



Proceedings of
THE 1st INTERNATIONAL
CONFERENCE OF
HYOJEONG ACADEMY
2023

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VENUE: Sun Moon University, Korea

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THE 1st INTERNATIONAL CONFERENCE OF HYOJEONG ACADEMY 2023

Towards The World Of Co-Existence, Co-Prosperity And Co-Righteousness

We cordially invite you to the 1st ICHJA! Scholars and professionals from Korea, the United States, Japan, Asia, Europe, and Africa will present their papers in this international conference. Studies on Unification Thought and Unification Theology and their applications to church and social movements and medical areas will be presented. Also, papers on science and technology that are broadly related to the conference's theme of co-existence, co-prosperity and co-righteousness will be presented. Your participation and discussion will be of great value for this conference to develop into a venue for collaboration among participants towards co-existence, co-prosperity and co-righteousness. This conference is held online/offline, so please participate in a convenient way.

HOSTED BY: Hyojeong Academic Foundation, Sunhak Educational Foundation, Hyojeong Magnolia Global Medical Foundation

ORGANIZED BY: Hyojeong Academic Foundation, Unification Thought Institute

CONFERENCE CHAIR: Dr. Hiroi, Takahiro (Department of Earth, Environmental and Planetary Sciences, Brown University)

CONFERENCE CO-CHAIR: Dr. Han, Chul Hee (Unification Thought Institute)

DATE: 27(Fri)-29(Sun), Jan 2023

VENUE: Sun Moon University & Online (Zoom ID: 914 345 0669)

INFORMATION: hyojeong.academia@gmail.com www.ichja.org

	27(Fri) Jan	28(Sat) Jan		29(Sun) Jan
09:00~		Opening Ceremony Plenary Talk (International Conference Room, 6F Main building)		Special Session Closing Ceremony (Multipurpose room, 1F Library)
10:20~		Session1 (#604)	Session2 (#1CR)	
13:30~		Plenary Talk		Seminar for research collaboration with delegates from overseas
14:05~		Session3 (#604)	Session4 (#1CR)	
16:00~	Registration	Plenary Talk		
16:30~	Program preview and preparatory meeting with delegates from overseas	Session5 (#604)	Session6 (#1CR)	
17:50		Awards Ceremony		

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Intelligent Design in Planetary Science as the First Step Toward the Unification of Science and Religion

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Abstract

Planetary Science has been revealing more and more facts over the last half century how apparently chance events led to the ideal environment for life to evolve to humans and allows them to develop science. This implies that the purpose of creation includes the emergence of intelligent life who can reveal the secrets of the creation process and the creator's motivation. Discoveries in planetary science provide some of the simplest and persuasive examples of Intelligent Design.

KEYWORDS: Intelligent Design, Planetary Science, Solar System, Earth, Moon, Antarctica, Meteorites, Asteroids, Unification of Science and Religion

1. Introduction

Theory of Intelligent Design (ID) holds that certain features of the universe and of living things are best explained by an intelligent cause [1]. It emerged as an alternative hypothesis that can overcome issues of Creationism and Evolutionism, mainly the lack of scientific basis in Creationism and the limited scope of Evolutionism. ID accepts all scientific discoveries and pursue their common cause among the simplest and plausible explanations, that is the existence of the intelligent creator. ID can be the first step toward the unification of science and religion. In this presentation, examples of ID in the field of planetary science are introduced, and further steps toward the unification of science and religion are proposed.

2. ID in Planetary Science

Although planetary science mainly studies planets and satellites in our solar system, the planet Earth is also a special target of planetary science. In this section, many unique characteristics of our home planet are introduced as an example of ID in planetary science.

2.1. Solar System in the Milky Way Galaxy

Milky Way is a spiral galaxy that can be sustained gravitationally only because of the existence of dark matter [2]. Only within such a spiral galaxy, the following ideal conditions can be realized for astronomy.

Location: Our solar system is situated between two large arms of our spiral galaxy in the middle of the galaxy that is neither too close to the dangerous galactic center having many stars nor too far away to have sufficient heavy elements, especially iron to form a molten core (dynamo) to produce a magnetic field as a protection against solar wind (energetic positive ions).

Orientation: The orbital plane of the solar system is highly inclined relative to the galactic plane, that allows ground-based telescopes to observe distant galaxies in a very dark sky when the galaxy is not visible from the Earth.

These are ideal for our astronomical observations to understand the structure of our galaxy and even the age and evolution of the universe. However, as the solar system revolves around the galactic center, this fortunate situation of the Earth has not been or will not be always realized. Is it a mere coincidence that we humankind who can develop science emerged during this period?

2.2. Asteroids and Comets in the Solar System

Although asteroids and comets pose threats to life on the Earth if a large piece falls onto it, they retain important information on the raw materials and the record of their evolution as fossils of the solar system. That information may reveal secrets such as how the Earth came to exist and how likely Earth-like planets can be found around other stars.

Origin of terrestrial water: Comets the most pristine materials that come close to the Earth and could have brought a significant amount of water to the Earth. Asteroids also can contain not only hydrous minerals but water ice as revealed by studying carbonaceous chondrite meteorites. By comparing the isotopic composition, especially the D/H ratio, among comets, asteroids, meteorites, and the Earth, we may address the question how and from where terrestrial water came.

Evolution of planetesimals: Asteroids are believed to be remnants of planetesimals that could not grow into

planets due to strong perturbations by Jupiter. As a result, most of them either remained small with no effective thermal insulation for its interior to become hot enough to melt or broke up due to collisions to expose interior structure if any. By studying asteroids and meteorites that are mostly samples of asteroids, we can find how early evolution occurred that could have let them grow into planets if it had not been for Jupiter.

Sample return missions: Compositions of asteroids and comets can be studied by either telescopic observations or spacecraft missions. NASA Stardust mission collected dusts flying from comet Wild 2 in an aerogel racket and returned it in 2006. As the first asteroid sample return missions, JAXA Hayabusa and Hayabusa2 missions returned samples from S-type asteroid 25143 Itokawa in 2010 and C-type asteroid 162173 Ryugu in 2020. Hayabusa mission finally proved the existence of space weathering on S-type asteroids [3], and Hayabusa2 mission discovered the parent body of CI1 chondrite meteorites and their true composition that is not contaminated with terrestrial materials [4]. NASA OSIRIS-REx mission is scheduled to return samples from asteroid 101955 Bennu in September 2023. These sample return missions were made possible within our capability in propulsion (ΔV) and short mission periods thanks to highly-elliptical orbits of comets and near-Earth asteroids that come close to the Earth orbit.

2.3. Earth-Moon System

Since the first lunar sample return by NASA Apollo 11 mission in 1969, evidence for the miraculous formation of the Earth-Moon system emerged over the last half century. There had been three scenarios of the Moon formation: co-accretion, fission, and capture. Because the first two models could not easily explain the difference in spin-axis orientation between the Earth and the Moon, the capture scenario could be the answer. However, returned lunar rocks and soils had exactly the same oxygen isotopic composition (^{17}O and ^{18}O contents) as that of the Earth [5]. Because it is unlikely that a captured body had exactly the same isotopic composition as the Earth, the giant impact theory emerged as the most plausible process of forming the Earth-Moon system.

According to numerical simulations of the giant impact to form the Moon, planetesimals hit proto-Earth multiple times at certain angles and speeds to be mixed together and accrete the Moon around the Earth [6]. It can explain the tilt of the Earth's spin axis, the orbital motion and composition such as low iron content of the Moon, and the amount of water on the Earth among possible other things observed today. Such simulations reveal that Earth used to spin much faster than it is today, and the tidal force of the Moon slowed down the Earth's spinning and transferred its spin angular momentum to the Moon, moving the Moon farther from the Earth. The Moon is still moving away from the Earth by 3.8 cm per year today. This Earth-Moon system has many benefits for humankind to emerge and perform science.

Earth's spin axis: Thanks to having a large satellite, the Earth's spin axis has been highly stable at 23.3 ± 1.3 degrees throughout its history [7]. Otherwise, climate on earth would have varied too much for intelligent life like humankind to evolve by taking billions of years.

Solar eclipse: After the Moon kept moving away from the Earth over the last 4.5 billion years, its apparent size now coincides with that of Sun, allowing total solar eclipses to occur. Taking advantage of this situation, a prediction of Einstein's general relativity that light can bend by strong gravity was proven through the observation of a star seen very close to the Sun which was darkened by a solar eclipse. As mentioned above, the Moon is moving away from the Earth, and is it a mere coincidence that humankind appeared and developed science right before the Moon becomes apparently too small to hide Sun?

Lunar surface: Numerous craters on the lunar surface records the history of past impact events on not only the Moon but also the Earth which are largely lost due to its activities and weathering. Lunar surface is also an ideal classroom of space weathering that chemically or structurally alters materials by solar wind and radiation and micrometeorite bombardments.

Space exploration: Moon is also a promising place for the expansion of human exploration into space as the source of necessary materials such as water (ice) and oxygen, and nuclear energy through ^3He . In addition, the Earth-Moon orbit can be used as a relay station (such as NASA's Gateway) for transportation among the Earth, the Moon, Mars, and beyond.

All the above conditions are ideal for humankind to emerge/survive and conduct science and exploration.

2.4. Planet Earth

Land and ocean: Earth has both land and ocean, which is very unique among known planets and can be indispensable for intelligent (science-capable) life to emerge. Without an ocean, life would not have been born at all, and humankind would not have emerged without a land.

Magnetic field: Earth's magnetic field is generated by molten iron ion spinning in the outer core, which protects life from harmful solar wind. For this strong magnetic field to be generated, Earth needed certain amounts of iron and radioactive as heat sources.

Plate tectonics: Earth is the only planet known to have active plate tectonics, which allows supplying and circulating necessary elements such as hydrogen, carbon, oxygen, and nitrogen to develop and sustain atmosphere, ocean, and life.

Antarctica: The history of the Solar System has been greatly revealed by studying meteorites which include fragments of left-over planetesimals, building blocks of planets. Tens of thousands of meteorites have been found on Antarctica that has a special mechanism to concentrate meteorites at the foot of its mountains. Those meteorites fell and sank into Antarctic ice, remained frozen, moved with ice, and accumulated at the foot of mountains, where surface ice evaporated by sunlight/heat [8]. Antarctica also kept ancient air and water, allowing us to derive the history of past atmospheric temperatures. However, Antarctica was not always in its current place but moved from north to the south pole and formed its ice layer only within the last ~40 million years and may move away from there in future. Interestingly, humankind emerged and conquered Antarctica at the right timing.

3. Steps toward the Unification of Science and Religion

ID in every scientific discovery: In the field of particle physics applied to cosmology, ID is found in a very precise fine tuning of all the forces in the universe that allowed planets and life as we know of. The multiverse hypothesis claims that we find everything is fine-tuned simply because we could only exist in such a universe, and there are many more universes where no humankind exists. However, this logic breaks down as for ID in planetary science and biology. Planetary collisions occur in such an unpredictable and chaotic manner that anything can go wrong to prevent the existence of our kind of planet and species. Multiverse hypothesis cannot refute the fact that we came to exist through too many number of apparently fortunate events to be interpreted as accidents.

Cause of ID: The simplest explanation on why we emerged and survived until now and have developed science thanks to special situation and timing of all the things is that we are expected to discover the secret behind every existence in this universe that is the purpose of our creator. Then, why does the creator want us to discover it? As the reasons, Bible states that God loves us and wanted us to become as perfect as Him, and Divine Principle states that God as our Parent wanted us to be the second creator, which requires us to learn all the secrets of His creation through science.

Unification of science and religion: Science needs to expand its scope to include the spirit world and God as targets of its investigation, starting with ID toward discovering the existence of the spirit world and God and the purpose of His creation. Religion needs to accept all scientific discoveries and adopt the scientific method to verify its teachings. In such a process, only true elements of each religion would survive and the unification of religions can be realized. The new truth with science and religion united can become a new ideology to create a new ideal and peaceful world and societies there.

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Dentistry develops through interdisciplinary research - Biology and Engineering/Medical and Dental Sciences, Psychology, and Data Science -

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Abstract

Nowadays, interdisciplinary research has become mainstream research in the scientific field. We learned that none of the existing things could survive nor develop without reciprocal relationships with others. Science can also develop in the same manner. In this 1st ICHJA conference, I would like to share two recent research topics:

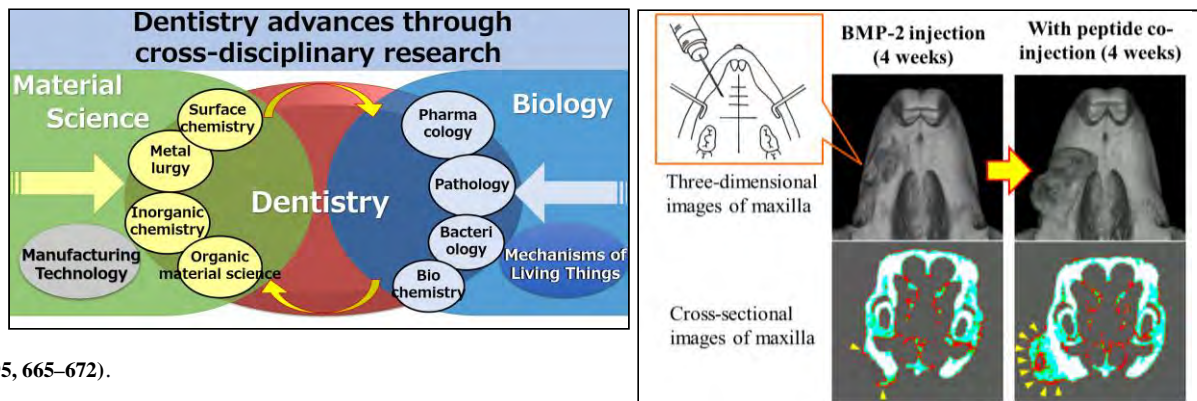
1) the development of bone anabolic reagents in the basic study and 2) the happiness level-based cancer marker search in saliva to show that interdisciplinary research is a key to proceeding the medical and dental field of work.

KEYWORDS: Interdisciplinary research, bone formation, material science, biology, happiness scale, N1-acetylspermine, cancer marker, saliva

Topic 1: Biology and Engineering Are Two Wheels On A Cart For Dental Science.

I have been researching to bridge the gap between basic research and clinical practice for over two decades. In collaboration with a different field of work, a piece of evidence was published in Nature to clarify the principle for maintaining physiological bone amount [1]. This finding led us to develop further collaboration with bio-engineering researchers, and we found a new anabolic agent for orthopedic surgery and dental treatment. On the other hand, we have been working with material researchers on developing scaffolds for the sustained release of a bone anabolic agent. We have also developed a method to promote bone formation by injecting an anabolic agent with a particulate gel (Fig. 1) [2]. Details were shown in reference [3]. Dentistry has progressed with biology and material science like two wheels on a cart. Still, interdisciplinary research that brings the poles together is necessary to pave the way for further conceptual advance and clinical tools for human beings.

Fig. 1. The collaboration between biology and material science researchers paved the way for developing a new tool for bone formation by injection. (Modified from Uehara et al., 2016, *J Dent Res*.



Topic2: Investigation of Cancer Markers in Saliva by Adding the Happiness-Scale Point of View

1. Introduction

Quantitative data following the statistical analyses are necessary to clarify a hypothesis. Basic studies, especially in the biological field of work using small animals such as mice or rats, have been used to show conceptual advances. However, human samples usually have a large variety of data in clinical studies. We hypothesized that one of the reasons why the large variety of data appears in clinical studies could be a lack of consideration of the human mind and body relationship.

Saliva is used for predicting cancer risk [4]. N1-acetylspermine, one of the metabolites in saliva, is known as a cancer marker [5]. On the other hand, happiness hormones, such as β -endorphin and oxytocin, are known to suppress the proliferation of tumor cells [6, 7]. However, the predicting method of cancer risk does not consider the human mind, which could change the concentration of a cancer biomarker in saliva and the cancer risk. The purpose of this study has two points: 1) to reveal the existence of salivary metabolites, which are associated with

the happiness scale, and 2) to find out a metabolite, which increases a correlation coefficient with N1-acetylspermine concentration in saliva by way of dividing into two groups; happiness-scale low and high groups.

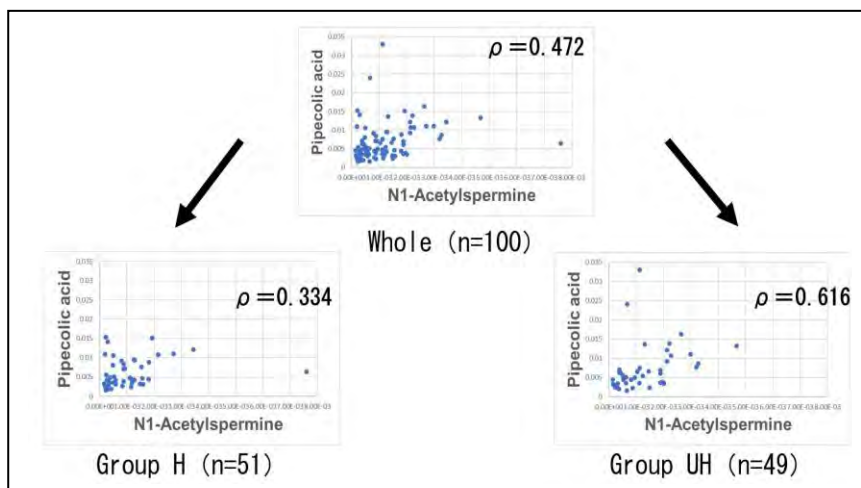
2. Materials and Methods

One hundred research subjects were recruited mainly by snowball sampling. Three happiness scales - the positive and negative affect schedule (PANAS), visual analog scale (VAS), and satisfaction with life scale (SWLS) were used for happiness scoring. The saliva samples were subjected to metabolome analysis. The mouse wash samples were subjected to metagenome analysis using the next-generation sequencer.

3. Results and Discussion

One hundred research subjects could divide into two groups: 1) Higher level of happiness scale (group H) (n=51). 2) Lower level of happiness scale (group UH) (n=49) by three happiness scales. The metabolome analysis with the Wilcoxon rank sum test detected eight metabolites, significantly changing when compared between H and UH groups ($p < 0.05$). When we searched for a metabolite, which increased Spearman's rank correlation coefficient with N1-acetylspermine concentration, a known cancer biomarker, by dividing into H and UH groups, pipecolic acid was found among 284 salivary metabolites (Fig. 2). Surprisingly, pipecolic acid was reported as a cancer marker in serum and urine for esophageal squamous cell carcinoma [8]. The oral bacterial flora and diversity of oral bacteria also changed depending on the happiness scale.

Fig. 2. Pipecolic acid showed a higher correlation when focusing on only 49 UH group subjects from 100.
 ρ : Spearman's rank correlation coefficient ($p < 0.05$)



Conclusion

These studies showed that salivary metabolite concentration could change depending on the happiness scale. Furthermore, the correlation between N1-acetylspermine and pipecolic acid increased in the UH group compared to the H group, suggesting that adding a measure of happiness, scoring the human mind, may be a potentially good method for identifying a new cancer marker in saliva.

Acknowledgment

I thank all researchers involved in bone and happiness projects and research subjects for their cooperation. I also thank Human Metabolome Technologies (Yamagata, Japan) for metabolome analysis and Number One Solutions (Tokyo, Japan) for metagenome analysis.

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Fatigue restoration studies and a research plan for restoration mechanism: A review on recent progress

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Abstract

Due to economic demands to further increase the efficiency of mechanical components, it is essential to exploit the full potential of the fatigue restoration mechanism. Restoration of fatigue strength of the used mechanical components is as like the rejuvenation of the human organism. Basic experimental studies on the restoration of rotary bending fatigue (RBF) and rolling contact fatigue (RCF) strength showed that nearly 75% of fatigued specimens were restored by UNSM to more than 100% fatigue cycles of new test specimens. The fatigue strength of the used large-size (more than 500 mm in diameter) rolling bearings for the steel mills and cement industry was restored by UNSM, which showed similar performance in terms of function and service life. The fatigue strength of the corroded fatigue test specimens of Al alloy for aircraft structure was also restored by UNSM. It showed that the average service life of the restored corroded specimens was longer than the average service life of the uncorroded new specimens. This study reviews the fatigue restoration studies and introduces a research plan to shed light on the fatigue strength restoration mechanism which is expected to introduce a new perspective and paradigm to solve these issues.

KEYWORDS: Restoration mechanism, Fatigue strength, Fatigue lifetime, Corrosion-Fatigue, Surface Modification

1. Introduction

In 2012, at Fukushima Nuclear Power Plant further stressed the need for the development and application of renewable and environment-friendly energy systems [1]. The wind power generator is one such system, but certain technical problems hinder its wide application. For example, wind generators typically employ medium-sized and large spherical roller bearings (SRBs) and double taper roller bearings (DTRBs) to support the drive shaft, which is driven by the wind blades. Due to their sizes, weights, and elevated locations, the replacement of these bearings is difficult and costly. This problem can be prevented or minimized by improving the high cycle performance of new bearings and re-manufactured already fatigued bearings by the application of ultrasonic nanocrystal surface modification (UNSM) technology.

It is one of the surface modification technologies which utilizes ultrasonic energy. In UNSM technology, a tungsten carbide ball is attached to an ultrasonic horn that strikes the surface with a frequency of 20 kHz. A detailed description of this technology was described in our previous study [2]. Strikes, which can also be described as micro cold forging, cause severe plastic and elastic deformations on the surface layers, thus inducing a nanocrystalline structure and deep compressive residual stress. These strikes also produce controllable micro-dimples on the top surface of the specimen, which improves the tribological characteristics of the interacting surfaces in relative motion. The produced nanostructure of the surface layer after UNSM treatment can simultaneously improve the strength (hardness) and ductility (toughness) of the specimen, according to the well-known Hall-Petch relationship. The restoration method of friction, wear and fatigue performance of remanufactured crankshaft by UNSM technology has been presented in a previous study [3]. The main objective of this study is to review the fatigue restoration studies and also to investigate the mechanisms behind the restoration of the fatigue process by basic experimental studies on the restoration of rotary bending fatigue (RBF) and rolling contact fatigue (RCF) strength.

2. Materials and Methods

In this study, both fatigue specimens are made of SAE 52100 bearing steel, which is commonly used in bearings. RBF tests were conducted on the YRB200 rotary bending test machine produced by Yamamoto Company, Japan. Specimens were prepared to investigate the effect of UNSM treatment on the accumulated RBF surfaces of the

SAE 52100 specimens. The percentage of fatigue life (25, 50, and 75% F in this work) indicates the number of cycles applied to a specimen according to the average fatigue life, thus simulating real-life usage. The RBF tests were carried out under the following parameters: 990 MPa stress; 3,125 rpm rotational speed; $R=-1$ stress ratio; and room temperature. An RCF tester custom-built at Sun Moon University was employed for the RBF tests. Such tester supports pin-on-disk analysis according to KOLAS (official certification organization in South Korea) as well as friction force analysis. The specimens were prepared to investigate the effect of UNSM treatment on the accumulated RCF surfaces.

2.2 UNSM technology

Fig. 1 shows the UNSM treatment processing under the parameters listed in Table 1.

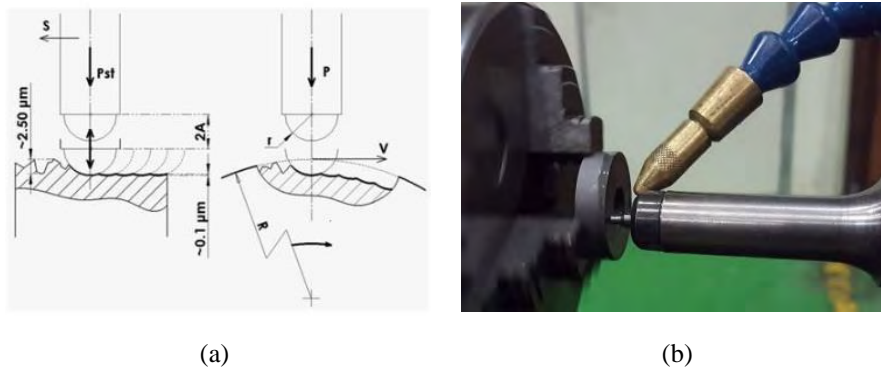


Fig. 1. (a) Ultrasonic nanocrystal surface modification (UNSM) treatment principles and (b) the processing of the specimen

Table 1. UNSM treatment process.

Amplitude (μm)	Load (N)	Rotational Speed (rpm)	Feed (mm/rev)
30	60	60	0.07

3. Results, Discussions, and Conclusions

The average surface roughness at the neck areas of the specimens was found to be $0.1 \mu\text{m}$. The surface hardness of the as-received and UNSM-treated specimens was about HRC 60 and HRC 64, respectively. Fig. 2 shows the S-N data of the untreated and UNSM-treated SAE 52100 specimens. Obviously, the fatigue life of the UNSM-treated specimens was improved, and even the specimen with a 75% fatigue was improved approximately ~ 4.3 times compared to the untreated new specimen. It can be due to the microstructure of the specimens was a martensite structure with a large amount of Fe_3C embedded in the ferritic matrix. During UNSM, surface severe plastic deformation was introduced to the surface of the specimen, and a gradient microstructure from the top surface was formed.

