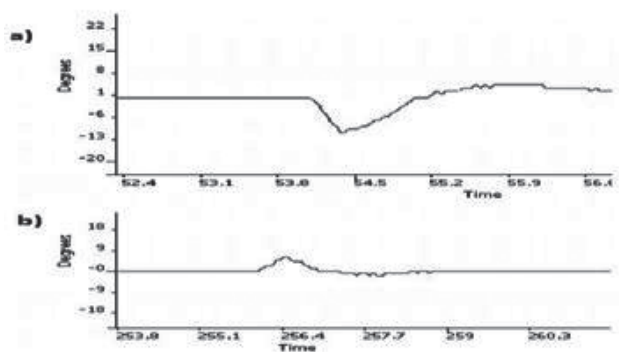


Figure 3: Sample tilt angle versus time plots for (a) Left (b) Right turns.

**3.2. Mouth opening or yawning & nodding analysis:** There are two methods to evaluate the driver’s drowsiness detection. When the driver opening his mouth, the yawning and nodding can be analyzed and summarized the value in the following Table-1.

Table 1: Result of classification for normal, Nodding & yawning mouths

State	Normal	Yawning	Nodding	Correct rate
Normal	250	40	38	88%
Yawning	9	32	30	84%
Nodding	20	30	35	74%

The method to detect the fatigue behaviour of drivers whether there are consumed in alcohol and they talked through mobile with another person while driving, finally any obstacle detected in the road. In this three main condition, when the fatigue behaviour of the driver recognized and also compare the normal driving level state and alert to driver, with safe driving mode. The vehicle speed also reduced rapidly. After that the message sent to the user authorized person and control room by the GSM modem. The measurement of accuracy on various types of parameters are given in Table 2

Table 2: Classification measurements in various levels

Subject	Drinking	Object distraction	Phone call	Normal driving
Accuracy	95.54	92.78	95.53	89.97
Sensitivity/recall	86.12	23.74	80.855	96.10
Precision	51.43	68.22	87.49	85.47
Specificity	96.18	98.90	97.00	87.36
f measures	60.78	26.31	81.70	81.13
g-means	90.90	40.16	87.91	80.92

### EXPERIMENTAL RESULTS

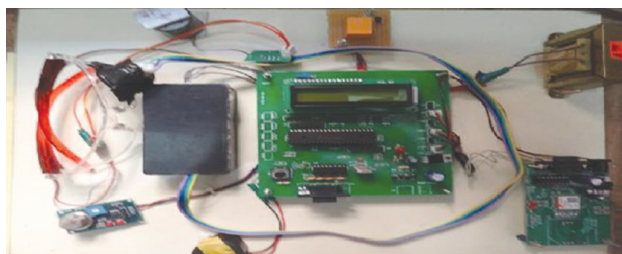


Figure 4: Experimental method

The above experimental setup to recognize the well safety driving for the drivers. There are various sensor are used to detect the drowsy level. The alcohol, tilt and eye blink sensor are used in this model. These systems control the speed of the vehicle. Increases standard of the vehicle Increases safety of driver. The reliability and

accuracy of driver drowsiness detection is better than others. Passengers could be able to know whether the driver drunken or not. This System is mainly used in heavy and light vehicles such as car, truck etc. Hopeful way for driving Increase measure of Human life safety.

### CONCLUSION

We introduce the automatic vehicle speed control and drowsiness detection by driver status monitoring. This technique may help people to avoid road accident and increase the safety of Human life. We have successfully completed this project and submitted for the Board Examination. We have gained experience very and over the practice difficulties in carrying out this project, with the suggestion and guide and positive help of our well wisher. This knowledge we have gained regarding our research and development work of a commercial set up and how to process to make it successful. the safety driving approach and analysis this methodology to keep the driver without drowsy.

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