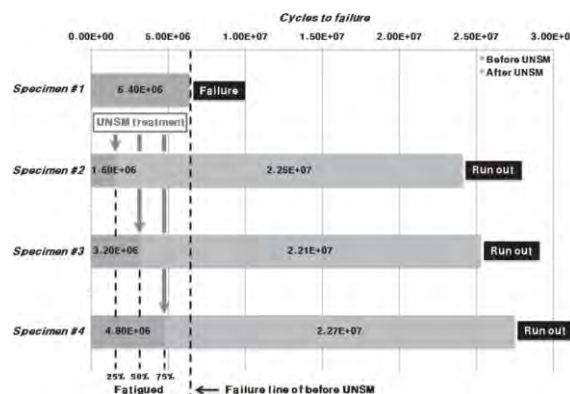
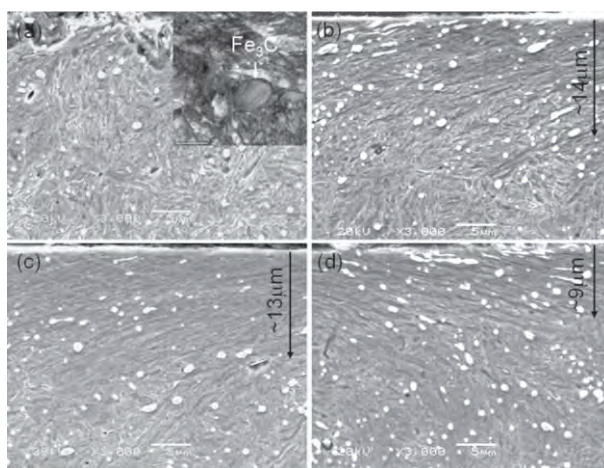


Fig. 2. S-N data of the specimens

Figure 3 shows the cross-sectional SEM images of the untreated and treated specimens. In the untreated specimen (Fig. 3(a)), a relatively uniform microstructure was observed from the surface, and the grain size of the ferrite matrix (martensite) was estimated to be $\sim 300 \text{ nm}$, as shown in the TEM image in the inset of Fig. 3(a). In

the treated specimens (Fig. 3(b)-(d)), the strain-induced microstructural refined layers were observed. It is easy to see that the depth of the refined layers ranged from ~ 14 to ~ 9 μm , depending on the processing condition, which was decreased with the increase in fatigue life percentage. Besides, in the refined layer, the grain size was refined to ~ 100 nm, which was much below the original grain size (~ 300 nm). During the UNSM treatment, the surface layer was deformed plastically at a very high strain rate leading to the formation of nano-grains, where the grain boundaries were invisible. Interestingly, it was discovered that Fe_3C particles migrated toward the surface after UNSM treatment [4]. It can be explained that during the UNSM treatment (compression) refined the Fe_3C particles into nano-sized particles along with ferrite (Fe_3O_4) nano-grains resulting in the migration of Fe_3C particles toward the surface. The volume fraction of Fe_3C particles decreased with increasing the depth from the top surface, which is indicative of the dissolution of Fe_3C particles by SPD. Also, Fe_3C particles had sufficient energy to break bonds with their neighbor atoms. Even though SAE 52100 bearing steel becomes fully austenitic at a temperature of 900 $^\circ\text{C}$, usually about 3–4% of Fe_3C is undissolved. At a temperature of 750 – 800 $^\circ\text{C}$, a grain boundary of Fe_3C particles can be broken up, where new Fe_3C particles are reformed and then a nanocrystalline structure was formed through dynamic recrystallization.

Fig. 3. SEM images of the untreated and UNSM-treated specimens. (a) untreated (inset: TEM image showing the fine structure of the martensite matrix) and Fe_3C ; (b) 25% F+UNSM; (c) 50% F+UNSM; and (d) 75% F+UNSM.



4. Conclusions

In this study, the effect of UNSM technology on the RCF behavior and fatigue restoration mechanism of SAE 52100 steel for bearing applications was investigated. It was found that the RBF specimen with accumulated fatigue followed by UNSM treatment was substantially higher up to 4.3 times than the fatigue life of the untreated specimen. Thus, the UNSM technology is capable of restoring fatigued surfaces. An international joint research project on the development of a portable commercial UNSM device for MRO service in the corroded aircraft structure was launched recently. The scientific study of how and why restoration of fatigue strength is very important not only for economic benefits but also for zero carbon and climate control of sustainable earth.

Acknowledgment

The authors would like to take this opportunity to thank Prof. Do-Sik Sim of Korea Maritime and Ocean University for preparing the RCF specimens.

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Development of remanufacturing technology for large industrial bearings and analysis of the sustainable economic impact

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Abstract

To regulate and prevent global warming, companies in each country participate in carbon emission reduction through technological development such as resource and energy saving. As a result, companies need substantial resource reduction, such as recycling and reusing materials, parts, and equipment. In particular, in companies in critical industries where expensive components are used, remanufacturing-related technology development is being carried out. Remanufacturing is to dismantle and disassemble aged equipment or discarded products due to long-term use, replace and re-process the degraded parts through cleaning, inspection, and diagnosis of features, and then reassembling to show performance close to that of a new product. It refers to a series of processes made because remanufactured products reuse a large part of the production factors used to produce new products, and costs can be reduced. The cost of manufacturing remanufactured products can be reduced by 40 ~ 65% compared to creating new products. It can also contribute to zero carbon and climate temperature reduction of the earth. This paper describes the development process of remanufacturing technology for large bearings used in steel rolling lines, and the analysis of economic savings effects through remanufactured bearings is discussed.

KEYWORDS: Remanufacturing; Bearing; Ultrasonic Nanocrystal Surface Modification

1. Introduction

The presidential commission on carbon neutrality and green growth of the Korean government announced that “2030 NDC (Nationally Determined Contribution) are intermediate goals for the realization of carbon neutrality by 2050, determined by the participating nations themselves, based on the Paris Agreement. One of the action plans in 2050 carbon neutrality scenarios is to reduce from 260.5 (unit: million ton, 2018 basis) to 51.1 in industries. The major industries of these action plans are the steel and cement industries. POSCO’s ambition is to reduce from their average of 78.8 in 2017-2019 “By 2030, in the short-term, reduction of CO2 emissions by 20%, By 2040, in the mid-term, reduction of CO2 emissions by 50% and By 2050, in the long-term, we aim to achieve a carbon neutral.” The purpose of this research is to suggest an innovative technology to make a substantial reduction of CO2 emissions, which could be easily realized in the steel and cement industries.

Famous foreign bearing manufacturers such as FAG, SKF, and TIMKEN are remanufacturing bearings to save time and money, and are leading the development of the bearing remanufacturing industry. Bearing life, remanufactured by traditional standards, recovers 87-99% of new products. In developed countries, remanufactured bearings are used in a number of areas, including aircraft, railroad cars, and ships. A paper published at the Glenn Research Center showed that the cost of remanufacturing bearing production could be reduced by 53-82% compared to the cost of producing new bearings. [1-3] The standard remanufacturing method does not reproduce bearing life by 100% compared to new products. In this regard, there is a need for a technology that can improve lifespan by 100% or longer. From an economic point of view, existing remanufacturing methods can reduce costs from new to 27-39%, but new bearing remanufactures can improve bearing costs by more than 40% compared to new by increasing lifespan by more than 100%. The purpose of this study is to utilize ultrasonic nanocrystal surface modification (UNSM) technology in the remanufacturing process so that the performance and fatigue life of discarded bearings can be equal or improved with new bearings. [4]

2. Bearing remanufacturing process

The rolling bearings used may damage the bearings due to specific application conditions such as wear, rust, indentations, contamination of rolling contact areas such as micro cracks or sporadic metal-to-metal contact. As a result, the life of the bearing may be shorter than the calculated rated life. An alternative to these problems is to apply a remanufacturing process before bearing failure or failure occurs. This substantially extends the life of the bearing in question, reducing cost and lead time. The differences and improvements between the existing bearing remanufacturing process technology and the developed remanufacturing process technology are as follows. Existing Remanufacturing Method Level-I's main process is to polish inner and outer raceways, but the development process is to polish the bearing inner and outer raceways and apply UNSM technology. Apply UNSM technology. Level-II process honing (super finishing) inner and outer races, but the developed process technology polishes bearing inner and outer races instead of honing and applies UNSM technology. Level-III

process is to grind the inner and outer raceway and insert the ball and roller, and the developed process is to apply the UNSM technology after grinding the inner and outer raceway and insert the ball and roller. The process of Level-IV manufactures and uses a new ring, but the developed process applies UNSM technology to the raceway after manufacturing the bearing ring. The developed process technology can improve the design and manufacture new ones, if necessary, by severe cracking of the used bearings and reverse design when broken. In the case of retainers, use after barrel processing and polishing when conditions are good. In case of poor condition, severe rust, corrosion, cracking and bending, replace and rebuild. The developed remanufacturing process depends on the bearing condition. Follow the same procedure as Fig. 1.

2.1 Example of tapered roller bearing remanufacturing process

The following are key processes in the remanufacturing process. After cleaning, polishing and barrel processing are performed to remove rust and accumulated fatigue on the contact and the other side. Barrel processing is used to moderately polish and polishing is used to remove rust and accumulated fatigue. The main part is the contact surface and polished until complete removal of rust and accumulated fatigue as uniform as possible when polishing. Contact surface polishing conditions are shown in Table 1 below. Polishing conditions can vary depending on the size of the bearing.

Table 1. Roller and inner ring raceway polishing parameter

	Grinding [rpm]	Rotational speed [rpm]	Feed [mm/rev]
Double inner ring	1000~3800	10~50	1~5
Double outer ring		10~50	
Single outer ring		10~50	
Taper roller		10~200	

Depending on the bearing condition, # 80, # 150, # 400 polishing process is sometimes performed. Roughness should be within 0.2um after polishing. Fig. When bitten by four, bite well so as not to be eccentric. Fig. As in 1, the polishing process is (a, d) taper roller, (b, e) inner raceway, (c, f) outer race.



Fig. 1. Polishing and UNSM treatment process of (a, d) rollers, (b, e) inner ring, and (c, f) outer ring

The difference between the remanufacturing process technology using UNSM technology and the existing remanufacturing process technology is the UNSM treatment after polishing and polishing the inner and outer race

raceways and rollers of rolling bearings. The inner and outer raceway of the large tapered roller bearings, roller UNSM treatment conditions are shown in Table 2.

Table 2. UNSM treatment parameter

	Amplitude [μm]	Load [N]	Rotational speed [rpm]	Feed [mm/rev]	Tip diameter [mm]
Double inner ring	30	30	12	0.07	2.38
Double outer ring		40	10	0.07	
Single outer ring		40	10	0.07	
Taper roller		40	150	0.1	

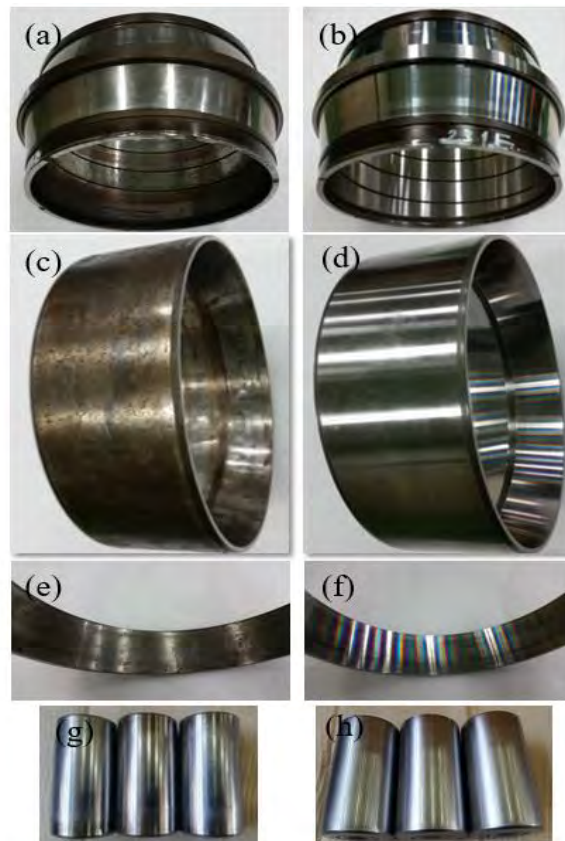


Fig. 2. Comparison of bearing (a, c, e, g) before and (b, d, f, h) after remanufacturing

Fig. 2 shows before and after the inner ring remanufacturing of the four-row tapered roller bearings. Looking at (a), it can be seen that rust and fatigue accumulated in the inner ring, and (b) after polishing and UNSM treatment in bearing remanufacturing process confirmed that rust and fatigue were removed. Below (c, d) shows before and after re-manufacturing double outer ring of four row tapered roller bearings. Looking at (c), it can be seen that rust and fatigue accumulated in the double outer ring, and (d) after polishing and UNSM treatment in the bearing remanufacturing process confirmed that rust and fatigue were removed. Below (e, f) shows the before and after manufacture of the outer ring of the four-row tapered roller bearings. Looking at (e), it can be seen that rust and fatigue accumulated in the outer ring, and (f) after polishing and UNSM treatment in the bearing remanufacturing process confirmed that rust and fatigue were removed. Below (g, h) shows before and after roller remanufacture of four row tapered roller bearings. Looking at (g), rust and fatigue accumulate on the roller, and (h) after polishing and UNSM treatment in bearing remanufacturing process confirmed that rust and fatigue were removed. The roughness and hardness of the inner and outer raceway of the large tapered roller bearing, and before and after the roller remanufacturing are shown in Table 3. Before remanufacturing, roughness double inner ring decreased from $0.242\mu\text{m}$ to $0.125\mu\text{m}$, hardness increased from 58HRc to 62HRc, roughness single outer ring decreased from $0.272\mu\text{m}$ to $0.163\mu\text{m}$, hardness increased from 58HRc to 62HRc, roughness double outer ring $0.138\mu\text{m}$ in $0.189\mu\text{m}$ Decrease to μm , hardness increased from 58HRc to 62HRc, roughness roller decreased from $0.352\mu\text{m}$ to $0.120\mu\text{m}$, hardness increased from 59HRc to 63HRc, and the inner and outer rings and roller roughness and hardness were improved after remanufacturing.

Table 3. Surface roughness and hardness measurement result of inner ring

	Surface roughness [μm]		Surface hardness [HRC]	
	Untreated	UNSM treated	Untreated	UNSM treated
Double inner ring	0.242	0.125	58	62
Single outer ring	0.272	0.163	58	62
Double outer ring	0.389	0.138	58	62
Taper roller	0.352	0.120	59	63

The measurement conditions of NTN E-M26871, KOYO 45T835921A bearing inner and outer ring raceway and roller were analyzed under conditions of exposure time 20 seconds at collimator diameter 2mm and exposure time 10 seconds at diameter 3mm. Fig. 3 Compression residual stress measurement, (a) is single outer ring, (b) double inner ring, etc. The measured values before and after remanufacturing the compression residual stress of inner and outer raceways and rollers are shown in Table 4.

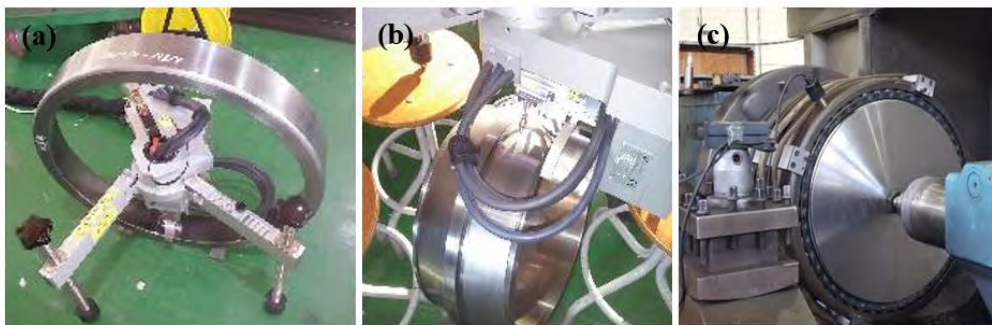
**Fig. 3. Residual stress measurement of (a) outer ring, (b) inner ring and (c) vibration test**

Table 4 shows the results of measurement of compressive residual stress for NTN E-M26871 bearings, from -772.2 MPa before remanufacturing the outer ring race to -903.4 MPa after remanufacture, -1100.2 MPa after remanufacturing from -810.9 MPa Increased from -847.1 MPa before roller remanufacturing to -1025.8 MPa after remanufacturing. In the case of KOYO 45T835921A bearings, the results of the measurement of the compressive residual stress increased from -559.3MPa before remanufacturing the outer ring raceway to -897.3MPa after remanufacturing; It increased from -882.5MPa to -1261.5MPa. After remanufacturing, the increased residual stress of the inner and outer rings of the bearings and the rollers can be considered to improve the fatigue life of the bearings.

Table 4. Residual stress measurement of Taper roller bearing

		before remanufacturing	After remanufacturing	Before and after comparison
NTN E-M26871	Outer ring	-772.2	-903.4	-131.2
	Inner ring	-810.9	-1100.2	-289.3
	Roller	-847.1	-1025.8	-178.7
KOYO 45T835921A	Outer ring	-559.3	-897.3	-338.0
	Inner ring	-736.7	-895.5	-158.8
	Roller	-882.5	-1261.5	-379.0

Vibration test was conducted to verify the operation and performance after bearing remanufacturing. Four-row tapered roller bearing operation and vibration test are shown in Fig. Proceed as 3 (c). Operation and vibration tests were carried out by rotating the outer ring fixed state inner ring using the CNC 9N forward. After the operation and vibration test, if the vibration value is less than 0.5 and more than 0.5, check the inner and outer raceway and roller condition of the bearing.

2.2 Remanufactured taper roller bearing field test results

After collecting the broken or expired bearings used in the steel industry, the UNSM applied remanufacturing process recovered and reused the service life. Table 5 shows examples of remanufacturing and using bearings in the steel industry. As a result of the field application, the performance and lifespan of the remanufactured bearings

were found to be higher than those of the new bearings.

Table 5. Examples of Bearing Used in Steel Manufacturing Industry

	Number	Part Number	Period of use	Load, T	Remarks
Receipt E/R	1	RRRNP-041(D-K)	15.11.04.15:27~	10758461.2	
	2		15.11.04.15:27~	10758461.2	
	1	SCWRZZ-001(1H1-01)	16.10.28.13:34~	6,222,846.42	
	2		17.01.21. 06:27	550,254.71	
RW	1	RCWRRE001(DM-HR-1)	17.06.03~18.12.11	1,949,755.92	Obsolete
	2		17.10.10~18.05.15	899,834.24	Obsolete
	3		17.10.10~19.01.14	1,819,602.9	Obsolete
R1		R1WRRE001(DM-HR-1)	18.07.~	2,378,532.66	
			18.07.~	2,378,532.66	
HW	1	FLWRRE001(DM-HR-1)	17.06.06~	1,408,632.80	
	2		17.09.17~	1,438,481.28	
	3		17.09.17~	1,271,754.46	
	4		17.10.01	1,242,554.33	
FW	1	FFWRRE001	18.01.12~	1,428,715.96	
	2		18.01.12~	1,428,715.96	
	3		18.02.09~	1,403,889.96	
	4		18.04.24~	1,113,447.76	

3. Conclusions

After polishing the inner and outer rings of the tapered roller bearings and the roller raceway, UNSM technology was applied. In the case of inner and outer rings, the roughness was decreased from 0.389 μ m to 0.125 μ m before UNSM, and the inner and outer ring hardness was increased from 58.0HRc to 62.0HRc than before UNSM, and the compressive residual stress of inner and outer rings was -559.2 MPa. It was confirmed that the improved from MPa to -1261.5MPa. UNSM technology was applied after polishing to reclaim the discarded spherical rollers. The surface roughness decreased from 0.352 μ m to 0.120 μ m, and the surface hardness was increased from 59.0HRc to 63.0HRc before barrel. After polishing on the raceways of rollers and inner and outer rings, fine cracks and fatigue are removed, and after nano application, fine dimples are generated on the raceways and roller spheres to create patterns, and the fatigue life and performance on the raceways and roller spheres are greatly improved. It was to be confirmed that the new bearing is equivalent or better. The large tapered roller bearing was remanufactured by the above technique, and was used after confirming that the vibration test resulted in G0.5 or less. Large-scale tapered roller bearings NTN-M26871, KOYO-45T83592A, FLWRRE001, etc., used by steelmakers, were remanufactured in 17 sets using UNSM technology remanufacturing process technology. After remanufacturing the inner and outer rings, the roughness decreased, the hardness increased, and the quality improved compared to the new product. Reduced purchasing and manufacturing costs by 65% compared to new bearings, and reduced time by 50-90%. When 1,000 kgs bearing is reused instead of new bearing, the reduction of CO₂ emission is about 3,000 kgs. This is estimated using two simple data. the first one is that 1.89 kg of CO₂ emission for the 1 kgs of steel product is produced. And the second one is that the raw material is more than 150% of net bearing weight.

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Corrosion fatigue life extension and life restoration technology development plan for aircraft aluminum alloy material and impact on sustainable economy

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Abstract

This paper introduces the selected Korea R&D project on “Service life extension and restoration of Al 7XXX alloys by nanocrystal surface modification systems” this year. The final goal is to develop a portable UNSM device and process technology using ultrasonic nanocrystal surface modification (UNSM) technology. It is intended to solve the problem of corrosion and corrosion-fatigue of aluminum alloys used in aircraft structures. A portable surface strengthening device of other technologies has already been developed. However, it was necessary to develop a portable type product of the UNSM technology, which has strengths in improving compressive residual stress, corrosion, and corrosion fatigue. There was also a demand from global aircraft manufacturers. Through this development, we plan to advance into the MRO service of aircraft manufacturers and the maintenance/repair of domestic military aircraft and KAI. We expect a sustainable economy and development by contributing to resource saving.

KEYWORDS: Corrosion, Corrosion Fatigue, Aircraft Structure, Al Alloy 7XXX, Surface Modification

1. Introduction

Fig.1 shows the parts of the aircraft body made of aluminum alloy and also the defect phenomena occurring in each part. The direction of technology development pursued by the world to prevent corrosion and corrosion-fatigue that occurs in the aircraft body. It is intended to develop materials with excellent corrosion resistance, to reduce corrosive environment and to minimize stress change.

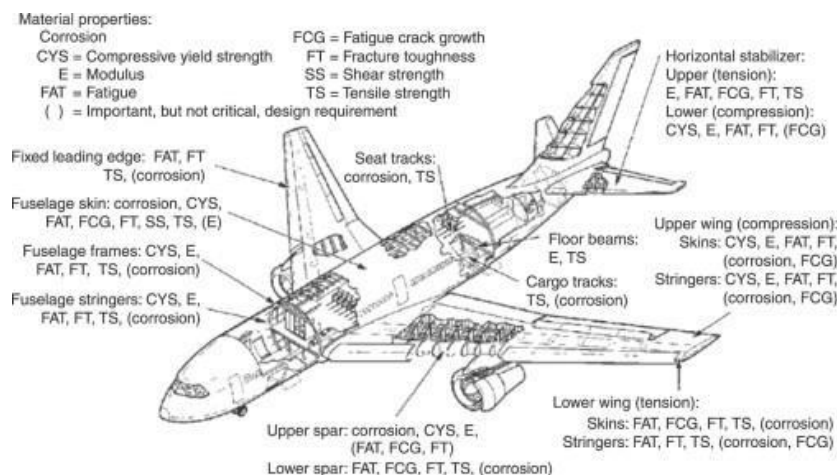


Fig. 1. Defective parts of aircraft airframe

The patented UNSM technology jointly developed by the Institute for Manufacturing System Technology, Sun Moon University and DesignMecha Co., Ltd. is a surface modification technology. In a previous study, basic research was conducted to improve the corrosion-fatigue lifespan of Al 7075-T6 alloy by UNSM treatment [1]. The development of technology to extend the life of aircraft fuselage is a key technology that is continuously needed - UNSM technology is considered an innovation technology that can improve the corrosion-fatigue lifespan of Al 7075-T6 alloy. The important task is to develop a compact portable UNSM device and process technology that can be used for Corrosion/Corrosion-Fatigue MRO service of aircrafts and verify its effectiveness.

2. Development and Evaluation of Nanograined Optimizer Device for Improving Corrosion Properties of Aviation Materials

Table 1 lists the final objective and the 1st year research contents.

Table 1. R&D objectives and contents

Final Objective		Development of Compact Portable UNSM Process Technology for Corrosion and Corrosion Feature MRO (Maintenance-Repair-Overhaul) Service of AIRBUS Aircraft Structures
1st Year	Objective	Development and Evaluation of Nanograined Optimizer Device for Improving Corrosion Properties of Aviation Materials
	Content	<ul style="list-style-type: none"> - Development of an oscillator for UNSM optimizer - Development of a UNSM processing optimizing device - Development of compact portable UNSM processing system technology - Optimization of UNSM treatment conditions and measurement of basic properties of Al 7xxx alloys with UNSM optimizer - Microstructural analysis of Al 7xxx alloys - Perform corrosion and fatigue corrosion tests

2.1 Development of an oscillator for UNSM optimizer

The UNSM device was developed in the first year is shown in Fig. 2. UNSM optimizer consists of unit and equipment, mechanical part, and control device.

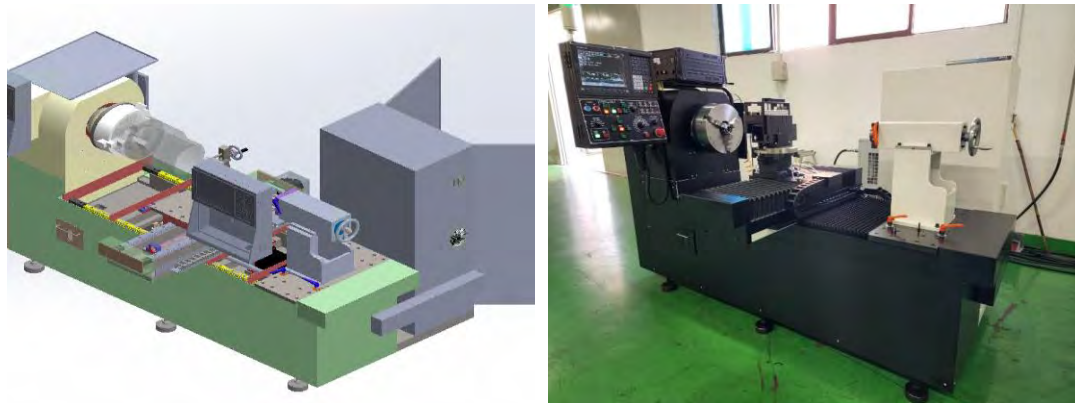


Fig. 2. UNSM optimizer for surface modification of aircraft materials

2.2 Fatigue performance rejuvenation of corroded 7075-T651 aluminum

Fig. 3 shows the scale parameter is about 2.0×10^5 , 2.8×10^5 , and 6.0×10^6 for corrosion 2 h, corrosion 2 h + burnishing, and corrosion 2 h + UNSM specimens at a stress level of 160 MPa, respectively. From the Weibull analysis, it can be noticed that UNSM improves the fatigue life of the corroded specimens by 30 times, while burnishing improves the fatigue life by only 1.4 times. [2]

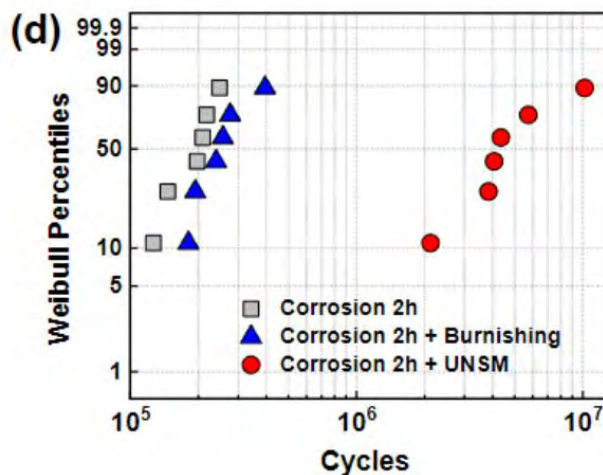


Fig. 3. Weibull plots for different groups of specimens at a stress level of 160 MPa [2]

3. Conclusions

The expected ripple effects and conclusion of this development are as follows:

- Technological ripple effect
 - ✓ Development of compact portable UNSM device to secure new application technology for corrosion and corrosion-fatigue MRO service of civil aircraft (AIRBUS) in operation
 - ✓ Development of UNSM device with manipulator/robot to improve cost and stability by extending corrosion and fatigue life of newly manufactured civil aircraft (AIRBUS, etc.) and secure technology to replace ultrasonic/laser peening technology currently in use

- Economical and industrial ripple effect
 - ✓ AIRBUS will achieve sales of 5 billion won within 10 years of development by entering new market with new application technology (compact portable UNSM device) (corrosion and corrosion fatigue MRO service of civil aircraft in operation)
 - ✓ AIRBUS will achieve 3 billion won in sales within 10 years of development by entering a new market with new application technology (Manipulator/Robot equipped with UNSM device)
 - ✓ Domestic KAI and BOEING/Lockheed Martin are expected to achieve 3 billion won in sales in MRO and new markets within 10 years after development
 - ✓ AIRBUS will enter to the military aircraft market and achieve sales beyond the size of the civil aircraft market
 - ✓ As it grows into a company specializing in surface treatment improvement, it can hire 5 additional professional engineers within 5 years of technology development, and 5 additional engineers each year for the next 5 years (10 people in total)

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An accurate indirect measurement system and algorithm for changes in the external environment

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Abstract

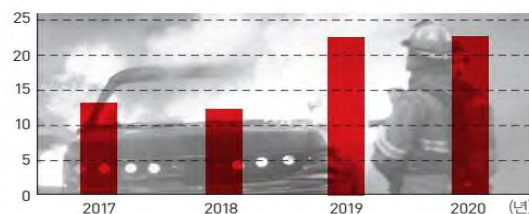
Recently, many issues have arisen due to battery fires. In the Battery Management System (BMS), a system for protecting an existing battery, the voltage of the battery was measured by physically connecting each battery cell and the MCU. However, if a battery voltage operating at up to 1,000 volts incorrectly affects a control board operating at 5–24 V, the control part of BMS would fall into an inoperable state, and in severe cases, Stable BMS operation would be required to lead to a battery fire. Previous studies proposed and designed an indirect measurement technology that physically isolates the battery and control unit. The battery indirect measurement technology in previous studies confirmed that the battery cell monitoring value changed significantly according to changes in the external environment. Accordingly, in this paper, accurate measurement results even in changes in the external environment were studied on the environment. If an accurate value is not derived from the battery monitoring system, the battery may be overcharged or overdischarged during operation of the battery system, and thus the battery system may not ensure an accurate operation, causing a problem such as battery explosion. In addition, battery state data values, such as State of Charge (SoC), State of Health (SoH), and the like, may cause malfunction of the battery system, causing confusion to the user. In this paper, the reference voltage Ref of the low drop out (LDO) is in the same circuit as the circuit that measures the existing battery cell voltage to move to change characteristics such as external environmental changes. A parallel compensation circuit was proposed to operate as an LED, an algorithm that could accurately read a battery cell voltage even in a change in an external environment was presented based on the circuit, and the algorithm was presented to have an accurate result, and a stable operation result was ensured with an error within 5 mV.

KEYWORDS: Indirect Measurement System, BMS(Battery Management System), LED, LDO(Low Drop Out)

1. Introduction

Recently, with the development of battery technology, it is widely used in the field of electric vehicles, such as Uninterruptible Power Supply (UPS) & Energy Storage System (ESS), etc., demand for a system using lithium-ion batteries has increased rapidly. Accordingly, the demand for battery management system (BMS), which has a function of controlling and protecting a battery, is increasing [1]. However, as battery fires have recently occurred, many issues have been raised. The status of electric vehicle fire accidents is shown in Figure 1 [2].

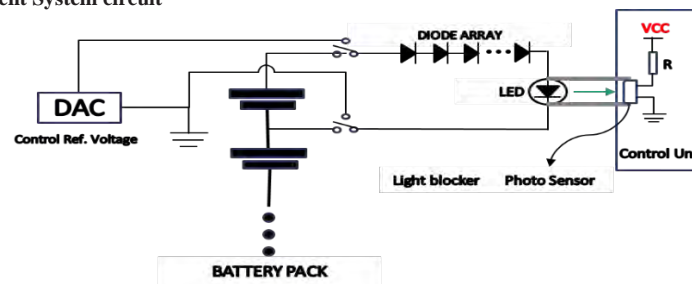
Fig. 1. Current status of electric vehicle accidents [2]



As illustrated in Fig. 1, it can illustrate that fire accidents involving electric vehicles significantly increase as the registration of electric vehicles continues to increase. Therefore, this study proposes a system to identify the main causes of electric vehicle fire and prevent fire accidents. A battery fire is caused by various causes, such as temperature and humidity of the surrounding environment, a battery fire caused by overcharging, etc [3]. However, most of the causes are that the overvoltage of the battery affects the control unit that uses a low voltage, which destroys the control unit, and accordingly, the control unit cannot react with it, leading to a battery fire. As a representative function of BMS, it monitors the voltage between cells of a battery to support an overcharge protection function and safely performs charging and discharging through battery cell balancing. However, it is reported that the control unit is destroyed due to an imbalance between a battery capable of representing 600V or higher and a control unit operating between 1.2 and 2.4V, and a fire accident of battery is ensued due to BMS failure. Accordingly, as a fundamental solution, a study was conducted to isolate the high voltage battery and the control module in previous control module [4]. The indirect measurement circuit of previous studies is shown in

Figure 2.

Fig. 2. Indirect Measurement System circuit



As illustrated in Fig. 2, the indirect measurement system of previous research estimates the battery voltage by measuring the LED whose light intensity changes depending on the battery voltage by connecting the battery, LED, and diode in parallel. The control unit controls the switch connected to the LED and the diode so that the battery voltage and the Digital to Analog Converter (DAC) are sequentially connected. DAC is a device that generates a specific voltage according to an input digital value and is used to generate a changeable voltage. Accordingly, DAC was used as a reference voltage for converting the brightness of an LED indicated by a specific battery voltage into an accurate voltage, thereby significantly improving the battery voltage measurement accuracy of an indirect measurement system. However, the purpose of the indirect measurement system is to isolate the battery and the control unit to prevent the control board from being destroyed due to the high current of the battery even if the battery malfunctions. Such a system has a limitation in that the DAC cannot be physically isolated because it is controlled by the control unit. In this paper, we propose a system that removes the DAC and completely isolates the control board and battery

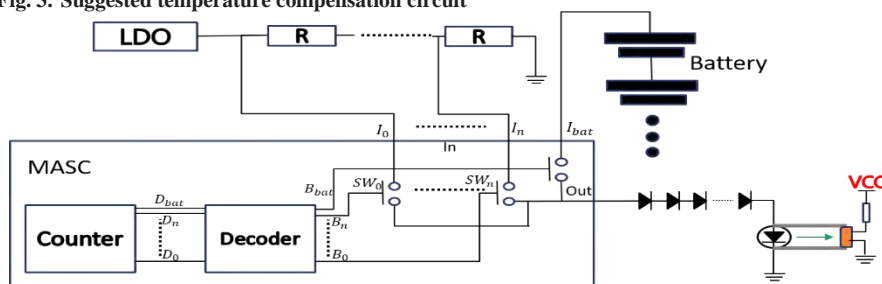
2. Novel temperature compensation circuit

The battery and the control board should be isolated to be used as a reference voltage in the indirect measurement method, so the voltage source of the reference voltage should not be controlled by the control board. Therefore, it must operate on its own without the control of the control board. The reference voltage is a reference voltage used to change the brightness of an LED changed according to a battery voltage to a voltage, and when the reference voltage is changed according to an external environment (temperature and humidity), the accuracy of the indirect measurement system is lowered. Therefore, the conditions that can be used as the reference voltage must generate the output desired by the user without control of the control board and accurately represent the output of the device even in changes in the external environment.

2.1 temperature compensation circuit

This paper proposes a circuit using a multi-analog switch with counter (MASC), which can operate without control of a control board, and represents a reference voltage using low drop out (LDO), which accurately represents a desired power even in an external environment change. The circuit proposed in this paper is shown in Figure 3.

Fig. 3. Suggested temperature compensation circuit



In the structure of Fig. 3, the battery voltage and LDO are connected in parallel, the LDO and the resistor are connected in series, and the voltage represented by the LDO is changed to a user's desired voltage using the resistor, a voltage to be used as a reference is supplied to the Multi Analog Switch with Counter (MASC), and one of the connected voltages is selected to the LED. Since MASC includes a counter function, it generates a specific cycle to operate the switch sequentially without control of the control board. Accordingly, the control board, which is a problem of the existing indirect measurement technology, may obtain the intensity of light matching the battery voltage required to convert the intensity of light of the LED into a voltage without being involved in the battery

area. The MASC includes a counter function and sequentially controls the switch without external control. A clock is generated in the counter, and a signal is generated in the decoder, and SW0 to SWbat are sequentially operated. SW0 to SWn are switches responsible for the reference brightness value of the corresponding battery cell, and SWbat is switches that switch the brightness circuit of the reference light using the battery and LDO. The control board measures the intensity of light by issuing a command to the analog to digital converter (ADC) at a specific moment. However, in the technology proposed in this paper, only the counter is used to control the control board without connection with the control board, so it is impossible for the control board to check whether the measured intensity of light is the reference brightness or the battery brightness value. This patent technology controls SW from a low reference voltage to a high voltage, and then indicates the intensity of light depending on the battery voltage. Using this, when the measurement from I0 to Ibat is completed, it is possible to define the use of the measured value. Also, due to the nature of a system that generates a reference voltage using LDO that generates the same output even if the temperature and humidity of the LED change as the intensity of light of the LED changes according to the temperature change, so it is possible to accurately measure the voltage.

2.2 Algorithm of Indirect Measurement Technology

The indirect measurement circuit measures the battery voltage by measuring the brightness of the LED, which changes according to the battery voltage, with a photo sensor. Therefore, there is a need for an algorithm that converts the brightness value of the LED into a voltage. Accordingly, this paper proposes an algorithm that converts brightness values of LEDs into voltages. The resistance value of the photo sensor used in this paper changes according to the input intensity of light. Accordingly, when VCC is connected to the front end of the photo sensor, when the resistance value increases according to the light of the LED, the voltage applied to the photo sensors at both ends is measured to measure the brightness value of the light. In this paper, it is defined as Brightness. Figure 4 shows the value of brightness that changes with battery voltage.

Fig.4 . The measured brightness value of the photo sensor

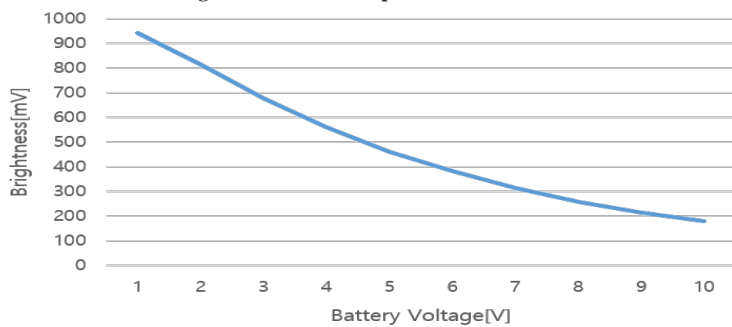


Figure 4 shows the measured brightness value of the photo sensor. The brightness value of the LED measured by the photo sensor is measured in inverse proportion to the battery voltage. Accordingly, this paper uses LDO and MASC devices to measure the intensity of light from 3.9V to 4.2V, which is the operating section of the battery voltage, stores it in the memory of the control board, and compares the intensity of light from the LED to 4.2V. Equation 1 shows the equation for estimating the voltage through the voltage measurement method of the indirect measurement system.

$$\text{Battery Voltage} = \frac{\text{Brightness}[l - 1] - \text{Brightness}[l]}{k} \tag{1}$$

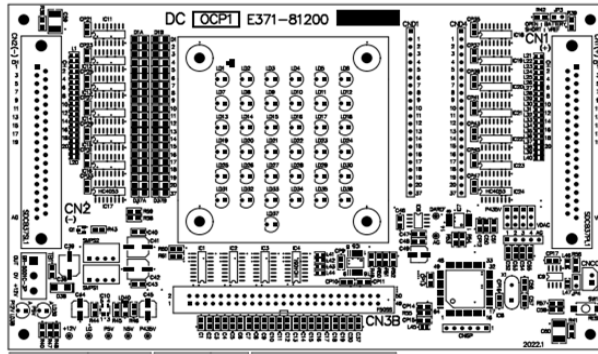
(l : The level at which the measured brightness value becomes less than the reference brightness value)
 (k : a divisional rate)

The battery voltage measurement algorithms are smaller than the measured battery voltage of the light obtained by using the measured battery voltage of the measured battery voltage, according to each voltage. Accordingly, the battery voltage calculates the battery voltage as shown above.

3. Results

The layout of the designed indirect measurement system is shown in Figure 5. Figure 5 shows the circuit design using LDO and MASC, and the algorithm for indirect battery measurement is included.

Fig. 5. Designed Indirect Measurement System



The average of values measured more than 10 times by applying a voltage from 3.9V to 4.2V to the LED channel of the designed board is shown in Table 1. Measurement Voltage [V] #1 in Table 1 is the value measured at room temperature, Measurement Voltage [V] #2 is the result measured while continuously applying heat to the LED, and Measurement Voltage [V] #3 is the value measured in the freezer environment. In the results of Table 1, it had an error value of 5 mV even in external environmental changes.

Table 1. Result of Designed Board

Battery Voltage[V]	Measured Voltage[V] #1	Measured Voltage[V] #2	Measured Voltage[V] #3
3.900	3.902	3.901	3.901
3.950	3.953	3.948	3.952
4.000	3.998	4.002	4.001
4.050	4.052	4.049	4.050
4.100	4.099	4.102	4.101
4.150	4.148	4.152	4.151
4.200	4.203	4.199	4.201

4. Conclusion

In this paper, a clear physical isolation circuit, which is an existing problem, is proposed and implemented by using LDO and MASC as the reference voltage of the indirect measurement system. The voltage measurement error of the proposed system was within 5 mV. In addition, the reference voltage in a system using LDO and MASC derived the same voltage even in changes in the external environment, and a solution to the error according to temperature was presented using the characteristics of the system sharing the measured LED. In future studies, we will study a system that performs cell balancing, the main function of BMS, without physical connection.

Acknowledgement

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A social movement-state coalition: A comparative analysis of the Victory over Communism Movement between South Korea and the United States

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Abstract

This study examines the Victory over Communism (VOC) movement that the Unification Movement led until the fall of the Soviet Union. Investigating this international movement, the research focuses on how the same VOC movement operated similarly or differently in two distinct national settings of South Korea and the United States. Specifically, we examine coalition strategies of the VOC movement with its respective government. We collected archival data for the VOC movement and conducted interviews with former VOC activists in both countries. Our findings show similarities and differences in the ways in which each VOC movement collaborated with its government. Their similarities are: 1) Both VOC movements were able to build a more cooperative relationship with a particular administration when a president had a strong desire to defeat communism. 2) Both movements contributed to a government's anti-communism initiative by offering the most needed resources for each government at the time. Their differences are: 1) The coalition relationship was more independent in the U.S. VOC movement than in the Korean movement, presumably due to the different social and political contexts of a democratic country versus an authoritarian state. 2) Relatedly, the coalition type was different with the Korean movement forming a "linking coalition" of a vertical network with the government, as opposed to the U.S. movement establishing a "bridging coalition" of a horizontal network with its government.

KEYWORDS: Anti-communism, social movements, Unification Movement, coalitions

1. Introduction

The Unification Church (UC) or Unification Movement (UM), despite being a religious organization, has founded various NGOs as the church's external arms, under the banner of establishing world peace centering on God (Pokorny 2018). Among the many peace initiatives that the UM led, the Victory over Communism (VOC) movement was most prevalent until the Soviet Union collapsed in 1991. During the Cold War era, the VOC movement made international efforts to defeat communism. This article compares the VOC movement across two countries, South Korea (hereafter Korea) and the U.S., from social movement perspectives. Drawing on a social movement concept of coalition, we investigate how the coalition strategies of the movement were similar to or different from each other between the two countries.

2. Literature Review: A Movement-State Coalition

Social movement organizations often form coalitions as they strive to achieve movement goals. Coalitions refer to cooperative efforts among social movement groups to work toward common goals, while maintaining their distinct organizational identities and structures intact (McCammon and Moon 2015; Staggenborg 2015). The most common types of coalitions include within-movement coalitions, cross-movement coalitions, and transnational coalitions. (Brooker and Meyer 2019; Van Dyke 2017). A less common form of coalition is a social movement-state actor coalition. A small number of studies examine how social movements work together with state actors, such as state agencies, political parties, and judicial courts, to achieve their political goals (Stearns and Almeida 2004; Brooker and Meyer 2019). Frequent partners of a movement-state actor coalition are oppositional political parties and social movement organizations challenging existing politics. The religion-based VOC movement, on the other hand, built an unusual partnership with an administrative branch of the government in both countries. Investigating this unconventional type of coalition that also took place in different national settings, we aim to expand our knowledge base about a social movement-state coalition from comparative perspectives.

3. The Victory over Communism Movement: Historical Background

The VOC movement started as one of the many peace initiatives that the founder of the UM, the Reverend Sun Myung Moon (hereafter Rev. Moon), established. From the very beginning, Rev. Moon emphasized that the movement is not simply an anti-communist movement, but a movement that aims to overcome communism that denies the existence of a monolithic God (Moon 1976). According to UM theology, the rapid spread of communism across the world posed the biggest threat to world peace centering on God (Park 2002). From the late 1950s, Unificationists were mobilized to stop communism from infiltrating into local villages of Korea. With the establishment of the International Federation for Victory over Communism (IFVOC) in 1968, the movement expanded beyond Korea, particularly to Japan and the U.S. The Korean government began to recognize the VOC

movement as a valuable resource for its anti-communism education from the early 1970s, and sponsored hundreds of VOC educational seminars to civil servants, soldiers, police officers, and local officials (IFVOC 1990).

The VOC movement in the U.S. started in 1969 with the creation of the Freedom Leadership Foundation (FLF). The FLF was an educational organization to promote VOC theory, targeting politicians in Washington, D.C. (Ward 2006). Another organization, called the College Associate for the Research of Principles (CARP), also conducted VOC activism as a student-based group to confront the anti-Vietnam War movement in college campuses during the 1970s. In 1983, a new organization, CAUSA USA, was founded to lead a nation-wide VOC movement. CAUSA educated retired military officers, former politicians, and religious leaders about the dangers of atheistic communism, with the catchphrase of “God or no God” (Park 2002). VOC activism gradually dissolved in both countries since the late 1980s as the communist countries began to collapse, culminating in the dissolution of the Soviet Union in 1991.

4. Data and Methods

The major sources of our data are documents published by the IFVOC and interviews with former VOC leaders. The documents we collected include: 1) official reports of VOC activities and accomplishments in multiple IFVOC publications, 2) memoirs of VOC leaders, 3) the UM magazines covering VOC activism, and 4) scholarly works mentioning VOC movements. After reviewing these documents, we constructed interview questions to directly ask about the relationship between the movement and its respective government. We interviewed six former VOC activists who played major roles, such as lecturers or executive directors, in VOC organizations. Four of them were involved in the Korean movement, and the rest were active in the U.S. movement. The first three authors of this research interviewed two people each, through a Zoom/phone call or in person. Using a prepared list of interview questions, we conducted semi-structured interviews for about one to one and a half hours per each interview. We also reviewed the 615 selected volumes of Rev. Moon’s words, using a search function with keywords related to VOC, to understand the directions of the VOC movement set by its top leader. Finally, we analyzed the contents of the collected data to find answers to our research questions, by looking for patterns in the data.

5. Findings

5.1. Similarities in VOC coalitions between Korea and the U.S.

VOC efforts were most active from the late 1960s to the late 1980s in both countries. While each VOC movement operated under different presidential regimes over two decades, the best cooperation between the movement and a government took place when a president showed a strong desire and executing plan to fight against communism. In Korea, Park Chung-hee was more cooperative with the VOC movement and serious about defeating communism, compared to his successor Chun Doo-hwan. The Park administration was eager to prove South Korea’s superiority to North Korea, by making an economic advancement over North Korea, while educating South Korean people about the fallacy of communist regimes simultaneously. Frequent attacks of armed communist guerrilla at the time also posed a serious threat to the Park administration. On the other hand, Chun Doo-hwan was initially reluctant to work with the VOC movement, because North Korea’s communist threat became weaker over time, and South Korea achieved rapid economic development by the 1980s.

In the case of the U.S., several presidents took the office during the Cold War era, and Ronald Reagan had the strongest desire to end communist regimes in the world, which happens to be the time of the VOC efforts being most active. Reagan was different from Richard Nixon who pursued a détente policy. Whereas Nixon took a relaxed approach to communist countries, the Reagan administration had a firm stance to stop communism’s spread, as reflected in his support for the contras in Nicaragua (*Interview with Ward*).

In both countries, when a president had a strong desire to fight against communist threats, the VOC movement offered valuable resources to each government. In Korea, the Park administration was in need of a nation-wide system of educating Koreans against communist threats. For instance, when armed communist guerrillas frequently appeared in Kangwon Province, the VOC movement provided the local government with ideological resources to educate village residents about the fallacy of communism. Although the Park administration established the Korean Anti-Communist League throughout the nation, the government relied more on the VOC movement for anti-communism educational seminars, because the movement offered a unique VOC theory as well as passionate lecturers working tirelessly, trying to fulfill their religious mission (*Interview with Lee*).

What the Reagan administration needed in its anti-communism efforts was different, which was support from conservative voices. Despite Reagan’s strong desire to defeat communism, social and political contexts at the time did not welcome overtly anti-communist stances, particularly after the retreat from the Vietnam War and the legacy of McCarthyism (*Interview with Ward*). For instance, U.S. Congress stopped Reagan’s plan to send military and financial aid to the contras, which was struggling against the leftist regime Sandinistas in Nicaragua. When Reagan faced such opposition, conservative groups, including CAUSA USA, participated in mobilizing “humanitarian aids” for the contras, in order to back up Reagan’s policy (Walker 1987). The Washington Times,

an external arm of the UM and conservative daily newspaper published in Washington, D.C., also showed strong and consistent support to Reagan's Strategic Defense Initiative (SDI), as opposed to other liberal newspapers, such as the New York Times (Ward and Swarts 1997).

In summary, cooperation between the VOC movement and a presidential administration in both countries was most prominent when a president had the strongest desire to defeat communism and the VOC movement was able to offer what each administration needed in its anti-communism efforts.

5.2. Differences in VOC alliances between Korea and the U.S.

Although the VOC movement in both countries had the same goal of overcoming communism during the Cold War era, the ways in which the movement worked with each government differed significantly. The biggest difference was that the U.S. movement kept an independent relationship from the U.S. government, whereas the Korean movement was contingent upon the reactions of the Korean government. For instance, former VOC activists in the U.S. emphasize that they did not expect or even tried to get any assistance from the government for their VOC activism, but instead they supported the government's anti-communism policies through CAUSA USA and the Washington Times (*Interviews with Fefferman and Ward*). The social contexts of the U.S. at the time made it even more difficult for the VOC movement to build an open partnership relationship with the government, as the criticism of the Vietnam War and McCarthyism were still dominant in the society. Moreover, because CAUSA USA was not registered as a lobbying organization, but as an educational group, the movement could not directly engage in politics.

On the other hand, the Korean VOC movement took place under authoritarian regimes, which eventually restricted the operation of the movement. When the needs for defeating communism were met between the two, the Park administration sponsored VOC activism by sending government, military, and police officials to VOC seminars. However, when Chun Doo-hwan realized that the UM was expanding its influence on local politics across the county through the VOC movement, he went against the movement, discouraging people from participating in VOC seminars (*Interview with Seol*). Although the Chun administration changed its position later on and resumed a partnership relationship with the movement, this exemplifies the imbalance of power in the movement-state coalition in Korea.

The difference in social and political contexts between the two countries also led to creating distinct forms of a movement-state coalition. Borrowing a concept from social capital theory, we call the type of coalition in Korea a "linking coalition," and the coalition type in the U.S. a "bridging coalition". "Linking" in the theory of social capital refers to a particular group vertically networked or engaged with states or government agencies (Bhandari and Yasunobu 2009). Linking social capital allows engaged groups to be networked with important decision makers in the state, yet the relationship is inevitably hierarchical. This concept reflects the relationship that the Korean VOC movement had with the Korean government. Although the movement benefited a lot from the official recognition and sponsorship from the government, the hierarchical nature of the relationship also put the movement in danger when the government took an oppositional position against the movement.

The U.S. VOC movement, on the other hand, formed a "bridging coalition" with its government. "Bridging" in social capital theory refers to distant ties between groups that are horizontally connected to one another to achieve a common goal (Bhandari and Yasunobu 2009). As discussed earlier, the U.S. movement could not form an open partnership relationship with its government. Thus, the movement decided to support the government indirectly through its civil society activism and conservative news media, which led to creating a "bridging coalition" for the shared goal of defeating communism with the Reagan administration. Such an independent relationship might have also helped the movement retain its power, even when their leader, Rev. Moon, was briefly imprisoned during the Reagan era. In fact, imprisonment of Rev. Moon made it possible for the movement to be connected to other religious groups under the banner of religious freedom and fight against atheist communism in the 1980s.

In summary, different socio-political contexts across countries influenced how the VOC movement strategized its coalition efforts with its respective government, with Korea forming a vertically dependent coalition, as opposed to U.S. creating a horizontal and independent relationship.

6. Conclusion and Discussion

This research examines a less studied topic of a social movement-state coalition in the coalition literature, with the case of the VOC movement in Korea and the U.S. We ask under what conditions the coalition of the VOC movement and the government is formed, and how different socio-political contexts affect the type of coalitions created. We find that the best cooperation between the movement and the state takes place when there is a president who shares the same goal with the movement and when the movement can offer valuable resources for anti-communism efforts to its respective government. We also find that the VOC movement in each country formed a different type of coalition, Korea creating a "linking coalition" and the U.S. building a "bridging coalition," influenced by the social and political environments of the countries at the time. Future research may investigate how the different types of coalition, one being vertically networked and the other horizontally networked, affect the outcomes or effectiveness of the coalition.

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A review on activities of religious based sex education organization for youth: Focused on the 'Korea Youth Purelove Movement', Family Federation for World Peace and Unity

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Abstract

The value of Chasity, Purelove or Absolute Sex is crucial in Unification Movement. Marital love is located at the center of the ideal of true family in the teachings of Family Federation for World Peace and Unity, and this marital love is maintained through chastity before marriage and fidelity after marriage. Since sexual purity is an important value of the FFWPU, the Purelove movement is one of the many social movements developed by the FFWPU.

The purpose of this study is to review activities of 'Korea Youth Purelove Movement' and suggest policy implication of the movement. I chose 'Korea Youth Purelove Movement' as a case, since the Founder of FFWPU used the KYPM for providential reasons on the importance of youth chastity based on Unification Principle and Unification Thought. In addition, KYPM is one of the places where the Founder's ideology of Purelove met with public. Therefore, this KYPM's activities are organically linked to the establishment of department of Pure Love and the development of 'Pure Love Studies' Also, I reckon there are still KYPM has contributions left in the school-based sex education in Korea.

This study reviews the contents of activities of the KYPM in the three dimensions of structure, culture, and teacher-student interaction derived from previous research. It also suggests a direction of future activities as a venue that can apply Purelove studies to real life. Previous studies on the subject of Purelove studies have been developed at the general level. They researched the academic definition of Purelove on the Unification Thought and the Founder's teachings. Some studies have applied its practical application. More concrete and specified researches in the field of Purelove should be conducted. In particular, compared to international research trends, Purelove is devalued as an outdated value linked to patriarchy in the research of school-based sex education. Purelove needs to be thoroughly studied and given meaning again as a value that establishes the safety and health of adolescents.

KEYWORDS: School based sex education, Pledge movement, Purelove education, Korea Youth Purelove Movement

1. Introduction

The value of Chasity, Purelove or Absolute Love is crucial in Unification Movement. Marital love is located at the center of the ideal of true family in the teachings of Family Federation for World Peace and Unity, and this marital love is maintained through chastity before marriage and fidelity after marriage. Since sexual purity is an important value of the FFWPU, the Purelove movement is one of the many social movements developed by the FFWPU.

Sex education for youth has been regarded important by parents, government and scholars. Those actors, however, maintained different view on which contents to be taught and how it should be delivered. A discourse on sex education, or sexuality education for young adolescent has been divided into several realms. If I dare to generalize, it can be divided as three: structure, culture, teacher-students interaction.

Korea Youth Purelove Movement was established in 1997. Maintaining sexual purity before marriage, in other words, not experience sexual intercourse before marriage was crucial guidance for youths in the Unification Church. It was not until the 'Movement' was established, that UC aimed to provide 'Purelove education' for youth in public. Since the founder wished Korea to be the model and center of Purelove movement, Korea, 'Korea Youth Purelove Movement' was established in after following some 'providential' events.

The purpose of this study is to review KYPM's activities and suggest policy implication of the movement. I chose 'Korea Youth Purelove Movement' as a case, since the Founder of FFWPU used the 'Movement' for providential reasons on the importance of youth chastity based on Unification Principle and Unification Thought. Also this 'Movement' is one of the place where the founder's ideal of Purelove met youths in public. If we narrow down the age of youth to students aged 8-18, this 'Movement' is the only UC organization that actually approached students in their school. Therefore, this movement is organically linked to the establishment of department of Pure Love and the development of 'Pure Love Studies' in the Sun Moon University. Alongside of this internal significance, I reckon there are still this 'Movement' has contributions left in the school-based sex education in Korea.

This study reviews the contents of activities of the 'Movement' in the three dimensions of structure, culture, and teacher-student interaction derived from previous research, and suggests a direction of future activities as a venue that can apply Purelove studies to real life.

2. Methods and Previous studies

2.1 Method

This study was conducted through the literature review method. Firstly, previous studies on school-based sex education were reviewed. Next, I reviewed the internal data of the Family Federation. The homepage of the KYPM, the autobiography of Kim Bong-tae, the first president of the KYPM, and newspaper articles on the activities of the KYPM. were reviewed.

2.3.1 Previous studies on Purelove

Purelove studies attempted to systematize based on the Unification Thought. Since the establishment of the Department of Purelove in 1999, this work has been led by the faculty of the Department of Purelove. Sang-huy Moon, who was appointed as a professor in 1999, described the ideology and educational content of Pure Love Studies as a unification thought.¹The characteristics of Purelove Studies are emphasized in that it is a study that seeks to answer the following questions about human nature. In other words, Purelove Studies, based on the Unification Thought, identifies 1) the origin of human life, 2) the structure of human existence, 3) the function and ability of human beings, 4) the purpose of human existence, and 5) the universal principles of human life. Many studies focused on the general character of Purelove², and some studies tried to apply the character of Purelove to practical topics.

2.3.2 Previous studies on School-Based Sex Education

Previous studies on school-based sex education can be divided into three levels, referring Smith³. School-based sex education works at multiple levels, including structural, cultural and interactive aspects, so it can be studied sociologically at various levels. Hereby I present previous studies on School-Based Sex Education by the three dimensions.

The structural dimension concerns policies laws. This is an external resource outside the educational content that can strengthen or weaken a particular direction of sex education.

The cultural dimension is located some 'blurry and less certain attitudes' between the two sides of religiosity, morality and political orientation. Parents' concern about their children's health and safety, not of their religion or political parity where they belong to can be a cultural motivation for sex education can be an example. Also, the message of sex education may vary by different region⁴, teacher's translation⁵, influence of popular culture⁶.

In terms of the interactive dimension, three actors-teachers, parents, and students are involved. In this paper, the analysis will be limited to the role of teachers. Previous studies researched the effect of school-based sex education on the delayed effect of student's first sexual experience and the use of contraceptives; however, they didn't focus on possible mediating and moderating variables in the classroom. They might include practitioner experiences, interactions in the SBSE classroom, etc.

3. Results, Discussions, and Conclusions

3.1 Founder's strategy on 'Korea Youth Purelove Movement'

3.1.1 Being 'School-based' sex education at all schools in Korea

The founder wanted all elementary, middle and high school students to receive Purelove education. To him, getting all students to receive Purelove education was like setting a signboard for developing 'providence' to the next level⁷ Receiving Purelove education was the first task that youth of motherland (Korea) should complete. The founder is also proposing to educate students within the school system. Because students grow up in the education system, it is believed that students educated in middle and high school can continue to be connected to education even after graduating and going to university.⁸ The founder also suggested working through government ministries related to education. He said that exchanges between countries would be possible through each country's Ministry of Education.⁹

3.1.2 Becoming a lifestyle movement beyond the school classroom.

The founder wanted the Purelove movement to become a **social movement** as well as a school-based education.¹⁰ He urged that the educators of the Purelove movement would develop the purity movement even in the streets around the school centered on the principal.¹¹

The founder also hoped that the contents of Purelove education conducted in schools would be 'generalized' not known only by teachers. That is, to form a culture, rather than remaining only in the classroom. He hoped that students' writings on Purelove education they have received and practiced would be published in newspapers and magazines and aired on TV and radio.¹²

3.1.3 Becoming holistic educators who were fully responsible for young people.

He also wanted Purelove Movement educators to take full responsibility for their students. He urged educators to visit the students in his district and carry out activities to edify them day and night.¹³ If there is a standard for taking responsibility for students, the Purelove educators have to become a police officer at night and have a maintenance campaign if there are bad people while walking the streets.

3.2 Review on Korea Youth Purelove Movement's activity

3.2.1 Being 'School-based' sex education at all schools in Korea

Since Purelove education was conducted in schools, the target for the number of educated students was achieved. According to president Kim, KYPM was established in Oct of 1997 and completed Purelove education of 8.3million students in Korean Primary and Secondary schools by the first half of 1998.¹⁴ To achieve the goal of educating many students in a short time, three method was used. They were 1) to have all students in the school ground at the same time 2) to teach the Principals and Teachers to educate their pupils (providing video tape) 3) speak through a broadcasting speaker to each of the classrooms simultaneously.¹⁵ Instead of recruiting students to be educated, KYPM used the school system that already had students.

As an effective strategy, KYPM registered as a corporate body with the Ministry of Education and entered into partnerships with related organizations and officials. Kim Bong-tae, who was the first head of the 'Movement' registered the KYPM as a corporation under the Seoul Metropolitan Office of Education, and promoted that each provincial office of education sends an official letter to each school to invite educators from the Korea Youth Purelove Movement.¹⁶ Those official status and partnerships protected KYPM from an accusation from individuals concerned about KYPM'S religious background. A member of the National Assembly raised questions about KYPM's status as a corporate body and demanded a parliamentary audit to cancel the status¹⁷, but the issue was resolved without a major harm thanks to the relationship of trust that had already been built up.¹⁸.

3.2.2 Becoming a lifestyle movement beyond the school classroom

KYPM's Purelove education in the classroom already includes cultural elements. The Purelove education of KYPM includes the purity pledge ceremony, distribution of Purelove candy, Purelove badge and stationeries pictured with silver-ornamental knife which is a symbol of chastity in Korean tradition.^{19,20} The Purelove candy and chastity bookmarks were printed with the campaign phrase, 'Purelove is my pride, my happiness'.

Purelove education tried to expand to cultural movement beyond school. They organized youth writing contest, published the newsletter 'Pure Generation', and hosted a youth Purelove concert.²¹ In the Purelove concert, celebrities such as Fin.K.L. and Shinhwa who were appointed as public relations ambassadors for the KYPM performed. The Purelove Writing Contest was sponsored by the Ministry of Education, the Office of Education, and several universities, and the Grand Prize was awarded in the name of the Minister of Culture, and the President's Committee on Youth Protection also awarded the Chairman's Award.²²

3.2.3 Becoming holistic educators who were fully responsible for young people

KYPM had difficulty securing trained educators from the early period. Although the headquarters received an activity goal from the Founder, it was unable to mobilize trained youth leaders or pastors and was in a poor financial situation.²³ They ran expert training courses for lecturers and counselors from 1999, almost every year.²⁴ The training course for Purelove lectures continued after 2000. Most of lectures received instructor qualifications through training course once a year and received retraining once a year. Such short-term education has limitations in cultivating high-quality talents who can meet the Founder's standards.

The form of sex education such as special lectures in school and workshops elsewhere also inherent limitations in establishing a continuous and responsible teacher-student relationship. Since its establishment, KYPM has successfully conducted sex education classes in schools as an external instructor. As a result of that influence, as mentioned earlier, it was already in 2000 that concerns about KYPM's nationwide school sex education activities appeared in the Ministry of Education's parliamentary audit.²⁵ Since 2007, all schools have been required to provide health education,²⁶ KYPM got a greater opportunity to provide sex education in schools as an outside instructor.²⁷ KYPM has continued this school sex education method through the sending external instructors until the temporary suspension due to COVID-19, 2021. This method allows many advantages. However, this educational setting allowed only one-time meetings between teachers and students, and it was difficult for the whole person education that the founder wanted to take place.

3.3. Conclusion

KYPM is a social movement that practices the FFWPU's teachings on Purelove through educational activities targeting youth. The purpose of this study is to find out the intention the founder had for this organization and to find out how much that intention was embodied in the organization's activities. Through this, I tried to come up with suggestions for future sex education activities for adolescents of the FFWPU. This is because I reckon that KYPM still has a part to contribute in the field sex education for adolescents in current society.

As a research results, in three dimensions of structure, culture and teacher-student relationships, the Founders hoped that Purelove education would be carried out in all schools in Korea, and that it would become a cultural movement beyond the classroom. It appears that he wanted the educators to be whole person who takes full responsibility of its students.

KYPM developed activities by successfully forming partnerships with related organizations to realize the founder's will in three dimensions. At the cultural level, activities were vigorously developed until the early 2000s, but these activities were difficult to sustain without large financial support from the outside, and only activities supported by the government were maintained afterwards. In the teacher-student relationship, it developed into a form of maintaining the form of external instructor input and increasing the number of lectures, but this one-time

relationship had limitations that made it difficult for holistic education to occur.

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The use and conceptual composition of 'Sim-Jung' or 'Heart' in the Family Federation for the World Peace and Unification (FFWPU)

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Abstract

The purpose of this study is to clarify the concept of heart in the Essential of Unification Thought. Unification Thought views "Sim-Jung or heart" as the most essential part of God's attributes and defines heart as 'the emotional impulse to seek joy through love'. On the other hand, in Korean culture, 'Sim-Jung' is 'an emotion or emotion that cannot be expressed in words that occurs inside a person'. However, there are conflicting interpretations among scholars of the Family Federation of Korea regarding the applicability of the doctrine and the texts of Rev. Sun Myung Moon in the Family Federation of the concept of heart in Unification Thought. One of them is the view that it is connected to the meaning of heart commonly used in Korean culture, pointing out that the concept of heart that appears in the texts and doctrines of the Family Federation is not interpreted as the heart of Unification Thought. On the other hand, from a different angle, some say that Shim-Jung in Unification Thought should be understood as "an identity that fundamentally defines God's original image," rather than viewing it as a specific one among the various forms of simple Heart. Therefore, this thesis saw that it is necessary to study whether these two concepts are completely different and independent concepts, how they are related to each other, and what meaning Shimjung is used in the Family Federation. To this end, we looked at how Simjung was used in the Family Federation using autonomous linguistics and cognitive linguistic methods. In addition, as a result of synthesizing and logically organizing the concept of heart described in Unification Thought, it could be divided into four types. The first type is Sim-jung or heart of an unbearable urge to love and to have the object of love, and this also includes the meaning of a more internal nature than God's internal nature. The second type is Sim-jung or heart in a relationship in which love is given and joy is obtained through the object of love. The third type is Sim-jung or heart in a relationship where love cannot be given or received when the object of love is lost or cannot stand in the position of the object. The fourth is of Sim-jung or heart wanting to regain the object of love. According to this type, the use of heart was classified in the texts of Rev. Sun Myung Moon and Hak Ja Han Han. As a result of the above, it was concluded that the concept of Heart of the Family Federation is a higher level concept than the concept of Heart understood in Korean culture, and accordingly, the concept of Heart commonly used in Korean culture is human heart, which originated in the heart of God.

KEYWORDS: heart, Sim-Jung, concept, Korean culture, emotion, relation, use

Introduction

The word "Sim-Jung" is a word that contains the representative emotions of Korea. The term "Sim-Jung or heart" is theologically reinterpreted as the concept of God's most fundamental attribute in FFWP. To the extent that the ideology of FFWP can be called "Sim-Jung Ideology," the word "Sim-Jung" appears countless times in hundreds of books that record the words of Rev. Sun Myung Moon and Hak Ja Han. In general, Korean culture is characterized by placing importance on human relationships between members, and cultural phenomena that share affection between members are remarkable. In this Korean culture, the heart we understand are emotions or emotions that cannot be expressed in words that occur inside a person. Sim-Jung is a compound word of 'Sim', which means mind, and 'Jung', which means to arise by feeling. On the other hand, FFWP's "Essential of Unification Thought" sees 'Sim-Jung' as the most core part of God's attributes and defines them as "an emotional impulse to seek joy through love." The words of Sim-Jung or heart used in the Family Federation, such as "God's sorrowful heart," "grieved heart," and "the world of heart," are close to the concept of heart in Korean culture and can convey their meaning naturally. This part may raise the question of whether the concept of heart mentioned in the Unification Thought does not encompass the meaning of heart used in the Family Federation. This may lead to the question of whether the concept of heart spoken by Unification Thought does not encompass the meaning of heart used in FFWP. In this regard, there are various interpretations among scholars of FFWP-Korea on the definition and the use of "Sim-Jung" in the words of "Essential of Unification Thought" and "Divine Principles." One of them is the view that the concept of Shim-Jung, which appears in the Divine Principle and Words of the Family Federation, is very close to the meaning of Heart generally used in Korean culture. This view argues that the concept of heart defined in Unification Thought is the source of the phenomenon in which heart is expressed in Korean culture, and it is necessary to comprehensively understand both. On the other hand, from a different angle, some say that Shimjung in Unification Thought should be understood as "an identity that fundamentally defines God's original image," rather than viewing it as a specific one among the various forms of simple Heart.

If so, the question of whether Sim-Jung used in the Family Federation cannot be understood as the concept of Unification Thought and whether the concept of Sim-Jung in Unification Thought is a theological concept representing the attributes of God, separate from the concept of Heart in Korean culture is raised. In order to accurately understand the doctrines and core ideas of FFWP, it is necessary to establish the concept of heart, which is the core idea of FFWP. Therefore, it is necessary to study whether the definition of the heart of Unification Thought encompasses all the concepts of heart used in FFWP or limited to special concepts, and whether the concept of the heart of FFWP is absorbed into the concept of heart in Korean culture or rather encompasses the heart of Korean culture. To this end, we would like to examine in detail what “Sim-Jung or Heart” were used in the words of Rev. Sun Myung Moon and Hak Ja Han, the founders of FFWP.

2. Methods

First, in order to study the concept of the word Simjung used by the Family Federation, the concept of Shimjung, which is commonly used in Korean society, was investigated. And as a result of integrating and organizing all the contents related to the heart of the Unification Thought, four types were derived. Next, we found the word of heart in Cheon Seong-gyeong, which is a condensed collection of Sun Myung Moon's words, and classified the meanings it represents according to these four types. Based on this, we intend to reconstruct the concept by analyzing and synthesizing the use of the “Sim-Jung” of FFWP through comparison with the concept of the heart in psychology. For this, we would like to take two approaches (Lim Ji-ryong, 2000): Autonomous Linguistics, which logically systematizes the regularity of language structure and meaning, and Cognitive Linguistics, which understands language structure and meaning in human body and life, and cultural context.

3. Results

In this paper, among the usages of heart in Cheon Seong-gyeong, which summarizes the core ideas of the Family Federation, I classified examples in which heart is used as an adjective and a subject.

3-1. a heart (adjective) + noun

1) the words that a heart modifies

root, body, purpose, basis, standard, resting place, father, substance, connection, duty, subject, reason, dedication, conversation, bone marrow, depth, fruit, ancestor, word, path, dress, inner love, great work

- (1) root, body, father, substance, subject, bone marrow, ancestor
- (2) Purpose, basis, standard, depth, duty
- (3) connection, conversation, inner love
- (4) word, path, robes, dedication, feat, fruits

In the sentence structure of (1), Sim-Jung is a modifier, which forms the center of the origin of Sim-Jung. It means God's identity and can be seen as an original attribute of the creator, which means an irresistible emotional impulse to love. Words such as purpose, basis, standard, depth, and duty in (2) refer to the logos meaning of the heart. According to Divine Principle, God created it according to Logos, the design of creation, which means both “Word” or “reason-law” (DP, 1987). For God, the motive for creation is the heart (called the “Heart Motivation Theory”), so the heart becomes the base of the Word (thought) and reason-law (Unification Thought, 2018). (3) is the result of external activities centered on the heart having a relationship with others. (4) is the result of inner activities centered on the heart and has an abstract, mental, and inner character.

As a result of examining the examples of adjective phrases in Cheon Seong-gyeong where Simjeong decorates nouns, we can see that it is related to the concept of Heart in Unification Thought, that is, the concept of Heart, which is the core of the nature of God and is the foundation of the conception and logos in creation. In this respect, it can be seen that it is difficult to apply the above example as a concept of heart in Korean culture.

3-2 Heart (subject) + verb

- ① It's the heart of hope that mankind both wants
- ② Heart is at the center of the “four position foundation”
- ③ God's heart rises
- ④ God's heart is aroused by what he says

- ⑤ Heart is connected
- ⑥ have a high/low heart

The sentence ① and ② express the heart in an ideological way. And the sentence ③ and ⑤ represents the movement or action of the heart, and the sentence ⑥ represents the state of the heart. In ③~ ⑤, the sentences "heart rises," "heart is aroused," and "heart is connected" are already empirically recognized, so it is not difficult to understand what these sentences mean. This is because these expressions are used in real life. However, the heart expressed in ① and ② are not completely understood and feel awkward with the concept of heart explained in psychology as "the mind that feels what happened in the mind and the content of the mind." In these sentences, heart is understood in a more ideological and fundamental sense rather than the emotional meaning of "a mind that feels what has happened in the mind" or "an emotion that cannot be expressed in words that occurs inside." If the concept of heart that Korean culture or psychology normally talks about is a concept in a comprehensive category, it should be possible to include all possible situations within that category. Rather, ① 'the heart of hope' and ② 'the heart as the center of the four-position foundation' refer to something more internal than 'the inner *Sungsang*' in Unification Thought. Therefore, I think Sim-Jung here can encompass all of these by referring to the origin of Sim-Jung as it is said in Korean culture. In summary, when examining the use of Sim-Jung used in the Family Federation in the linguistic system, it is possible to derive a result that the concept of Sim-Jung in Unification Thought can be understood as a higher category of the concept of Sim-Jung in Korean culture or psychology.

3-3 Conceptual composition through classification of emotions by four types

As a result of synthesizing and logically thinking deeply about the contents related to the heart presented in the Unification Thought, the heart is not only God's urge to love, but it has been shown that the urge is connected to the urge to have an object of love. And this again appeared in the form of an extended love relationship. According to this logic, four types emerged. So we categorized the word "Sim-Jung" in the book of "Cheonseonggyeong" according to the four types and examined several sentences as examples.

The first type: the urge to love and have an object of love ("the heart is the core in the Inner *Sung-sang*" (UT 2006))

- 1) God, who is the essence of love and heart, created the universe with that love as the motive, and especially created human beings as substantial objects resembling God according to the words of Genesis 1:27 during this period. (1.1.2.:9)
- 2) The ultimate love is God. Heart is deeper than this love. God is the source of heart. Therefore, words, actions, and ideologies are established centering on this heart. (1.1.2.:10)
- 3) How could God create the universe and humans? It is because God has heart.(6.1.2:6) The origin of the cosmos was God Himself, and it was God's heart that provided the original impulse that set in motion the phenomena of creation. (1.3.1:3)
- 4) God's home is in the core of our hearts. God's masculine nature dwells in a man's heart and God's feminine nature dwells in a woman's heart. (1.3.2:18)
- 5) You must love and be proud of the heavens and earth and all things that God created with His heart. (6.3.2:17)
- 6) We can conclude that there is nothing that was not created with the heart of God as its root. (6.3.5:2)
- 7) No matter how good and comfortable the mind may be, not only does the mind go into the house of heart and cannot rest, but so does the body. (8.2.4:6)
- 8) God's inner heart must become your inner heart. In other words, you must become the substance of your original mind. (2.5.5:35)

The second type: the heart in a relationship where love is exchanged through the object of love

- 1) When parents die, they take their heart of love for their sons and daughters with them. (2.4.3:16)
- 2) If you become a person who receives God's love, the one among your relatives whose heart is closest to God will be attracted to you. (3.1.20)
- 3) A mother feels love and joy in her heart while nursing her baby. (3.1.2:19)
- 4) If you want to make a good family, then help the parents, the children and the grandchildren unite in heart. (3.2.1:2)
- 5) As fathers and mothers of their nations, with the heart of God's love, they need to establish the heavenly

political system wherein leaders sacrifice themselves. (10.4.5:18)

6) Through the Holy Wine Ceremony, she becomes one with me in spirit, heart and body. It is an absolute, internal covenant. (11.3.1:15)

7) Therefore, in order to inherit God's heart, you must inherit the lineage of the original tradition, centered on the pure love of God. (4.2.2:13)

8) Why is it that the Unification Church today teaches about the internal condition of all people from the viewpoint of a parental heart? (7.3.2:40)

Type 3: the heart in a relationship where you can't give or receive love when you lose an object of love or fail to stand in the position of that object

1) the heart You experienced when You had to expel Adam and Eve, (1.2.1:7)

2) We must comprehend the sorrowful fact that, because of the Fall, the heart of God, the heart of heavenly law, and the heart of human morality are in conflict. (1.2.1:12)

3) We have to feel the sorrowful heart of God. He had to watch Jesus dying on the cross after striving to fulfill his mission with such intense devotion and dedication. (1.2.1:23)

4) He weeps bitterly; His heart is scarred and broken in pieces. (1.4.1:12)

5) How painful it is for a father and mother to see the death of their beloved child! How their heart is grieved to watch their child suffer! (1.4.1:16)

6) There was no one whom I could lean on, not my parents, friends or teachers. I did not have a comfortable environment. All I had was a lonely heart. (2.4.1:5)

7) Externally, human beings have created a complex environment and complex systems, but our hearts cannot connect with them. (12.3.4:6)

8) Throughout my life, I have been doing my very best to dissolve God's pain and sorrow and bring liberation and total freedom to His heart. (13.3.1:16)

Type 4: The desire to regain the object of love or the desire to return to the object of love

1) We need to understand God's heart in history, always wanting to say to us, "I want to talk to you; I want to work with you." (1.2.1:10)

2) As you walked the course of restoration, you must know how much sorrow you have come to visit us. (1.2.1:10)

3) You were able to enter the loins of True Father because you have been one in heart with him. (2.3.2:24)

4) They do it because they have no way to be born again unless they connect to me with the heart of sons and daughters who were born through my body. (2.3.2:25)

5) I established the realm of internal heart that, through love, breaks down all barriers and opens gates in every field and on all levels, horizontally and vertically, throughout history (2.5.3:6)

6) We now know that God has devoted Himself throughout history, in ways beyond description, to finding His lost children with the heart of a parent, in the shoes of a servant, sowing sweat for earth, tears for humankind and blood for Heaven. (3.3.2:24)

7) We were dead, yet God went the way of death in order to revive us. Hence, we should go the same way—the way of blood, sweat and tears with a parent's heart. (3.3.2:26)

8) When you become a missionary, as you witness to sorrowful people, you must have a tearful heart. (6.3.3:15)

The following results were obtained by analyzing the cases by type. First of all, in the first type, from the fundamental point of view of heart, 'a feeling of an unbearable impulse to have an object of love because I want to love (A)' and 'a feeling that is more internal than internal characteristics (B)' appear in combination. As a result of classifying them, it was found that 1), 3), 5), 6) corresponded to A, and 2), 4), 7), 8) corresponded to B. In A, in 1), 3), 5), and 6), heart can be understood as God's impulse to love. And in the case of B, 2) can be understood as a more internal heart than God's inner *Sungsang*, and 7) as a more inner heart than human *Sungsang*.

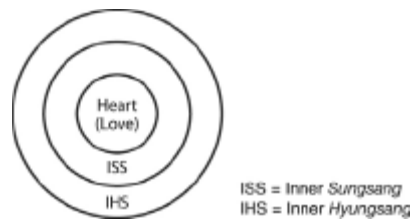


Fig. 1. Inner *Sungsang* and Inner *Hyungsang* centered on Heart

Next, in the second type if 2), 6), 7), and 8) represent the unity in one heart in the place where the heart of love resonates with one heart between God and human being, 1), 3), and 4) show emotional empathy and communication between each other in human relations. In the third type, it can be seen that 1), 2), 3), 4), and 8) are used as the heart of pain that have lost their beloved children from God's point of view, and 2)), 5), 6), and 7) are expressed as feelings cut off from the love partner in human relations. Finally, in the fourth type, 1), 2), 3), and 6) are 'Sim-Jung of God' who wants to recover the object of love. And 4), 5), 7), 8) are 'Sim-Jung' of wanting to be restored as objects of love that were severed in the relationship between humans and God and between humans.

Looking at the case analysis above, the Family Federation sees God not only as a transcendent God, but as a personal God who has all the emotional aspects of human beings. Not only that, but God is a being with a fundamental heart, which is the fundamental root of all beings, and human beings are beings resembling God, so they can resonate with God in heart and go out into the world of one heart. Therefore, the human heart derived from the heart of God resembles the attributes of the absolute, unique, unchanging, and eternal God, and can infinitely unfold the world of love, and by experiencing it, it can be constantly shared in life. When human beings feel God's love and align their lives with God's purpose of creation, they grow into characters who resemble all of God's attributes. In other words, you will experience the heart of God.

Discussions, Conclusion and Further Study

To sum up, the heart defined by the Unification Thought is a emotional impulse to love inherent as something more internal than internal *Sungsang*. However, God's desire to love did not remain as a emotional impulse but became the driving force of God's logos and creativity, and through creation, the object of love that God envisioned was embodied. As such, the urge to love is premised on Sim-Jung, so the heart that stayed only as a emotional impulse can be felt tangibly through the give and take action with the partner of love. As a result of exchanging love with the person you love, it builds up as affection. That affection is accumulated in the depths of my heart, that is, in the inner *Sungsang* (mind: 心), and through the give and take action with the other person, I feel and experience what is felt in the inner *Sungsang*. This is also connected to the concept of heart in Korean culture, which the psychology community says. 'The communicative of heart with heart' is a form of heart in which people who have been in human relationships for a long time or people in the same situation share their hearts with each other. The psychological world also says that the basis of expressing feelings is the desire or motivation of wanting, pursuing, disliking, or avoiding something inside the person who expresses these feelings. In this respect, the 'static impulse to love' mentioned in the Unification Thought and the desire or motivation to want something psychologically inside a person can be understood in the same context. Unification Thought expresses this inner desire as the core of God's attributes from a theological point of view. Since human beings created by God are also beings who resemble God's character, the same heart is inherent in human beings.

In conclusion, the Heart used in the Family Federation can be understood as the concept of Heart in the Unification Thought. The heart referred to in Unification Thought includes not only the static impulse to love, but also the feeling and experience through the give-and-receive action with the other person in the relationship of love that expands to the relationship of love based on the impulse. As a result, the concept of heart in Unification Thought includes not only the concepts of God's heart of creation, the heart of fall, and the heart of restoration mentioned in the Family Federation, but also the concept of heart used in Korean culture. Furthermore, it is clear that the heart of Unification Thought originates from God, and it can be seen that it is the identity of God.

It is also noteworthy that although heart in Korean culture is a narrow concept, its meaning is very similar to

the emotional impulse, an essential attribute of God. This show that although human beings have fallen, human beings created by God have the heart to seek God and aim for goodness in their original minds. Therefore, it can also be seen that human beings are beings who grow and move forward to resemble God's heart.

However, this thesis did not cover the fact that such human growth lies in experiencing God's heart through the three kinds of love of parents, husband and wife, and children over three generations. we hope that further in-depth research will be conducted on these three major loves and the four realms of heart, which have not been covered here.

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Worship Renewal in the Post-COVID Era: Home Church Worship as a Post-Emerging Church Worship

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Abstract

Even before emerging churches were of interest and settled, the COVID-19 pandemic drastically changed the situation of the Korean church. House churches that embrace the characteristics of emerging churches have been forced to emerge. Of course, even before Corona, house churches existed as "small churches within a church" rather than as independent house churches, but the corona pandemic became a stimulus for the revitalization of house churches. This paper is a study to suggest ways to overcome the crisis of the church, which is aggravated by postmodern culture and the COVID-19 pandemic, which is aggravated by distancing, non-face-to-face, individualism, and weakening of the sense of community. House church worship that combines the ecclesiology and pastoral style of emerging churches was proposed as an option.

KEYWORDS: postmodernism, COV19 pandemic, church crisis, emerging church, home church,

1. Introduction

"The Church must always participate in a new day, always adapt anew to the vicissitudes of history and the transformation of human life, always reform, renewal and rethinking."¹ As Hans King argues, the church has changed its form under the influence of the ideas and culture of the time.

Open worship emerged as postmodernism penetrated deeply into society and culture, and traditional evangelical worship declined. For about 30 years, worship services have been all the rage in the West. However, as Generation X and MZ led a new culture, open worship declined and emerged as a new form of worship in emerging churches.²

Even before emerging churches were of interest and settled, the COVID-19 pandemic drastically changed the situation of the Korean church. House churches that embrace the characteristics of emerging churches have been forced to emerge. Of course, even before Corona, house churches existed as "small churches within a church" rather than as independent house churches, but the corona pandemic became a stimulus for the revitalization of house churches. In addition to postmodern culture, distancing, virtual contact, individualism, and a weakening sense of community due to the COVID-19 pandemic have contributed to the weakening of the church's pastoral activities.³ This study aims to suggest ways to overcome the growing crisis of the church. I would like to propose a house church worship service that combines the ecclesiology and pastoral style of emerging churches as a solution.

2. The Necessity of Home Churches

To derive the need for home churches, we compared evangelical, traditional, emerging, and home churches based on nine types of Reconstructionist emerging churches as shown in the following table.⁴ Reconstructionist emerging churches are individual and independent churches, with a liberal form of ecclesiology like home churches while maintaining evangelicalism. This form of emerging church has a form of faith that transforms the realm of secular life into a place of sacred life, living a communal life.

This form is consistent with the ecclesiology and ecclesiology of the home church. Home churches are centered on each church, and small groups of members are called by God in the world in the form of extended families to become holy communities centered on God's will. The experience of home church members becomes education, evangelism, and service.

Comparison of traditional churches/emerging churches/home church pastoral forms

Category	Traditional Church, Evangelical	Emerging Church	Home Churches
Ecclesiology	Neo-orthodoxy, evangelicalism	Embracing postmodernism	Contextual form

organization	Form-conscious	Dismantling the format	Configure context and format
sacred/ profane	Detachment, dualism	The Sanctification of the profane	God's Presence - sacred
Knowing God	Transcendent	Transcendent and immanent	with God
communication	Words, Writings	Face-to-face, Internet, Media	Face-to-face, non-face-to-face, media
church service	Formal, Seeing Worship	Experience-Centered, Worship	Family Community, Participatory Worship
sanctuary	Temples	The Presence of the Holy Spirit	Home, Community Gathering
culture	Separation of profane and sacred	Unification of sacred and profane	Sentimental Culture
evangelism	Seeker-centered	Relationship-driven	Family Community Life Exhibition

- Comparison of Home Churches and Local Churches

From the point of view of the denomination-centered church, the existing church becomes the mother church as the local church, and the home church can be seen as the relationship between the self-churches. The pastoral structure that these local churches and home churches should aim for is shown in the following table.⁵ Local churches and home churches should form an organic relationship and balance to evangelize and nurture the people of God's kingdom.

[Comparison of the pastoral structure of local and home churches]

category	Local Church	Home Churches
objective	Quantitative growth (evangelism, megachurches)	Nurturing the People of God's Kingdom
Pastoral Leadership	Pastor-Leader	Democratic, functional, pastor-guide
communication	Vertical, one-way	Horizontal, two-way
Clergy Authority	powerful, authoritative	Horizontal, shared authority
church service	Authoritarian, one-way, church member duty	Participatory and open worship, membership privileges

3. Home Church Worship Direction

1) Worship as a feast

When God created creation, He expressed His joy at the end of each stage of creation, saying, "It was good to see" (Genesis 1:1~31). Since God's purpose in creating creation is to feel joy from creation, worship should be an act of salvation that responds with joy and emotion, and it should be festivity.

The vast majority of Christian worship today is a formal, passive worship service centered on the pastor and emphasizing only the duties of the congregation. Especially in megachurch services, members have been marginalized, becoming clergy-centered, and formal and passive services with an emphasis on duty and obedience. When worship is offered as a privilege by the spontaneity of the believer, it can be lively and joyful, and it becomes a worship that is pleasing to God.⁶ Home church worship services should be indigenized with the same festivities as Korean feasts.

2) Family Community Worship

The family is a community of love where the love of God and man, the love of the couple, the love of parents and children, and the love of brothers are combined. The church is a community in which this family love is extended. The connection and unity of families centered on God's love is the ideal of the home church and the goal of mission.⁷

When worship becomes worship as a feast of cooperation and family acts, it becomes worship pleasing to God. Therefore, home church worship should be a family community worship service with service, sharing, and fellowship offered by family members.

3) Indigenized worship

When worship ignores the situation and culture that is here and now, it loses its solidarity with the congregation. Worship cannot transcend the consciousness and culture of the times. Worship should be expressed in the rituals and culture of the time. For the inculturation of Christianity in Korea, the following points should be considered:

First, the statues of our ancestors can form a point of contact with Christian worship. Our ancestors served Hanul and offered sacrifices to Hanul, which is the worship of God by our ancestors. Therefore, the festival of Hanul to give thanks to God and to please God with a sincere heart should be accepted into Korean worship.

Second, Korea's representative folk religion Good has many implications for worship. The purpose of the folk belief good is to be in the form of a person who has han, and the form is that of a festival. When music and dancing take place, the god descends, and the god mingles with the congregation. The god does not look down from high or watch from a distance but mingles with the people in the midst of the good plates, weeping and laughing, and in this way, the gods, shamans, and congregations will be able to accommodate the model of worship offered in a divine way.

Third, we can find a model of worship at Korean feasts. For Koreans, there are many feasts that correspond to rites of passage, such as the first birthday feasts, wedding feasts, and the sixtieth birthday feasts. Those who participate in the feast make relief with their own produce, share food, and also play communal games. At the feast, the villagers feel a sense of community and satisfy their vitality for life.

Fourth, the Korean deity becomes the spirit of worship. Koreans are a people who love to play. Playing well is called "having fun." The root of this statement is that play should be combined with the gods, not just their own pleasure. When worship becomes worship as a holy game of community, we can overcome confrontation and conflict and become a cage of oneness.⁸

In general, in home churches that started from the concept of cell churches, it is common to hold home church services through a set class with positions such as home director, assistant home manager, general affairs manager, praise manager, service manager, etc. The process of the lesson consists of devotion, relationship-building, invitation, and reproduction, but in reality, the invitation and reproduction are not carried out well, so even if the lesson is carried out, it is not exciting and it is often mandatory to do it. In addition, in such a situation, the existing home church situation is a way to deal with the function of efficiently managing family members by district, function, or organization, as in the old district worship service, and the lack of alienation and static interaction that can be felt in large groups. Most home churches, with the exception of a few home churches, are not doing much in the field of mission.

Therefore, it can be seen that home churches based on the existing cell church also need renewal, and that there are parts of its direction and method that can be applied with reference to the worship services of emerging churches.

4. Results, discussion and conclusions

Along with the postmodern culture, distancing, non-face-to-face, individualism, etc. due to the COVID-19 pandemic have occurred. This phenomenon has led to a crisis in the church due to a decline in the number of believers, a weakening of the enthusiasm of the faith, and a **weakening** of the sense of community. As a way to overcome the growing crisis of the church, we would like to propose a home church worship service that combines the ecclesiology and pastoral style of the emerging church. Home churches must create new forms of worship through tradition and culture, holiness and profane, and religious pluralism. For this form of worship, worship as a family feast, community worship across generations, worship of lay leadership, unity worship in holiness, and profane worship should be oriented.

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Unification Medical-Psychological Approach to Family and World Peace from the Perspective of Postmaterialism

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Abstract

In medicine, we hope to realize a peaceful world based on the latest scientific evidence and full of creativity to protect people's health, but in the world, there are still various conflicts among nations, races, politics, and religions, and poverty and disease are still prevalent. In order to solve all these problems, it is important that the Divine Character of God dwells within the family. In other words, "parental love" must become the core of the "family relationship," and the family consciousness must become one, centering on the subconscious with spiritual awareness. I present the following three steps derived from the treatment theory based on Unification Medical-Psychological Science in order to build a parent-child relationship that meets the creation purpose. Step 1 (Origin): Each individual clarifies the goal of completing the family. Step 2 (Division): The couple realizes the reality that men and women are not the same in nature. Step 3 (Union): The couple becomes one, and complete in the image of God. Through the above process, the "Creation of a family environment" will be created and become the foundation for world peace.

KEYWORDS: Creation principle, Ideal modeling, Unification medical-psychological approach, Parent-child relationship, Subconsciousness

1. Introduction

In medicine and medical care, there is a desire to realize a peaceful world based on the latest scientific evidence and full of creativity to protect people's health. However, in the world, there are still various conflicts among nations, races, politics, and religions, and poverty and disease are widespread. In order to solve all these problems, it is important that God's Divine Character dwells within the family. In other words, it is the unification of the family consciousness, centering on the subconscious with spiritual awareness, with "parental love" as the nucleus among "family relationships."

1.1. Objective/Goal

Domestic problems are a microcosm of the impoverished world, and the solution of domestic problems requires a deductive medical approach derived from the Creation Principle, rather than aimless human beings lost in a relative view of good and evil. Specifically, it is to work toward a heavier life and resurrection through the circulation of consciousness, centering on the subconscious, based on spiritual awareness in accordance with the Creation Principle.

1.2. Medical Background of the Means

In order to re-create parent-child relationships that meet the creation purpose and realize "family" peace, which is the foundation of world peace, the "Three Steps for Re-creating Family Relationships (Origin-Division-Union action)" are important through approaches based on Unification Medicine [1] and Unification Psychology [2] as core and this must be explained and presented medically.

1.2.1. The nature of the "parent" derived from the Primary Cause: The causal entity in the family is the "parent," but what is the more causal entity (the Primary Cause)? By clarifying this Primary Cause, we can clearly realize the true nature of the "Parent". To this end, it is the stream of consciousness or cognitive action that is fundamental to the re-creation of familial relationships. Since human beings are not only physical but also spiritual beings, considerations about "spirit" and "consciousness" are important.

1.2.1.1. Characteristics of spiritual (subtle) energy [1] / 1.2.1.2. The process by which the subconscious

acts on the brain [1] / 1.2.1.3. Cleaning (purifying) the subconscious mind [1] / 1.2.1.4. Techniques Rewriting the subconscious [1] / 1.2.1.5. The Circulation and Instantaneous Movement of the Subconscious (Quantum effect) [3]

1.2.2. Unification Medical-Psychological Approach based on the Creation Principle: The first thing to focus on is self-value creation and to clarify the purpose of creation by Primary Cause. Then, we must understand the concepts in order from the most abstract and develop them deductively. This is because with a relative value system, one becomes a slave to one's environment, one's self-esteem is lowered, one cannot even see one's own value, and nothing can be resolved.

The Primary Cause is religiously called "God." Thus, a treatment theory based on the Creation principle with "Godism" as its foundation is necessary, and this is realized by Unification Medicine and Unification Psychology, which start from the Heart (Shimjung) of God, that is an emotional impulse to obtain joy through love, and inherit true life and true lineage with true love as its center. In other words, through integrated and comprehensive medicine that includes spiritual treatment, self-centeredness, hatred, and hostility derived from fallen nature can be erased, restored to the original state of creation, and all diseases eradicated. This approach can be the "Master key" to problem solving because it is practiced from a fundamental perspective. It creates health not only for individuals, but also for families, nations, and the world, thus achieving world peace.

The usefulness of this approach can be explained by the evidence of Quantum mechanics, particularly Quantum effects [3]. Specifically, an important first step toward the complete cure of disease lies in the habit of asking one's own subconscious mind about the "ideal future. This is because the first time a person is asked a question, he or she unconsciously tries to get an answer instantly, due to the aforementioned Quantum effect. This changes the orientation of the subconscious, and furthermore, by creating an image of fulfillment (a sense of presence), it results in the realization of the Creative purpose (goal). In other words, "the power of questioning oneself changes the future," and this leads to the Creation of the environment.

1.2.3. Process to the creation of a new environment: What, then, is important in order to envision an "ideal future" in which the "creation of a new environment" in the family realizes world peace? Through the Unification Medical-Psychological Approach, we present the following three steps (Origin-Division-Union action) from a medical perspective in order to re-create a parent-child relationship that serves the purpose of creation.

2. Main subjects

2.1. Step1 (Origin): Each individual realizes the creative value and clarifies the goal of home completion

2.1.1. Value Creation : In order for each individual to clarify his or her own creative value, first and foremost, the mind and body must be in complete oneness, which is the state of oneness of mind, oneness of spirit, and oneness of harmony. Of course, this is not easy. However, this is possible because we all have a conscience. In other words, if we follow the dictates of our conscience, our body will obey our mind, and if we absolutely trust our mind, absolutely love our mind, and absolutely obey our mind, we will come as close as we can to the standard of personality perfection, because our family power will increase overwhelmingly. Until now, this concept has been vague. Clarifying this is a prerequisite for re-creating the family environment and perfecting the family. There is nothing better than "conscience. To accomplish this, as mentioned earlier, it is necessary to purify the subconscious by eliminating and releasing negative emotions. Especially in married life, the purification of the subconscious is extremely important, and the perspective of perfecting absolute "sexuality" with love at the center is indispensable [1].

By the way, the most painful thing for human beings is the feeling of diminished love. To overcome the feeling that the being who should love us the most does not love us, we must make a commitment to realize the ideal family, centering on love, with the awareness that each one of us is responsible for it. Furthermore, by making this a habit, love-centered value creation will unfold.

2.1.2. True standard as a model : If there is an ideal family, it goes without saying that the center of that family is "ideal parents by ideal couple. In the world today, there are still various conflicts among nations, races,

politics, religions, etc., and poverty and disease are widespread. This is because, from the heavenly perspective, all human beings are equally children and are nothing more than brothers and sisters to each other. In other words, without "parents," there can be no peace among siblings, and parents can be the center of siblings.

Based on the above, what exactly is needed to reach the ideal goal? It is a "sense of presence. There are ideals and realities, but only imagining the ideal and strengthening the sense of presence of the ideal is not enough to reach the goal. This is because the direction of the subconscious mind is determined by the strength of the sense of presence.

2.1.3. To the Ideal Future: In order to move toward the ideal future, the first step is to weaken the sense of presence of reality. An effective way to do this is to "break away" from the environment, relationships and sources of information that have been used in the past. Then, the ideal sense of presence should be strengthened through imagery and spiritual perception using the five senses (sight, hearing, touch, smell, and taste).

Through the above process, perceptions begin to change. As a result, dreams become enthusiastically realized that were thought to be absolutely unattainable as an extension of the past. It is precisely because reality is so harsh that it is important to have a firm vision or "aspiration" for one's life.

2.2. Step 2 (Division): The couple realizes the reality that men and women are intrinsically different.

Although parents are unitary entities, brainscience proves this as follows. That is, in the process of a couple becoming parents, in the initial state of parenthood, the brain exhibits a "mosaic brain" in terms of gender, and no gender differences are seen in terms of brain shape. In other words, that the brain is a "parental brain," and that maternal and paternal characteristics are not initially in place [4].

However, in terms of genetics, embryology and brainscience, sex differences clearly exist [5][6]. In addition, differences in patterns of behavior and cognition have been suggested in men and women because of hormonal effects on the neuronal nuclei and cerebral cortex. For example, cognitive function is a function of the cerebral cortex and hippocampus, and it is widely accepted that estrogen acts on the cortex and strongly promotes cognitive function in women [7]. Thus, hormones act on the neuronal nuclei and cerebral cortex resulting from the structural sex differentiation of the brain, causing functional sex differences, mainly in terms of Sungsang.

The above process completes the sexual difference, which shows that men and women are intrinsically different (created to cross paths). However, the fact that the existence of parents has a unitive nature, but functional sex differences are recognized, confirms the fact that parents exist in the unitary dual characteristics of Yang (positive) and Yin (negative).

2.3. Step 3 (Union): Husband and wife become one, complete, and become the likeness of God

I would like to further discuss the perfection of "sex" in human beings and the perfection of the couple from the perspective of unified medicine. The main focus is on the harmony of man and woman.

The case that requires attention here is the issue of homosexuality. Homosexuality is different in concept from Gender Identity Disorder (GID), a mental disorder, and there are fundamental differences between the two.

The former is a concept related to sexual orientation, "which gender is the object of romantic love," meaning that a person chooses a partner of the same sex as a sexual object. Based on statistical evidence, it can be inferred that the factors influencing homosexual formation are not determined by biological factors inherent in the body of homosexuals, since the incidence rate varies with growth environment and the number of people experiencing homosexuality decreases with increasing age. Although not yet proven by conventional genetic explanations, from the perspective of epigenetics genetics, it can be inferred that the effects of negative latent memories of ancestors are deeply involved in the brain through the subconscious mind [1][2]. In addition, medical problems associated with homosexuality have been pointed out, such as structural and functional problems of the genital organs, immune disorders, hygiene problems, intestinal infections, and venereal diseases. In particular, since the onset of AIDS began with homosexual sexual activity, a thorough medical response is essential from the standpoint of the study of true health.

On the other hand, Gender Identity Disorder (GID) is a concept concerning "which gender one's gender

consciousness is," and since this is a disease, it must be "distinguished" from health in terms of treatment and does not constitute "discrimination" in terms of human rights. Therefore, further detailed medical verification is necessary, while eliminating the emotional distress of the patient.

In particular, when it comes to the elimination of gender differences, it can never be said that eliminating differences in the treatment of men and women in society and culture will eliminate suffering and "cure" the disease. This is because the suffering of the people concerned is not simply a matter of liking or disliking their sexual orientation, but is based on their own "sexual self-consciousness. In other words, it is a "physical gender mismatch," which is fundamentally different from the elimination of social and cultural gender differences.

Therefore, the "elimination of sex differences" will exacerbate the social decadence of "sex," disrupt healthy family functions, promote a declining birthrate, and shake the very foundations of the nation. It is extremely important that the couple become one, complete, and in the likeness of God. Sex-related research must continue to be further advanced and developed through the Unification Medicine and Unification Psychology approaches based on the Creation Principle.

Through the above three steps, the "Creation of a family environment" will be created, and this will become the foundation for world peace.

3. Conclusion

Regarding spiritual awareness and perception, the Unification Medical-Psychological Approach has a role to play in reuniting human beings with the cosmic consciousness in a meaningful way. It is possible to explain spiritual awareness, i.e., certain micro-energetic phenomena and spiritual healing, by applying current scientific theories while avoiding breaking the scientific framework, but unfortunately the situation is not fully accepted.

However, as new age technology advances and imaging systems that visualize the multidimensional structure of the human being are developed in the future, quantum mechanics-based medicine for healing and spiritual treatment will become widely accepted in the modern medical world.

To connect to God, it is possible to enter the next dimension only by redefining the present position from a higher phase that connects to God, rather than from an identical upper perspective.

Therefore, although the scientific perspective has not yet been reached, a divine standard, a religious perspective that transcends human knowledge, is necessary. As seen in the Pledge of Allegiance, "to be a filial son in the family, a loyal subject in the nation, a saint in the world, and a holy child in heaven and space" means to redefine oneself by connecting oneself with the higher phases, and Through the value creation and self-creation of ourselves in each phase, we will be able to create our family and environment.

We are now entering an era in which countless people on earth, even in the spirit world, are beginning to undergo spiritual transformation. In order to solve the mountain of social, economic, environmental, and global problems, we are in an era in which we desperately need to bring together an awakened higher spiritual awareness and consciousness. Medicine is essentially for the realization of love, and Unification Medicine and Unification Psychology are medicine and psychology based on the absolute truth, centering on "true love" and extending to spiritual, universal, and eternal truths. It is hoped that they will continue to be further developed as the trump card for the salvation of mankind.

Finally, if there is a person who, from this heavenly perspective, loves humankind equally and strives to free them from suffering, he or she is indeed the ideal "husband and wife" and the true "parents" of humankind.

However, it is easy to imagine that this life, which will be the light and lamp of human history, will be an extremely severe, harsh, and thorny road. The birth of the Heavenly Parent is the dream of mankind, and its realization is a miracle, but it is also a miracle because it is necessary to be the only son or daughter guided by Heaven who can clear up and solve all problems from the fundamental ruin of mankind, and to follow the path of a true husband and wife. The emergence of True Parents is the fruit of soul-stirring, sweat and tears, and is the victory of Heaven.

In particular, the "Mother of Peace" is an ideal woman who can fundamentally change each individual. The road to this point must have been the steepest path for a woman in the history of mankind. In the present age, the "only way" for individuals, families, nations, and the world to be happy and to further deepen their happiness is to be transformed by the Mother of Peace.

From the perspective of post-materialism, Unification Medicine and Unification Psychology are health creation

theories based on theistic principles to realize, establish, and secure family and world peace. We hope that this approach based on the Creation Principle will be deepened and further developed as "Heavenly Parent's Holy Medicine and Psychology" for the creation of a new environment.

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Yoga and Acupuncture for Depression and Prospective Side Effect of Psychiatric Medication

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Abstract

There are needs of alternative and complementary medicine to reduce severity of depression and secondary constipation. Biological marker of depression is a low level of Serotonin. Its function is to elevate mood and increase sympathetic function. Lexapro is one of the commonly used medications for depression. Its mechanism selectively inhibits the reuptake of serotonin. It increases the low level of serotonin. One of the possible side effects of Lexapro is constipation. Due to effects of Lexapro on the intestines to reduce its function, constipation happens as secondary. Acupuncture has been known as musculoskeletal treatment including low back pain. Some articles address its effects in psychiatric and gastrointestinal including serotonin level and peristalsis on the intestinal tract. Body & Brain yoga exercises (BB) and acupuncture treatment might be helpful for reducing both depression severity and possible side effects of medications, including constipation. The BB yoga protocol includes exercises and breathing for increasing intestinal movements and abdominal temperature. The intestinal movements help to excrete the waste and toxins from the intestines and to enhance the functions of internal organs. Through the vagus nerve, this change can deliver signals to the brain stem to induce the secretion of serotonin in the brain. Combination of BB yoga and acupuncture might be helpful for reducing depression severity and secondary constipation by stimulation of intestines, part of brains.

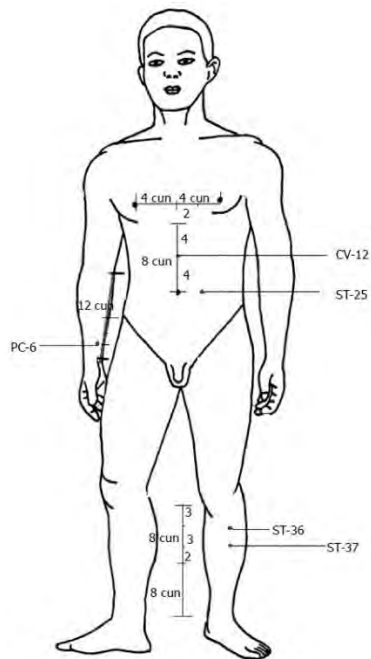
Keyword: Acupuncture, Serotonin, Depression, Body & Brain Yoga

1. Introduction

There are needs of alternative and complementary medicine to reduce severity of depression and secondary constipation. Biological marker of depression is a low level of Serotonin. Its function is to elevate mood and increase sympathetic function. Lexapro is one of the commonly used medications for depression. Its mechanism selectively inhibits the reuptake of serotonin. It increases the low level of serotonin. One of the possible side effects of Lexapro is constipation. Due to effects of Lexapro on the intestines to reduce its function, constipation happens as secondary.

2. Acupuncture

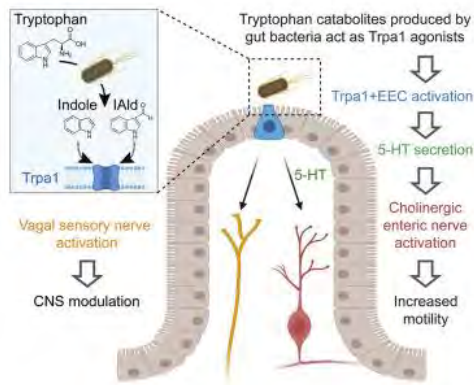
Acupuncture has been known as musculoskeletal treatment including low back pain. Some articles address its effects in psychiatric and gastrointestinal including serotonin level and peristalsis on the intestinal tract. Serotonin is a neurotransmitter that inhibits the amygdala, and antidepressants can increase serotonin level by blocking serotonin transporters. Acupuncture induces therapeutic effects by increasing serotonin system activity in the CNS and inhibits the process of serotonin degradation. Serotonin plays an important role in chronic pain control, while norepinephrine plays some role in acute pain management, Lexapro is one of the medicines often given to psychiatric patients for depression and one of the side effects is constipation. Acupuncture might be effective in constipation by increasing the peristalsis in the lower abdomen. One of the key mechanisms of the effectiveness of the acupuncture increasing the peristalsis by the stimulation of afferent fibers that induce signals by inserting the needles into specific points on the body and some somatic afferent nerve in the CNS can activate the gastrointestinal motility through this physiological mechanism. It also modulates the functions such as secretion of blood flow, immunity, and maintenance of the integrity of the epithelial barrier and submucosal plexus that contain numerous enteric neurons and glial cells that increase the flow of the blood. Therefore, the gastrointestinal motility increases. For example, as in the Figure 1, Acupuncture at Zusanli (St 36) which belongs to Foot-Yang Ming Meridian improves lower abdominal symptoms and restores slow waves, which are induced by rectal distension via the vagal pathway. Foot-Yang Ming Meridian may enhance gastric motility and improve gastric mucosal flow of the blood by regulating the concentration of motilin and somatostatin in sinus ventriculi medullae.



[fig 1. Zusanli ST 36]

3. Yoga

Body & Brain yoga exercises (BB) and acupuncture treatment might be helpful for reducing both depression severity and possible side effects of medications, including constipation. The BB yoga protocol includes exercises and breathing for increasing intestinal movements and abdominal temperature. The intestinal movements help to excrete the waste and toxins from the intestines and to enhance the functions of internal organs. Body and Brain Yoga (B&B Yoga) exercises can support the treatment of depression directly and indirectly by reducing the digestive side effects of the medicine. These are possible because the B&B Yoga exercises can promote gut health. As the gut health improves, the digestive and bowel functions are improved. Here's the review of how improved gut health can contribute to the improvement of depression. Enteroendocrine cells (EEC) in the intestinal walls act as sensors for the intestines, as in the Figure 2. They detect chemical, mechanical, and temperature changes in the intestines and secrete hormones. The detected signals are transmitted through the vagus nerve system to the brain. Enterochromaffin (EC) cells are a type of EEC and play an important role through the secretion of serotonin. EC cells respond to the chemical, neurological, and mechanical stimuli to secrete serotonin. The levels of serotonin affect the digestive conditions such as constipation or IBS. This can explain the improvement of digestive functions through the abdominal exercises. Through the vagus nerve, this change can deliver signals to the brain stem to induce the secretion of serotonin in the brain. Vagus nerve is a connector between gut and brain and its nerve endings are connected to the mucosa and muscles in the submucosa. The vagus nerve detects chemicals and muscular movements in the intestines and transfers the information to the brain. Using these characteristics of the vagus nerve, there is a vagus nerve stimulation method through electrical stimulation to treat depression or epilepsy.



[fig 2. Enteroendocrine Cell (EEC)]

4. Conclusion

Combination of BB yoga and acupuncture might be helpful for reducing depression severity and secondary constipation by stimulation of intestines, part of brains.

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I would like to take this opportunity to thank all those who participated in the study and the professors who commented on the presentation on this paper.

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Treatment to find good points

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Abstract

Since the basis of treatment is to normalize the bad point, diagnosis tends to look for the bad point. The author focused on the fact that the human mind prefers to be praised for its good points rather than pointed out its bad points, and applied it to the diagnosis and treatment of physical symptoms. In other words, if there are several bad spots, leave them as they are. Then, by looking for a good point and concentrating my consciousness and qi there, I observed the change in symptoms.

KEYWORDS: Acupuncture, Good point treatment,

1. Introduction

In western medicine, treatment is given after a disease is given a name. And the correct and clear understanding of what is wrong affects the outcome of treatment. Only when a diagnosis clarifies what is wrong and how is it wrong, an accurate diagnosis can be given and an accurate treatment can begin. So the doctor's eyes are always looking for the bad.

On the other hand, in traditional oriental medicine, instead of looking for faults from the beginning, the patient is examined first to grasp the overall situation of the patient. The practitioner's five senses are mobilized to check the color, hardness, smell, temperature, etc. of the body surface. In addition, especially observe the pulse of the wrist and grasp the state of yin-yang real-void. At this time, the oriental medicine's eyes are not looking for the bad points, but trying to capture the patient's yin-yang, real-void as they are. Without judging what is wrong, and therefore without naming the disease, the first acupuncture is given to stabilize the whole.

For example, we determine that the pulse is that of "Stomach-Real-Spleen-Void," which is common among Japanese people. This can be explained as too much qi gathering in the stomach group and a lack of qi in the spleen group. However, it does not tell us about the good or bad of the entity spleen/stomach. Predicts weather conditions, just like a weather forecaster, but does not indicate whether an organ or tissue is good or bad. The treatment can proceed without identifying the bad points, and in many cases, the chief complaint will be resolved as it is. It can be said that such a difference in perspective is one of the major differences between Eastern medicine and Western medicine.

In this paper, I will investigate the therapeutic effects of stimulating the good points instead of the bad points.

In the education of children, praising them attracts more attention than scolding them.

Even in the medical field, instead of looking for the bad, I thought about what would happen if I looked for the good and stimulated it.

By the way, there are three ways to cure diseases.

One is the method of removing or weakening the bad points.

These include surgery to remove a lesion, drug therapy to kill or weaken pathogens, and radiation therapy to burn away diseased tissue.

This is currently widely practiced in Western medicine, but in Eastern medicine there is also a method of removing qi, blood, and pus called phlebotomy.

The second is a method of improving a bad state caused by a lack of essential elements by supplementing the elements.

Metabolic abnormalities due to malnutrition are normalized by administering sugar, vitamins, minerals, etc.

Blood transfusions for lack of blood are also performed.

In oriental medicine, there are supplementary methods to compensate for lack of energy and blood flow using acupuncture, shiatsu, and qigong.

In this case, the location of the patient's chief complaint and the location of the lack of qi often do not match.

For example, qi and blood gather in a patient's painful area, and excessive qi also causes pain. However, in many cases, the cause of this pain is a lack of qi or blood in another place, and when the lacking place is supplemented, the chief complaint disappears or decreases. A place with such pain is called real, and a place lacking is called void. The void is generally painless, hollow, and weak to the touch. The third is a treatment that looks for good points and stimulates them. This is the purpose of this paper. A good point is not a bad point. In other words, it is neither real nor void. It is functioning normally. I would like to explain the actual treatment that seeks out this good point. Simply assuming that the painful part is the bad points and the good points is the painless part, I will investigate the treatment of stimulating the good points.

2. Experimental and Result

2.1.1 Experiment 1

In a patient with pain, bad point is where the pain is. So the good point without pain is located on the opposite side, the treatment effect is observed by stimulating the opposite side of the painful part.

All of the acupuncture needles used were No.3 x40mm stainless steel.

2.1.2 Result 1

Case 1: Sacral pain, 56-year-old male.

He has been experiencing pain at one point on the left side of his sacrum for about a month. When he was feeling pain, I lightly pressed the same spot on the right side of his sacrum for 10 seconds while standing, and the pain disappeared. However, the pain returned within 5 minutes. This time, when acupuncture was applied to the same point on the right side for about 1 minute, the pain disappeared and there was no recurrence. About one month, he felt occasional pain at one point on the left side of the sacrum. When he felt the pain, he lightly pressed the same point on the right side of the sacrum for 10 seconds in a standing position, and the pain disappeared. However, the pain returned after about 5 minutes. Next, acupuncture was applied to the same point on the right side for about 1 minute, and the pain disappeared and did not recur. For a patient in pain, the body part in pain is the Bad points. The good points is assumed to be located on the opposite side of the bad points, and the therapeutic effect is observed by stimulating it.

Case 2: Right deltoid muscle pain, 42-year-old female.

Acupuncture was applied to the left shoulder on the opposite side of the painful right shoulder for about 1 minute, and the pain was halved. When I lightly applied acupuncture needles around the point for about 2 seconds at about 5 locations, the pain almost disappeared. was applied to the right shoulder where she felt pain and to the opposite left shoulder for about one minute, and the pain was reduced by half. Acupuncture needles were lightly inserted in five places around the point for about two seconds each, and the pain was almost completely resolved.

A similar treatment is performed daily at my acupuncture clinic.

The contralateral method of treatment is also practiced by practitioners of traditional oriental medicine.

In Case 1, the pain did not change when the painful point was treated, but the pain disappeared when the contralateral side was treated. It is a good example that stimulating the opposite side is more effective than stimulating the bad part.

In Case 2, the pain was halved when the painful point was stimulated.

However, this is an example where the method of stimulating the opposite side was effective in eliminating pain until the end.

Treatment to the opposite side can be said to be treatment to a good point because it does not seem to be the affected part.

However, the left and right are void and real, and it can be regarded as the second method mentioned above.

Therefore, in experiment 2, we experimented with a case corresponding to the third method that is not void-real.

2.2.1 Experiment 2

In Experiment 1, the good part was on the opposite side of the bad part, but in Experiment 2, the good part was the Hyakue on the head.(GV20)

This is because Hyakue is the closest point to the heavens and is the point where heavenly spirits pour down.

And because it is the top of the head, it is less likely to be dented, and it has the characteristic that it is difficult for the void and real to appear.

I put acupuncture here and observed the symptoms.

The acupuncture needles used were No.3 x40mm. Happy Health HQ8000LC low-frequency electrotherapy device was also used.

2.2.2 Result 2

Case 3: Low back pain, 55 years old male, weigh is 130[kg].

After 30 minutes of treatment with a low-frequency electric therapy device on the abdomen and lower back, the chief complaint, the right low back pain, was halved, but the pain remained.

Next, acupuncture was applied to Hyakue for 1 minute, and the pain disappeared. Since the pain returned in a few days, he repeated the treatment once a week.

Case 4: 7 months pregnant, 26-year-old female.

She has a large stomach and difficulty breathing. Absorption is particularly bad. Breathing became easier when acupuncture was applied to Hyakue GV20 in the supine position for 10 seconds.

In case 3, electrical therapy was applied to the opposite side of the painful area after 30 minutes of treatment, but the pain remained.

After that, the third method was more effective because it was resolved by acupuncture at Hyakue.

Case 4 is an example of how stimulation of the good points eliminated the suffocation. There are many symptoms that can be resolved by stimulation of Hyakue.

3. Discussions, and Conclusions

In Experiments 1 and 2, I have listed two cases each, and similar treatments are performed daily in my acupuncture center. In particular, the method of treating the opposite side shown in Experiment 1 is also practiced by many traditional oriental medicine practitioners. Case 1 was treated on the painful body part and the pain did not change, but when treated on the opposite side, the pain resolved. This is a fine example of how stimulating the good points is more effective than stimulating the bad points. In Cases 2 and 3, the pain was reduced by half when the painful part was stimulated. However, the stimulation of the good points was effective in eliminating the pain.

As described above, we confirmed that stimulating the good points is sometimes more effective than stimulating the bad points. In this study, we examined the good points as the opposite of the bad points and the area around Hyakue.

In the future, I would like to do more research on what the good points are.

For example, when I face the patient and become aware of the location of the chief complaint, there are points of treatment that come to my mind.

This has nothing to do with real and void is not a pathological point, so it can be said that it is a treatment to find a good point.

I wanted to include it in this paper because the main complaint disappears when an appropriate stimulus is given at an appropriate angle, but the method of expressing the position of the acupuncture point has not been developed and the reproducibility is poor.

The point of treatment that comes to mind when the patient is in front of him is very effective, but it is difficult to record because he uses spiritual sensibility. I would like to overcome this and report next time.

When considering the unification of Oriental and Western medicine, we believe that there should be a mutual understanding of these differences in perspectives.

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HIV Seropositivity, Religious Affiliation and Sexual Violence among School Students in a Conflict-affected Country: Need for an Integrated School Health and Moral Education Program in DR Congo

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Abstract

The WHO African Region is severely affected with 3.4% of adult population living with HIV. In the Democratic Republic of the Congo (DRC), a country experiencing recurrent armed conflicts for two decades and where sexual violence has been used as a weapon of war by terrorist militia groups, the HIV prevalence is estimated to be 1.2-6%. To our knowledge, there is no recent scientific reports on the scope of HIV infection in Congolese teenage school students. This research project comprised two studies: a knowledge, attitudes and practices (KAP) survey on HIV/AIDS prevention conducted in schools and communities, and a 12-month prospective observational study conducted in voluntary counselling and testing (VCT) centers in two Congolese provinces, Kinshasa and Kongo central. We assessed the knowledge and practices regarding preventive measures for sexual transmission of HIV infection, and searched to determine behavioral, sociocultural, and faith-based factors associated with HIV/AIDS KAPs and HIV seropositivity. In the HIV/AIDS KAP survey, 59.8% of the 3,869 participants were females (41.2% of males), 55.4% were teenage school students. Mean age of the participants was 18.3 (+/- 5.2) years; 58% of school students lacked appropriate knowledge on the 6 high-risk behaviors for HIV infection. Overall, "forced sex history" was reported by 28.7% of participants, including 42.2% of teenage school students; of them, 50.8% of forced sex incidents occurred at age < 15 years. Overall HIV positive test rate was 11.1% (10.7% in school students); it was 11.5% in conventional Christian communities (catholic, protestant), 12.9% in participants from liberal Christian/spiritual communities, 12.5% in Muslims, 0% in those from Unificationist community and 12.3% in non-believers. In prospective observational study, of the 506 subjects tested there were 2.8% of positive HIV tests (3.2% in school students. In the KAP survey, HIV seropositivity was positively associated with gender (OR=1.46 (0.5); p<0.05), age of first sex (OR=1.79 (0.6); p<0.01 and history of forced sex (OR=1.59 (0.3); p<0.05); and it was inversely associated with knowledge on risk behaviors for HIV/AIDS (OR=1.97 (0.4); p<0.01) and "religious affiliation (non-conventional vs conventional Christian; OR=1.91 (0.1); p<0.05). In VCT center-based prospective observational study, HIV seropositivity was positively associated with age (OR=1.47 (0.2); p<0.05) and occupation (school students vs. others; OR=2.57(0.2); p<0.05). Findings from this research project showed that forced sex and religious affiliation are associated with HIV seropositivity in Congolese teenage school students. It is imperative to improve HIV awareness and implement school-based health and moral education program targeting the major local risk behaviors.

KEYWORDS: Democratic Republic of the Congo; HIV infection prevention; School student; Religious affiliation; Sexual violence.

1. Introduction

HIV-associated acquired immunodeficiency syndrome (AIDS) has become one the leading causes of deaths worldwide, and the sub-Saharan Africa (SSA) remains the most affected region. Recently, the UNAIDS reported that approximately 1.8 million adolescents are living with HIV in SSA in 2018 and, worldwide, 510,000 young people between 10 to 24 year of age were newly infected with HIV of whom 190,000 were adolescents between 10 and 19 years. Furthermore, over 40% of new HIV infections are among young people between 15 and 25 years of age, suggesting that the youth are more prone to HIV and other sexually transmitted infections (STIs). In the Democratic Republic of Congo (DRC), rates of human immunodeficiency virus (HIV) infection are relatively high. Our previous pilot study conducted among Congolese and Asian youth showed a higher proportion of Congolese young people lacking accurate knowledge on high risk behaviors for HIV infection as compared to their Japanese counterparts (Ngatu et al., 2012). Considering the vulnerability of youth to STIs, it is noteworthy to often evaluate their knowledge, attitudes, practices (KAPs); this helps in designing efficient preventive strategies. In this research project, we assessed the KAPs of Congolese teenagers on HIV sexual transmission and explored behavioral and sociocultural factors associated with HIV seropositivity.

2. Methods

2.1. Study design and participants

Mixed method study was conducted in two Congolese provinces, the capital Kinshasa and Kongo Central, from 1st January 2018 through April 2019. It comprised a descriptive cross-sectional study consisting of HIV/AIDS KAP surveys and a 12-month prospective observational study in 2 voluntary counseling and testing (VCT) centers.

2.2. Community HIV/AIDS KAP surveys

KAP surveys were conducted in schools and community settings (churches, social and training centers) between September 2018 through March 2019. Participants were male and female young Congolese aged 15-25 years. Of the 3,889 people were enrolled of whom 3,869 (99.4%) completed the survey. Participants anonymously answered a structured self-administered questionnaire, as we have reported previously (Ngatu et al., 2012). Accuracy of knowledge on high-risk sexual behaviors such as “precocious sex”, “having multiple sex partners”, “men sex with men”, “practice of abstinence before marriage”, “faithfulness in marriage”. On the other hand, considering the sexual violence epidemic that prevails in DRC since the beginning of the longstanding Congo war/armed conflict in 1997 and its influence on the increased prevalence of sexually transmitted infections (STI), additional questions related to sexual violence episodes and their perpetrators were included in the questionnaire.

2.3. Prospective HIV/AIDS Epidemiological Study at VCT centers

A prospective observational study was conducted in two VCT centers located in Kongo Central province from 1st January through December 2018. HIV testing forms from the DRC HIV/AIDS Program were used in this study. They contain information on demographics, medical history, sexual behaviors, previous HIV test results, result of the actual test and recommendations. HIV infection diagnosis was performed using rapid HIV testing algorithm following recommended procedures from the DRC National HIV/AIDS Program, Ministry of Health.

2.4. Ethical consideration and statistical analysis

For subjects aged 18 years or younger, consent was obtained from their parents prior, whereas adult participants provided informed consent individually. Ethical approval was obtained from two certified ethical review boards: the ethics committee of the School of Public Health, University of Lubumbashi, and that of the faculty of Medicine of William Booth University, DRC. Statistical analysis was performed with the use of Stata software version 2015. Group (teenagers vs. older subjects) comparisons was performed using chi-square test for categorical variables and Student t test for continuous variables. Multivariate logistic regression analysis was performed to determine factors associated with knowledge on high-risk behaviors and HIV seropositivity.

3. Results, Discussions, and Conclusions

In the HIV/AIDS KAP survey, of the 3,869 individuals surveyed, 59.8% were females (41.2% of males) and 55.4% were teenage school students aged 15-18 years (44.6% older subjects). Mean age was 18.3 (5.2) years; 58% of school students lacked appropriate knowledge on the 6 high-risk behaviors for HIV infection. “Forced sex history” was reported by 28.7% of study participants, including 42.2% of teenage school students; among them, 50.8% of forced sex incidents occurred at age < 15 years (not shown). Overall self-reported HIV seropositivity rate was 11.1%; it was 10.7% among school students. The distribution of HIV seropositivity rate by religious affiliation was as follows: 11.5% in participants from conventional Christian communities (catholic, protestant), 12.9% in participants from liberal Christian and spiritual communities, 12.5% in Muslims, 0% in participants from Unificationist community, 12.3% in non-believers (**Fig. 1**).

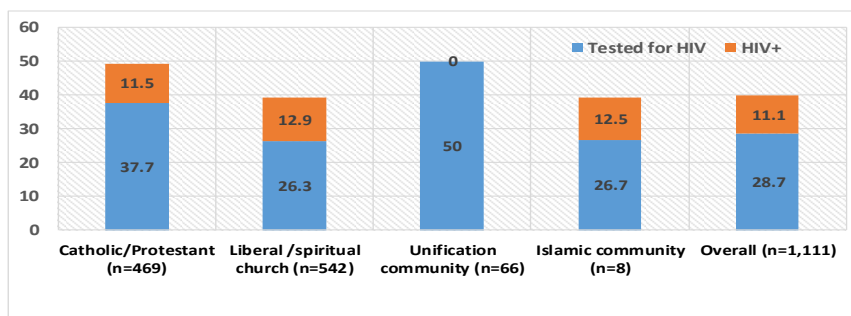


Fig.1- Trend in rates of HIV testing and HIV test results according to religious affiliation

On the other hand, of 506 participants in the prospective observational study, HIV seropositivity was 2.8%. In addition, among teenage school students, the rate of positive HIV test was 3.2%, whereas it was

2.7% in older subjects.

Predictors of HIV seropositivity

In the HIV survey, logistic regression analysis showed that HIV/AIDS knowledge was inversely associated with age (OR=1.78 (0.15); $p<0.05$) (not shown); HIV seropositivity was positively associated with gender (OR=1.46 (0.5); $p<0.05$), age of first sex (OR=1.79 (0.6); $p<0.01$) and history of forced sex (OR=1.59 (0.3); $p<0.05$); and it was inversely associated with poor knowledge on risk behaviors for HIV/AIDS (OR=1.97 (0.4); $p<0.01$) and “religious affiliation (non-conventional vs conventional Christian affiliation; OR=1.91 (0.1); $p<0.05$) (Table 1). In VCT center-based prospective observational study, HIV seropositivity rate was positively associated with age (OR=1.47 (0.2); $p<0.05$) and occupation (school students vs. others; OR:2.57(0.2); $p<0.05$) (Table 1).

Table 1. Associations between HIV/AIDS-related knowledge, behaviors, religious affiliation, sexual violence and HIV test positivity rate by logistic regression analysis

Characteristics	ORa (SE)	95% CI	p-value
<i>Cross-sectional survey</i>			
Age (15-18 y. vs >18 y.)	1.06 (0.2)	0.72 – 1.56	0.740
Gender (F vs. M)	1.46 (0.5)	1.04 – 3.05	0.048
Occupation (school students vs. others)	0.97	0.71 – 1.30	0.826
Religious affiliation (non-conventional vs. conventional Christian)	1.91 (0.1)	1.90 – 3.35	0.036
Knowledge on high risk behaviors (good vs. poor)	1.97 (0.4)	1.81 – 2.09	0.002
Age of first sex (< 15 years vs. older)	1.79 (0.6)	1.68 – 1.96	0.004
History of forced sex (no vs. yes)	1.59 (0.3)	1.08 – 2.34	0.017
Number of forced sex (one vs. more)	0.97 (0.1)	0.72 – 1.32	0.877
<i>Prospective study/VCT centers</i>			
Age (< 20 years vs. 20 or older)	1.47 (0.2)	1.08 – 1.89	0.019
Occupation (school students vs. others)	2.57 (0.2)	1.29 – 5.96	0.013
Education level (school level vs. higher)	0.79 (0.2)	0.47 – 1.33	0.381
Faith community affiliation (non-conventional vs. conventional)	1.02 (0.2)	0.71 – 1.47	0.910

*Notes: ORa, adjusted odds ratio (adjustment for age and gender); SE, standard error; 95% CI, 95% confidence interval.

Findings from this study showed poor knowledge of HIV infection prevention measures among participants, and relatively high rate of forced sex events among school students. There is an urgent need to improve HIV/AIDS awareness of Congolese teenagers and implement a school-based health and moral education program targeting gender-based violence and HIV infection is imperative.

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Ideal end-of-life care from the perspective of home medical care

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Abstract

Modern medicine is about to reach a new historical turning point. Western medicine has developed by subdividing the human body and scientifically analyzing it at the cellular and genetic levels. However, Western medicine has been unable to overcome "aging," and has been forced to change direction from "medical treatment to cure" to "medical treatment to support," and from "life extension" to "quality of life (QOL)."

And now, Japan, the world's largest super-aging country, is about to enter a society of unprecedented proportions, and the world is watching to see how Japan will overcome this predicament.

Against this context, a new movement is promoting home medical care. Home medical care is holistic, providing not only medical care but also support for family, social, and spiritual issues surrounding the patient, and can advocate a new value system that provides total management to better the patient's life until the end of life. It also has the aspect of an academic opportunity to consider the ideal way to send patients out into the spiritual world.

Based on the clinical experience of home medical care, I will discuss its attractiveness and potential from the viewpoint of unification medicine.

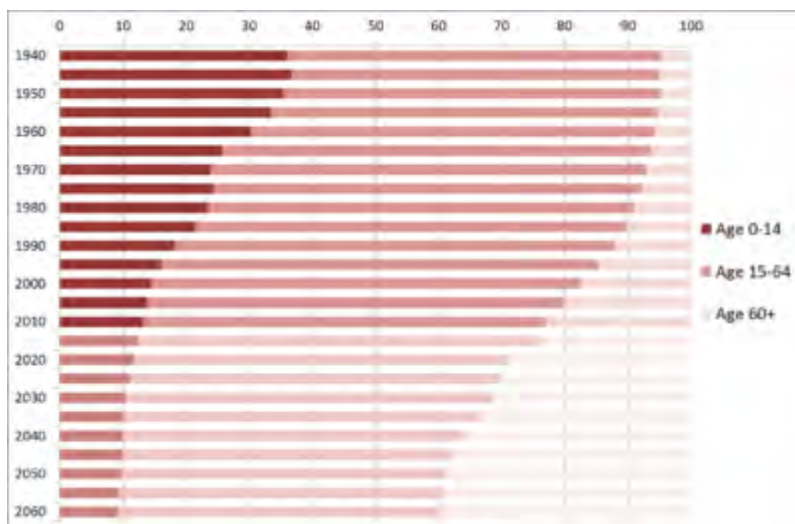
KEYWORDS: home medical care, end-of-life care, spiritual world, unification medicine

1. Introduction

Modern medicine has reached a new historical turning point. Western medicine has developed by subdividing the human body and scientifically analyzing it at the cellular and genetic levels. Even if a patient is diagnosed with cancer, a variety of treatments have made it possible to survive for a long time. Ultimately, however, Western medicine has been unable to overcome "aging," and the purpose of medical treatment has been forced to change direction from "medical treatment to cure" to "medical treatment to support" and from "life extension" to "quality of life (QOL)."

Japan is the world's largest super-aging country for the past 40 years. The world is watching to see how Japan will overcome the challenges of this super-aging society.

Fig.1 Changes in Age Structure in Japan



2. Home Medical care in Japan

In 2021, the average life expectancy for males and females in Japan was 81.47 years and 87.57 years, respectively. The number of births in 2021 was 811,604, a declining trend, and the number of deaths in 2021 was 1,349,809, an increasing trend. In other words, the total population is declining and the trend toward super-aging

is intensifying, and at the same time, we are entering unprecedented society of multiple deaths. This has given rise to a new problem: the shortage of places to care for patients with terminal stage. Against this social background, home medical care is being promoted as a measure.

2.1 Characteristics of Home Medical care

The target patients for home medical care are those who need medical care but have difficulty going to the hospital, and those who wish to spend their final days at home. There are no age restrictions for patients, and the service is available for those aged from 0 to over 100 years old. In principle, there are no restrictions based on disease, and patients with terminal cancer, dementia, patients with frailty, and intractable diseases are often treated. The medical services are a mixture of general practice, geriatrics, and palliative care. One of the features of the clinic is multidisciplinary cooperation involving not only physicians and nurses, but also dentists, massage therapists, helpers, and care managers.

2.2 Demand for Home Medical care in End-of-Life Care

In 2014, 74% of respondents answered that they would prefer to spend their final days at home, 88% of physicians and 92% of nurses answered that they would prefer to spend their final days at home as well. As expected, the vast majority of people prefer to be cared for at home during the final stages of life, and the reasons given include the desire to spend time in a familiar place and with family. In recent years, the need for home care has been growing stronger by COVID-19.

In recent years, the values of QOD (Quality of death) and the GDS (Good Death Scale) have been developed around the world, indicating the high level of attention paid to this issue.

Fig.2 Good Death Scale

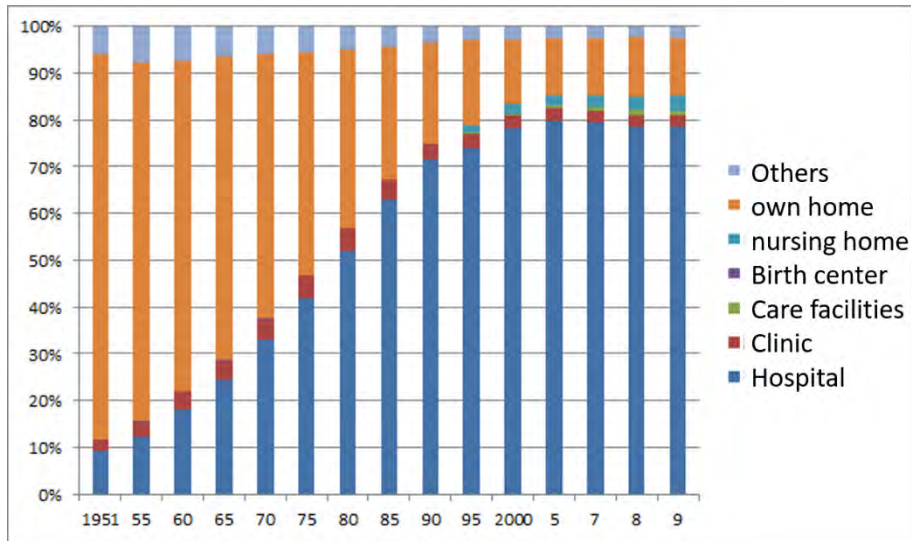
1. Has the patient known the fact that he/she is dying?
0. Complete ignorance
1. Ignorance
2. Partial awareness
3. Complete awareness
2. Could the patient accept his/her illness well?
0. Complete unacceptance
1. Unacceptance
2. Acceptance
3. Complete acceptance
3. Has the patient arranged everything according to his/her own will?
0. No reference to the patient's will
1. Following the family's will alone
2. Following the patient's will alone
3. Following both the patient and the family's will
4. Was the timing appropriate for the patient to pass away?
0. No preparation
1. The family alone had prepared
2. The patient alone had prepared
3. Both the patient and family had well prepared
5. How about the physical condition of the patient at that time?
0. A lot of suffering
1. Suffering
2. A little suffering
3. No suffering

図2 Good Death Scale 原版

2.3 Challenges of Home Medical care

In fact, however, home medical care has not yet become widespread enough, and this remains a challenge for the future. From the patients' perspective, they have strong concerns about home medical care, especially about how to respond to sudden changes in patients. On the medical side, there are several issues that need to be addressed, such as the lack of manpower, regional differences, and the lack of accumulated evidence.

Fig.3 Place of death in Japan



3. Attractiveness and Potential of Home Healthcare

Home Medical care not only provides medical care, but is also holistic, supporting the family, society, and spiritual issues surrounding the patient, and can advocate a new value system that provides total management for better living until the end of life. It also has the aspect of an academic opportunity to consider the ideal way to send patients to the spiritual world.

3.1 Attractiveness of Home Healthcare

Above all, it is rewarding for medical professionals to be able to support the patients and their family's true wish. One of the major attractions is not only to provide medical care, but also to practice holistic care in accordance with their wishes of the patient.

Another attraction is to support the entire family. In fact, the family is one of the main actors, and it is important point to know how to support the family members who support the patient.

3.2 Creating New Values

It is certainly not easy to unite family members and medical professionals to support the end of life for one person who is about to end their life on earth. However, it is also true that there are many more moving moments. It is truly moving to see family relationships being restored through the experience of caregiving, or to see a person depart for the spirit world while expressing gratitude for something that could never be said before. It is also a place that teaches us new values.

The following are some thoughts on this topic.

The significance of three generations of caregivers

Care for the bereaved family and consideration of the bereaved family questionnaire.

Conclusion

Life on the earth is the best place to be devoted to own parents. It is not only a valuable place for the patient, but also for the family, to receive care at home in the final stages of life, and it is an important period of preparation for going to the spirit world.

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Nuclear reactions for nucleosynthesis in stellar evolution

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Abstract

Heavy elements, heavier than lithium-7, are synthesized through stellar evolution. One of the important research subjects in nuclear astrophysics is to study how the elements in the universe, which consist of our environment including ourselves, are synthesized through stellar evolution. In the present extended abstract, we review our recent works on a theoretical framework to estimate the reaction rate of radiative alpha capture on carbon-12 in the red giant stars. We construct an effective field theory, which is based on the methodology of quantum field theory, for the process, and apply the method to the study of nuclear reactions related to the radiative alpha capture on carbon-12. We discuss the significance of our results and the foresight of the application of the theoretical framework to other nuclear reactions in stellar evolution.

KEYWORDS: Red giant star, helium burning process, radiative alpha capture on carbon-12, effective field theory

1. Introduction

During the first three minutes just after our universe was created, the light nuclei from hydrogen to lithium-7 are synthesized. This is now known as the big-bang nucleosynthesis, which occurred about 13.6 billion years ago involving a tremendous explosion, namely the big-bang [1]. The other heavier nuclei, such as carbon-12 and oxygen-16, which are the main constituents and make our environment as well as our bodies, are synthesized in the evolution of stars. The sun, for example, is shining through nuclear fusion reactions, a so-called hydrogen burning process that consists of the proton-proton (p-p) chain and the carbon-nitrogen-oxygen (CNO) cycle, in which four protons turn into a helium nucleus (an alpha particle) releasing the energy, $E = 26$ MeV. The alpha particles are accumulated in the core of stars, and when the temperature of the core increases high enough due to the pressure from the envelope of the core, the alpha particles start fusing through the helium-burning process, which mainly consists of the triple-alpha process and the radiative alpha capture on carbon-12. The nuclei up to the iron-56 are synthesized in the core of stars (typically 11 times heavier than the sun) because of the maximum binding energy of iron-56 [2].

Understanding the nuclear reactions is crucial for studying the stellar evolution and the number of nuclides existing in the universe. Reaction rates of the nuclear reactions, however, are difficult to measure in the experimental facilities because of the Coulomb barrier between the particles to be fused. One needs to employ a theoretical model whose parameters are fitted to experimental data measured at high energies, and the reaction rate is extrapolated to the low energy corresponding to the core temperature of stars. For the last decade, we have been studying a new theoretical framework based on quantum field theory for the study of nuclear reactions in stellar evolution. This particular group of theories is known as effective field theories (EFTs) [3]. We construct an EFT for the study of radiative alpha capture reaction on carbon-12, and apply the EFT to the calculation of three nuclear reactions; elastic alpha-carbon-12 scattering without bound states [4], with bound states [5], and with bound and resonant states [6], $E1$ transition of radiative alpha capture on carbon-12 [7], and beta-delayed alpha emission from nitrogen-16 [8]. In the followings, we discuss the EFT and its application to the study of the astronomical S factor of $E1$ transition of radiative alpha capture on carbon-12, and, then, we mention the results and discussion of the works.

2. Effective field theory

In the construction of an EFT, one chooses a large momentum scale Λ_H for the reaction in question to separate relevant degrees of freedom at low energy from irrelevant degrees of freedom at high energy. Then, one constructs an interaction Lagrangian in the most general form, which is restricted by the symmetry requirement for the system. While the irrelevant degrees of freedom at high energy are integrated out of the Lagrangian, the effect from high energy is supposed to be embedded in the coefficients of terms of Lagrangian. These coefficients, in principle, would be fixed from its mother theory, but in practice, they are fitted to experimental data. The terms of Lagrangian, in general, have an arbitrary number of derivatives, which provides us a perturbative expansion scheme in powers of Q/Λ_H , where Q denotes a typical momentum scale of the reaction at low energy. This perturbation scheme can control the theoretical uncertainties of the reaction. The reaction amplitudes are systematically calculated by drawing Feynman diagrams up to a given order [3].

We construct an EFT for a nuclear reaction at low energy, namely, the radiative alpha capture on carbon-12 reaction, $^{12}\text{C}(\alpha, \gamma)^{16}\text{O}$, at the Gamow peak energy, $T = 0.3$ MeV. It is known that the reaction rate at the very low energy, $T = 0.3$ MeV, is dominated by $E1$ and $E2$ transitions due to the excited sub-threshold 1_1^- and 2_1^+

(l_{i-th}^{π}) states of oxygen-16, whose binding energies are $T = -0.045$ MeV and $T = -0.24$ MeV, respectively, from the alpha-carbon-12 breakup threshold energy. While, the experimental data, to which the parameters of theory are fitted, are measured at low energies, typically a few MeV. The resonant states for $l = 1$ and $l = 2$ channels of oxygen-16 appear at $T = 2.43$ MeV for 1_2^- state, $T = 2.69$ MeV for 2_2^+ state, and $T = 4.35$ MeV for 2_3^+ state. Those excited bound states and the resonant states of oxygen-16 would play significant roles in describing the experimental data along with the extrapolation of the reaction rate down to $T = 0.3$ MeV. In addition, we choose the large scale of theory to be the breakup energy to the proton-nitrogen-15 channel from the alpha-carbon-12 channel, $T = 4.97$ MeV. Thus, the alpha and carbon-12 are relevant degrees of freedom (and the proton and nitrogen-15 are irrelevant degrees of freedom at high energy), and we treat the alpha and carbon-12 as structureless (point-like) particles. Then, we construct the effective Lagrangian which has the most general form, and calculate the reaction amplitudes up to sub-leading order by using the methodology of quantum field theory.

3. Calculation of the S factor for $E1$ transition of radiative alpha capture on carbon-12

We estimate the astrophysical S factor, which is related to the reaction rate, for the $E1$ transition of the radiative alpha capture on carbon-12 at the Gamow peak energy, $T = 0.3$ MeV, within the framework of the EFT. In the estimate, we need to calculate two reactions: one is the elastic alpha-carbon-12 scattering for p -wave channel, and the other is the $E1$ transition of radiative alpha capture on carbon-12.

The elastic scattering amplitude is calculated by drawing Feynman diagrams. In Fig. 1, we display the Feynman diagrams for the dressed oxygen-16 propagator, which is parameterized by four effective range parameters, $\{a_1, r_1, P_1, Q_1\}$. In Fig. 2, the Feynman diagram for the elastic alpha-carbon-12 scattering amplitude is displayed. Bare propagators and vertex functions are extracted from the effective Lagrangian, and the reaction amplitudes are composed of them. Because the reaction takes place at low energies, we include the Coulomb interaction between the alpha particle and carbon-12 non-perturbatively. The first effective range parameter, a_1 , is fixed by using the binding energy of the sub-threshold 1_1^- state of oxygen-16, and the rest of the three parameters, r_1, P_1, Q_1 , are fitted to the p -wave scattering phase shift data of the elastic scattering [9], where we obtain the chi-square per number of data as $\chi^2/N = 0.74$; N is the number of data, $N = 273$.

In Fig. 3, we display the curve plotted by using the fitted three effective range parameters to the phase shift data up to $T_\alpha = 6$ MeV where T_α is the alpha energy in the lab frame ($T_\alpha = \frac{4}{3}T$). The phase shift data are also displayed in the figure. One can see that the error bars of data are tiny while the fitted curve reproduces the data well; the phase shift data reveal the existence of the resonant 1_2^- state of oxygen-16 at $\delta_1 = 90^\circ$, i.e., at $T_\alpha = 3.23$ MeV.

We now calculate the $E1$ transition amplitudes for radiative alpha capture on carbon-12 drawing the diagrams and using vertex functions extracted from the effective Lagrangian. The reaction amplitudes are calculated from Feynman diagrams displayed in Fig. 4. As seen in the figure, the p -wave dressed oxygen-16 propagators appear in Fig. 4 (c), (d), (e), and (f), which we obtained from the study of elastic scattering above. In the amplitudes, two new coupling constants, $\{y^{(0)}, h_R^{(1)}\}$, appear; $y^{(0)}$ comes out as a coefficient of the alpha-carbon-12-oxygen-16 vertex in all the diagrams, which connects to the final ground state of oxygen-16, and the other one, $h_R^{(1)}$, does out as that of the contact p -wave oxygen-16-gamma-ground state oxygen-16 vertex, depicted as a filled square in the diagram (c) of Fig. 4. Infinities appear from the loop diagrams in the diagrams (d), (e), (f), and those infinities are renormalized by the coefficient $h_R^{(1)}$ in the diagram (c), and we have finite values for the amplitudes from the diagrams (a) and (b). We fit $y^{(0)}$ and $h_R^{(1)}$ to the experimental data.

In Fig. 5, we display the curve of the astrophysical S factor for the $E1$ transition of radiative alpha capture on carbon-12 as a function of the center-of-mass energy T of the initial alpha-carbon-12 state. The experimental data of S_{E1} are also included in the figure. One can see that the data of S_{E1} shows a peak at $T = 2.42$ MeV, which corresponds to the resonant 1_2^- state of oxygen-16: we have mentioned this state appearing in the phase shift data in Fig. 3. One can also see in the figure that the error bars of the data are relatively larger than those in the phase shift data, and especially the data at small energies about $T = 1$ MeV have the larger error bars. This is because the capture reaction rate is significantly suppressed by the Coulomb barrier at the lower energies. The two new parameters, $y^{(0)}$ and $h_R^{(1)}$, are fitted to the data, and we have the chi-square per number of data as $\chi^2/N = 1.7$; N is the number of data, $N = 151$. (The experimental data are well summarized in Table V of Ref. [10].) The curve plotted by using the fitted parameters reproduces the experimental data of S_{E1} fairly well. The curve is extrapolated to the low energy region, and at $T = 0.3$ MeV, we have $S_{E1} = 59 \pm 3$ keV · b. About 5% uncertainty of our estimate of S_{E1} at $T = 0.3$ MeV stems from the fitted values of $y^{(0)}$ and $h_R^{(1)}$, which reflect the errors of the experimental S_{E1} data.

The former estimates of S_{E1} at $T = 0.3$ MeV are well summarized in Table IV in Ref. [10], where the reported values are scattered from 1 to 340 keVb with various sizes of the error bar. Nonetheless, it is worth pointing out that the recently reported values are converging. In Table 1, we summarize the recently reported values of S_{E1} at $T = 0.3$ MeV; we find that our estimate of S_{E1} at $T = 0.3$ MeV is smaller, by about 30%, than the values reported

recently; 98.0 ± 7.0 keVb by An et al. [15] and 86.3 keVb by deBoer et al. [10].

4. Results and discussion

In the present extended abstract, we briefly discuss a calculation of the S_{E1} factor for the $E1$ transition of radiative alpha capture on carbon-12 at the Gamow peak energy, $T = 0.3$ MeV, within the framework of EFT. We calculated the elastic scattering amplitude and the $E1$ transition amplitudes within the theory, fix the values of the parameters by using the experimental data and extrapolate the S_{E1} factor to $T = 0.3$ MeV; we found $S_{E1} = 59 \pm 3$ keVb. This value agrees with the reported values with about 30% error bars, but underestimates, by about 30%, those with small (about 7%) error bars. Thus, the estimates of the S_{E1} factor are converged, at least, within about 30% uncertainty, and it is important to understand the reason for the 30% differences to reduce the uncertainty of S_{E1} within 10%.

The construction of an EFT for the nuclear reaction is a new method in the nuclear astrophysics community. This method is a phenomenological one and applicable to a reaction when one can find a clear separation scale and there are some good experimental data to fix the parameters of the theory. Possible candidates for the application of EFT are the nuclear reactions in the CNO cycle. The first attempt has recently been carried out for the radiative proton capture on nitrogen-15 reaction [16]. We are now planning the study for another reaction in the CNO cycle and can hopefully report it in the future.

Fig. 1. Feynman diagrams for dressed composite oxygen propagator. A thick (thin) dashed line represents a propagator of carbon-12 (alpha), and a thick and thin double dashed line with and without a filled circle represents a dressed and bare oxygen-16 propagator, respectively. A shaded blob represents a set of diagrams of one-photon-exchange contributions for Coulomb green's function.



Fig. 2. Feynman diagram for elastic alpha-carbon-12 scattering. A shaded blob represents a set of diagrams of one-photon-exchange contributions for initial and final state Coulomb interactions (Coulomb wave functions). See the caption Fig. 2 as well.

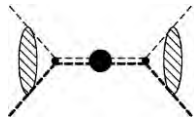


Fig. 3. P -wave phase shift of elastic alpha-carbon-12 scattering as a function of the alpha energy in the lab frame. The curve is plotted by using the fitted three effective range parameters in the theory. The experimental data are also displayed in the figure.

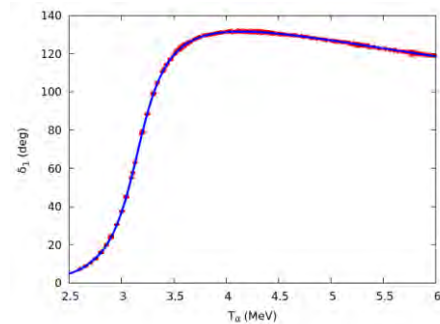


Fig. 4. Feynman diagrams for radiative alpha capture on carbon-12. A wavy line presents the outgoing photon, a thick and thin double line with a filled circle in the intermediate state, whose diagrams are displayed in Fig. 1, is the dressed oxygen-16 propagator, and a thick dashed line in the final state presents the ground state of oxygen-16. See the caption of Fig. 1 as well.

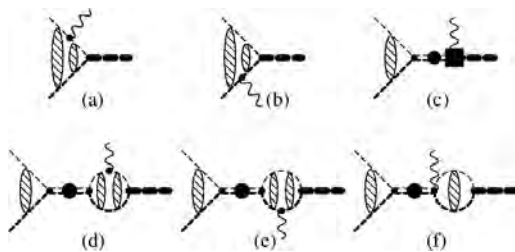


Fig. 5. S_{E1} factor of radiative alpha capture of carbon-12 as a function of the energy of the initial alpha-carbon-12 system in the

center-of-mass frame. The curve is plotted by using two fitted parameters in the theory. The experimental data are also displayed in the figure.

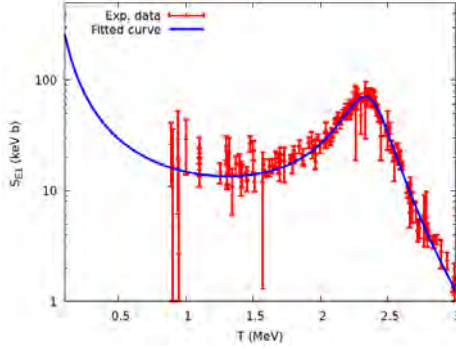


Table 1. Values of the astrophysical S_{E1} factor at $T = 0.3$ MeV of radiative alpha capture on carbon-12 in the recent literature.

	Ta. et al.[11]	Sc. et al.[12]	O. et al.[13]	Xu et al.[14]	An et al.[15]	de. et al.[10]	This work
S_{E1} (keVb)	86 ± 18	83.4	100 ± 28	80 ± 18	98.0 ± 7.0	86.3	59 ± 3

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Functional characterization of CYP105D17 from *Streptomyces laurentii*

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Abstract

Streptomycetaceae family genomes contain a higher number of CYP genes as compared to other bacterial species. Especially, the CYP105 family is widely distributed and involved in biosynthetic pathways of secondary metabolites and modification of structurally associated xenobiotics. Here, we identified CYP105D17 associated with the predicted lanthipeptide biosynthesis gene cluster from *Streptomyces laurentii*. The actual function of the gene cluster is still unknown, and CYP105D17 showed 81.8% identity with already characterized CYP105D18 from the same strain. The molecular weight of the protein was analyzed by SDS-PAGE to be ≈ 49 kDa. CYP105D17 also catalyzed the *N*-oxidation of papaverine in the presence of co-substrate (Hydrogen peroxide) H₂O₂ like CYP105D18. The optimum rate of papaverine *N*-oxide conversion by CYP105D17 was in the presence of 20 mM H₂O₂. Kinetic analysis for papaverine *N*-oxidation showed K_m and K_{cat} values $302 \pm 33 \mu\text{M}$ and $1.6 \pm 0.08 \text{ min}^{-1}$, respectively. The catalytic efficiency of CYP105D18 for papaverine *N*-oxidation was $0.31 \text{ sec}^{-1} \mu\text{M}^{-1}$. The structural model of CYP105D17 was generated using 7DLS as a template. Papaverine was buried in the complete hydrophobic core in CYP105D18. T239 was involved in the active site of CYP105D17 and Val231 was replaced with Ileu231 from CYP105D18. CYP105D18 was able to catalyze testosterone while CYP105D17 was unable despite the high structural similarity. Even with the high similarity with CYP105D18, CYP105D17 possesses low H₂O₂ tolerance and low catalytic efficiency towards papaverine *N*-oxidation. This provides insight into the biochemical properties, substrate preference, and detailed structural comparison of more closely related proteins.

KEYWORDS: CYP105D17, *Streptomyces laurentii*, Papaverine, hydrogen peroxide

1. Introduction

Streptomyces, included in a phylum actinobacteria, is the largest genus among bacteria, and one of the genera of the Streptomycetaceae family. Distribution of actinobacteria is very broad from terrestrial mainly in the soil to the marine environment [1,2]. Most of the bioactive compounds are produced by actinobacteria, of which more than 75% are derived from the *streptomyces* species. Almost all bioactive compounds are active against bacterial, viral, parasitic, and fungal infections. Bioactive compounds are also effective in various cancerous cells, and immunosuppressant activities [3]. Interestingly, like mycobacteriaceae, streptomycetaceae family genomes contain a higher number of P450 genes as compared to others. It is presumed that they are likely to involve in the biosynthesis of secondary metabolites. Nowadays, these enzymes are reported with substrate flexibility and mainly focus on the field of pharmacology, toxicology, and drug metabolism [4,5].

Cytochrome P450 (P450) are the heme cofactor-containing monooxygenases involved in various biochemical reactions such as hydroxylation, cyclopropanation, epoxidation, sulfoxidation, and demethylation of aromatic as well as aliphatic compounds [6]. Bacterial P450 are present in cytosol fraction and have stable nature, and they are of high interest for modification of a wide range of compounds [7]. Although deep insight into enzyme-substrate interaction is needed to maximize the activity of enzymes, bacterial P450 enzyme engineering with the rational or random method can further increase the activities of enzymes as well as broaden the substrate range [8]. P450 enzymes are important candidates in chemistry and biology because of their broad substrate scope, versatile activity, and C-H bond oxidation.

Here, we identified CYP105D17 associated with the predicted lanthipeptide biosynthesis gene cluster from *Streptomyces laurentii*. The actual function of the gene cluster is still unknown, and CYP105D17 showed 81.8% identity with already characterized CYP105D18 from the same strain. Further, we compared the structural and biochemical characteristics of CYP105D17 with CYP105D18.

2. Materials and Methods

2.1 Cloning and overexpression of CYP105D17 and redox partners

CYP105D17 encoding 396 amino acids (BAU81006) from the strain ATCC31255 *Streptomyces laurentii* was amplified by using forward 5'-GAATTCATGACCGAAGCCGT GGCT-3'(EcoRI) and reverse 5'-

AAGCTTCCTCTCACCAAGCGACG-3' (HindIII) primers. The PCR product was purified and cloned into pMD20-T vector using *E. coli* XL1-Blue and selected by Blue white screening and the nucleotide sequences were confirmed by automated sequencing (Macrogen, Korea). CYP105D17 confirmed gene was ligated in pET28a(+) and recombinant construct pET28aCYP105D17 was generated. Further, the construct was transformed to *E. coli* XL1-Blue and was grown on LB agar plate containing 100µg/ml Kanamycin. Amplified construct pET28aCYP105D17 encoding N-terminal His6-tag protein under the control of a T7 promoter was isolated and transformed to chemically competent C41 cells for overexpression and was plated on LB agar containing 100µg/ml kanamycin. Seed culture was grown and 0.5ml was added to 100 ml of LB-medium supplemented with 100 µg/ml kanamycin and incubated at an orbital shaker (180 rpm) at 37°C until cell density was about 0.6 at OD600nm. Then, 1 mM of 5-aminolevulinic acid hydrochloride (5-ALA) and 0.5 mM FeCl₃ was added to support heme synthesis. The culture was induced with 0.5 mM of IPTG and was incubated for 72 h at 20°C for protein synthesis. The cell pellets were harvested by centrifugation (3,500 rpm) for 25 min at 4°C and washed twice with 50 mM Potassium phosphate buffer (pH 7.4). Redox partners Pdx (*camA*) and Pdr (*camB*) were expressed as His383 tagged proteins in *E. coli* BL21(DE3) using plasmid constructs pET28a(+) and pET32a(+) as described previously [9] and cells were harvested by centrifugation (3,500 rpm) for 30 min at 4°C and washed twice with 50 mM potassium phosphate buffer (pH 7.4). Spinach ferredoxin (Fdx) and spinach ferredoxin reductase (Fdr) were obtained commercially from Sigma-Aldrich (Korea).

2.2 Quantification of CYP105D17, and Redox Partners

Overexpressed cell pellets were suspended in a potassium phosphate buffer (pH7.4) solution and lysed by ultrasonication. The lysate was separated by centrifugation at 24650g for 30 min at 4°C and the supernatant was purified by Ni²⁺ affinity chromatography with the use of TALON His-tag. Resins-bound proteins were eluted by using different concentration gradients of imidazole (10mM, 100mM, and 250mM). The purity of proteins were checked by SDS-PAGE electrophoresis in all the fractions and the purified fraction was concentrated by ultrafiltration with Amicon centrifugal filters with molecular 30kDa cut-off size for CYP105D17 and PDR (*camB*), and 10kDa molecular weight cut-off size for PDX (*camA*).

The concentration of CYP105D17 was determined by CO-reduction described previously [10]. Pdr concentration was determined as the average of concentrations calculated from wavelengths 378, 454, and 480 nm by using extinction coefficients (ϵ) of 9.7, 10.0, and 8.5 mM⁻¹ cm⁻¹, respectively. Pdx concentration was also determined as the average of concentrations calculated from wavelengths 415 and 454 nm by using extinction coefficients of 11.1 and 10.4 mM⁻¹ cm⁻¹, respectively [11]. All the samples were scanned using Biochrom Libra S35PC UV/visible spectrophotometer (Cambridge, UK).

2.3 Biochemical characterization of CYP105D17

The *in vitro* reaction was carried out in 250µl volume for papaverine and testosterone (200µM) with 3µM CYP105D17 in 50 mM phosphate buffer (pH7.4) using different redox partners (Pdr/Pdx and Fdr/Fdx system) and H₂O₂. The Pdr/Pdx regeneration system contains CYP, Pdr, and Pdx ratio of 1:2:16, catalase (100 mg/mL), MgCl₂ (1 mM), and NADH regeneration system, (formate dehydrogenase-1 U, sodium formate -150 mM). Similarly, CYP, Fdr, and Fdx ratio of 1:2:10 was used with the NADPH regeneration system (Glucose dehydrogenase, Glucose) was used for Fdr/Fdx system. The reaction was initiated by NAD(P)H and incubated for 2 h at 30°C with vigorous shaking at 800rpm. The reactions were optimized by using different concentrations of oxygen Surrogate H₂O₂ from 1mM to 200mM to achieve the maximum catalytic efficiency.

2.4 Bioinformatics and molecular docking analysis

The biosynthetic gene cluster associated with CYP105D17 was predicted by antiSMASH. Amino acid sequence alignment of CYP105D17 with CYP105D18 was performed using Clustal omega (<https://www.ebi.ac.uk/Tools/msa/clustalo>). The homology model of CYP105D17 was built based on the template CYP105D18 (PDB 7DLS) by using Alpha fold [12]. The quality of the model was evaluated by the Ramachandran plot and Z-score [13]. Molecular docking of papaverine and testosterone into the CYP105D17 and CYP105D18 active pocket was done using the GNINA 1.0 algorithm [14]. The structural optimization of the substrate and rigid formation molecular docking was performed. The grid box was setup (ADT ver.1.5.6, (<http://mglttools.scripps.edu/>) including HEM, and the box size was set to 35 x 35 x 30 Å, spacing 0.375 Å and locations were x = 14.721, y = -3.573, z = 14.768. The whole docking simulation parameter was set up to num_modes 500, exhaustiveness = 8, min_rmsd_filter = 0.5. The protein-ligand visualization and structure figures were prepared using PyMOL [15].

2.5 Product extraction, purification, and analysis

The reactions were extracted using an equal volume of ethyl acetate twice, dried, and dissolved in HPLC-grade methanol for further analysis. The mixtures were filtered with 0.2µm Whatman filter and injected into UHPLC and separated with the use of Mightysil reverse-phase C18 column (4.6X250, 5µm); Kanto Chemical, Tokyo,

Japan. The gradient system and solvents used for the separation of different compounds are described in previous work [16]. The product was analyzed using the standard compound in HPLC analysis.

2.6 Determination of kinetic parameters

The kinetics parameters for papaverine *N*-oxide formation was analyzed using 1 μ M CYP105D17, 20mM H₂O₂, and different concentration of papaverine (5 ~ 600 μ M). The reaction mixture was incubated for 1 h at 30°C with vigorous shaking at 800rpm and extracted as described above. Assuming the absorbance properties of the products and substrate same, the products were quantified by correlating the peak area of the respective product with the combined peak area of the product and the substrate. K_m and K_{cat} values were calculated by plotting the product formation rate against substrate concentration using the Michaelis-Menten equation.

3. Results and Discussion

3.1 Characterization of CYP105D17

CYP105D17 (locus-tag SLA 0051) was associated with the predicted lanthipeptide biosynthesis gene cluster from *Streptomyces laurentii* (accession AP017424.1) (Fig. 1a). The actual function of the gene cluster is still unknown. *Streptomyces* sp. are rich in numbers of Cytochrome P450 in their genome. Especially, the CYP105 family is involved in the biosynthetic gene cluster of secondary metabolites. Besides, they are also involved in xenobiotics metabolism and drug modification with substrate flexibility [17]. Here, CYP105D17 showed 81.8% identity with already characterized CYP105D18 from the same strain which was capable of modification of isoquinoline alkaloid and steroid drugs [16, Accepted].

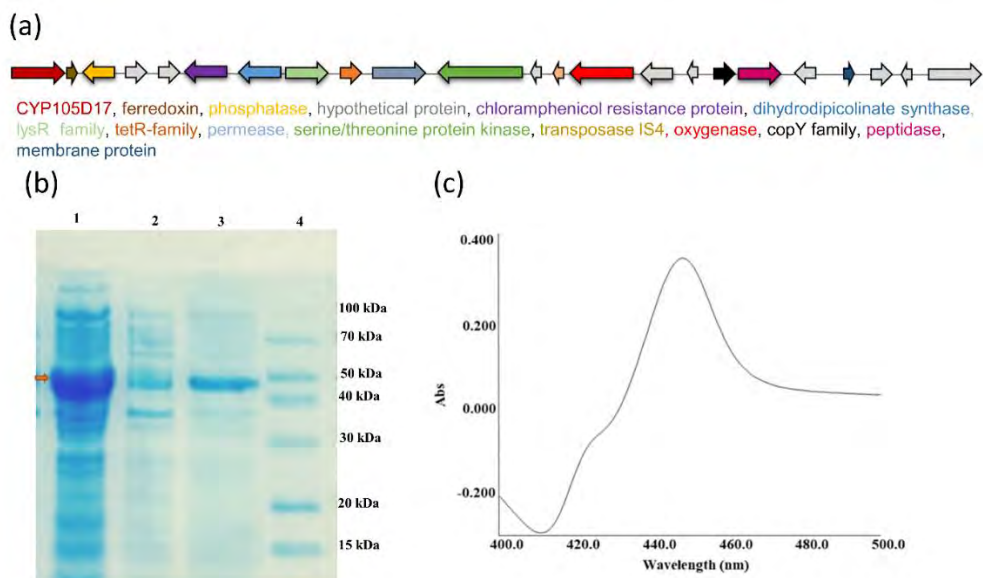


Fig. 1. (a); CYP105D17 involved biosynthetic gene cluster from *Streptomyces laurentii* (accession AP017424.1), (b); SDS-PAGE analysis of CYP105D17. (Lane 1) soluble lysate, (lane 2) resin unbound fraction, (lane 3) Purified fraction, (lane 4) Marker. (c); dithionite-reduced CO bound spectra from CYP105D17.

The theoretical molecular weight of CYP105D17 was 43.9 kDa and SDS-PAGE analysis of purified protein showed \approx 49 kDa due to the N-terminal His-tag from pET28a (Fig. 1b). The spectrum of dithionite, CO-bound of CYP105D17 showed a Soret peak at 450 nm (Fig. 1c). CYP105D17 was screened for papaverine and testosterone which was efficiently catalyzed by CYP105D18 [16, Accepted]. CYP105D17 showed a similar pattern of product formation with papaverine like CYP105D18, but there was no catalysis with steroids as catalyzed by CYP105D18. Different redox partners system (Pdr/Pdx and Fdr/Fdx) and oxygen surrogate (H₂O₂) was used for the screening of catalytic properties of CYP105D17. Here, CYP105D17 was only able to catalyze the papaverine *N*-oxidation in the presence of co-substrate H₂O₂. The optimum H₂O₂ concentration for the maximum product formation was 20 mM. The product peak of CYP105D17 was correlated with the Papaverine *N*-oxide produced by CYP105D18 in HPLC chromatogram at the retention time of 18.2 min (Fig. 2a).

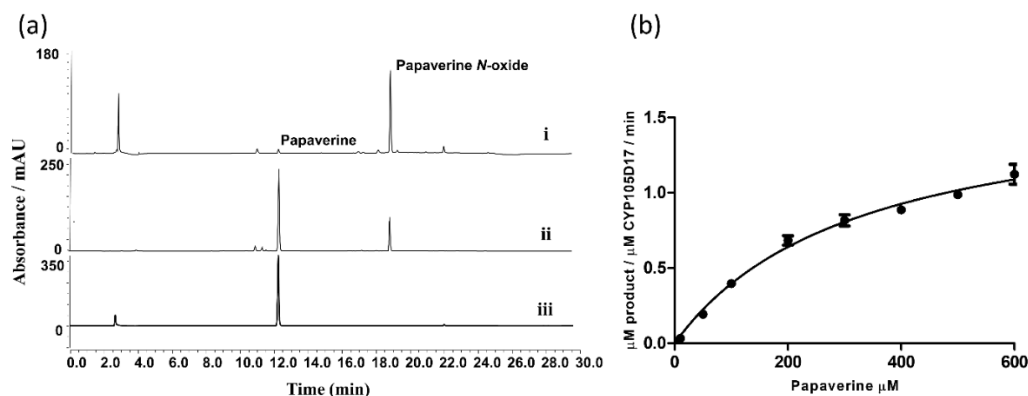


Fig. 2. (a) HPLC chromatograms. i; *in vitro* reaction catalyzed by CYP105D18, ii; *in vitro* reaction catalyzed by CYP105D17, iii; control. All *in vitro* reactions were catalyzed in the presence of 3 μ M CYP, 20mM H₂O₂ and 400 μ M papaverine. Control was performed in the presence of boiled (inactivated) CYP105D17. (b) Hyperbolic fit for papaverine *N*-oxidation catalyzed by CYP105D17. Values are mean \pm SD of three independent experiments under similar condition.

CYP105D18 was reported to have an optimum H₂O₂ concentration of 40mM for papaverine *N*-oxidation with high H₂O₂ tolerance capacity. Cytochrome P450 with peroxygenase activity has been reported for fatty acid modification mostly from the CYP105P family [18]. These enzymes usually suffer from rapid heme oxidation by the co-substrate. Some CYP peroxygenase has been reported with high H₂O₂ tolerance, and they get an advantage over the use of redox partners and expensive co-factors for compound modification [16]. There was no activity of CYP105D17 with the use of the Pdr/Pdx and Fdr/Fdx systems. The preference and high tolerance capacity to H₂O₂ for the papaverine *N*-oxidation by CYP105D17 get an advantage as a stable peroxygenase. Papaverine is an isoquinoline alkaloid drug used to treat vasospasm with some adverse effects [19]. Modification of papaverine like O-demethylation, hydroxylation, and *N*-oxidation can reduce the adverse effect which remains always the challenging chemical reaction. The enzymatic catalysis, O-demethylation of papaverine by CYP105D1, and *N*-oxidation by CYP105D17 and CYP105D18 offer the exploration of more CYP105D family for similar drugs modification and their possible pharmaceutical applications [19].

3.2 Kinetic analysis

Kinetics analysis for papaverine *N*-oxidation by CYP105D17 was performed (Fig. 2b). K_m and K_{cat} values were obtained to be 302 \pm 33 μ M and 1.6 \pm 0.08 min⁻¹ respectively. The catalytic efficiency for CYP105D17 was 4.5 times lower than CYP105D18. The comparative data for all the kinetic parameters for papaverine *N*-oxidation between CYP105D17 and CYP105D18 are summarized in Table 1.

Table 1. Comparison of kinetic parameters between CYP105D17 and CYP105D18 for papaverine *N*-oxidation

Kinetics parameters	K_m	K_{cat}	Catalytic efficiency
CYP105D17	302 \pm 33 μ M	1.6 \pm 0.08 min ⁻¹	0.31 sec ⁻¹ μ M ⁻¹
CYP105D18	213 \pm 26 μ M	5 \pm 0.3 min ⁻¹	1.43 sec ⁻¹ μ M ⁻¹

3.3 Structural comparison of CYP105D17 with CYP105D18

In our previous study, we solved the papaverine-bound crystal structure of CYP105D18 (pdb 7DLS) explaining the bendable structure of papaverine was preferable for *N*-oxidation [16]. CYP105D17 from the same strain showed 81.8% identity with CYP105D18. Therefore, we built the structural model of CYP105D17 based on the CYP105D18 structure for the structural comparison. Ramachandran plot shows that 92 % of the values were in the most favored region, 7.4 % in the allowed region, and only 0.3 % in the outlier region. Further, Z-score was 9.57 indicating the good quality of the model (Fig. 3).

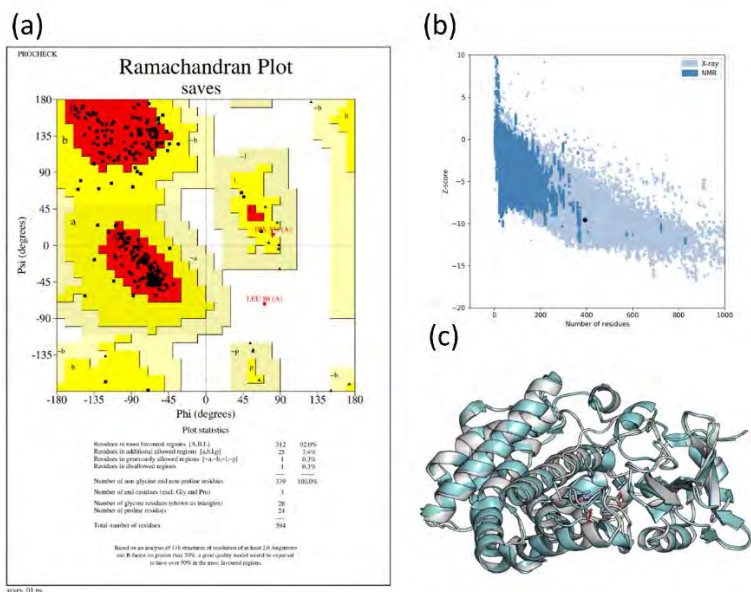


Fig. 3. Homology Modeling and Validation for CYP105D17. (a) The quality of model was evaluated by (a) Ramachandran plot and (b) Z-score. (c) Structural model of CYP105D17 (white) with superposition CYP105D18 template (cyan).

Even though the product formation pattern with papaverine was similar between CYP105D17 and CYP105D18, biochemical properties, product formation rate, and kinetics parameters were different. The computational approach for structural prediction and molecular docking may provide the hints for a site of metabolism and those differences in experimental data [20]. Papaverine was accommodated with all the hydrophobic residues Ala85, Leu87, Val231, Ala282, Val234, and Ile386 in CYP105D18 [16]. There was a residual difference that Val231 from CYP105D18 was replaced with Ile231 in CYP105D17. In addition, there was an involvement of additional hydrophilic residue Thr239 in the active site of CYP105D17 for papaverine accommodation. The presence of these residues may hinder the catalytic efficiency of CYP105D17 for papaverine *N*-oxidation as compared to CYP105D18.

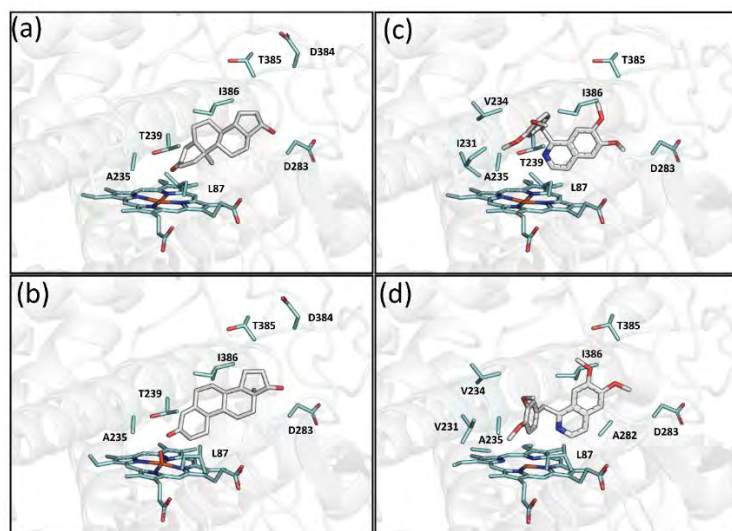


Fig. 4. Docking analysis of CYP105D17 and CYP105D18 with papaverine and testosterone. Docking model of CYP105D17 with testosterone (a), CYP105D18 with testosterone (b) CYP105D17 with papaverine (c) CYP105D18 with papaverine (d).

Despite, there were similar amino acids (Leu87, Ala235, Thr239, Ile383, Asp384, Thr385, and Ile386,) involved in the active site of CYP105D18 and CYP105D17 for the accommodation of testosterone, CYP105D17 was unable to catalyze testosterone like CYP105D18. CYP105D18 was capable to catalyze the testosterone to 2 β hydroxytestosterone [Accepted]. The docking analysis showed a similar accommodation of testosterone in CYP105D17 like CYP105D18, but experimentally CYP105D17 was unfavorable for hydroxylation of the 2C position (Fig. 4). Further, a molecular simulation studies can better explain the mechanism of catalytic differences

in CYP105D17 and CYP105D18 with testosterone, which lacks in our study.

3. Conclusions

We have investigated the new CYP (CYP105D17) from the CYP105 family from *Streptomyces laurentii*. CYP105D17 was able to catalyze the *N*-oxidation of papaverine in the presence of H₂O₂. The differences in kinetic parameters in papaverine *N*-oxidation between CYP105D17 and CYP105D18 were analyzed. The structural comparison between CYP105D17 and CYP105D18 for papaverine and testosterone accommodation was also analyzed. This provides insight into the exploration of other closely related CYPs from the CYP105 family and their potential use for drug modification.

Acknowledgement

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In-silico analysis and screening of trehalose biosynthesis pathways in Antarctica lichen-associated ***Variovorax*** sp. PAMC28711

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Abstract

Trehalose is a naturally occurring disaccharide that is abundantly present in nature. Its presence in cells has several effects, especially because it acts as a natural defender of proteins and membranes. It is utilized in food, cosmetics, and medications because of its excellent water retention properties. Following its esterification with fatty acids of different chain lengths, trehalose has also been shown to have anti-bacterial, anti-biofilm, and anti-inflammatory properties. Trehalose plays a structural part in the bacterial cell wall's adaptive reactions to stressors including osmotic variations and high temperature. Additionally, it was proposed that when bacterial cells are exposed to harsh environmental challenges such as heat, cold, desiccation, or reactive oxygen species, these organisms biosynthesize high concentrations of both intra- and extracellular trehalose to help them survive. Therefore, we analyzed *Variovorax* sp. PAMC28711 isolate from Antarctica, which was predicted by bioinformatics tools (RAST, Prokka, KEGG, CGView Server, and MetaCyc) to predict the enzymes involved in the different pathways of trehalose production. Furthermore, TLC analysis was carried out to characterize various trehalose biosynthesis pathways. According to the findings, it revealed that our polar bacteria *Variovorax* sp. PAMC28711 have potential to produce trehalose through three (OtsA/B, TS, and TreY/Z) pathways. We anticipate that this strain could be of potential use for manufacturing trehalose at the industrial scale.

KEYWORDS: Trehalose, Lichen-associated, Metabolic pathways, Antarctica

1. Introduction

Trehalose is a non-reducing disaccharide that is synthesized when two glucose molecules (α -D-glucopyranosyl- α -D-glucopyranoside) are linked by α , α -1 glycosidic linkage [1]. Normally, cells produce most of their trehalose under glucose limitation when there is very high flux of gluconeogenic energy from several carbon sources. However, trehalose is also synthesized when glucose is continuously used in a constantly unproductive manner to balance glycolysis; this process is triggered by various (occasionally external) factors, but will all reflect a "starvation-state," which is far less well-known [2,3]. There are various biosynthetic processes that can be used to synthesize trehalose. The most prominent pathway is the TPS/TPP biosynthetic pathway, also known as OtsBA. Two enzymes known as trehalose-6-phosphate synthase (TPS or OtsA) and trehalose-6-phosphate phosphatase (TPP or OtsB) convert glucose-6-phosphate and UDP-glucose to trehalose. Maltooligosyl-trehalose synthase/Maltooligosyl-trehalose trehalohydrolase (TreY/TZ) is another pathway for the trehalose synthesis. In this pathway, an isoamylase hydrolyzes the -1,6-glycosidic bonds in glycogen or other polysaccharides like starch to form maltodextrin. Then, employing an intermolecular transglucosylation mechanism, a maltooligosyl-trehalose synthase (MTS) catalyzes the transformation of maltodextrin into maltooligosyl-trehalose by creating an α , -1,1-glycosidic bond. Maltooligosyl-trehalose trehalohydrolase (MTH), a third enzyme, hydrolyzes the product to produce trehalose and a maltodextrin that is two glucosyl residues shorter [4]. Trehalose with different physical properties (low hygroscopicity, high freezing point, high glass transition temperature, greater stability, high-water retention capacity), chemical and functional properties (low carcinogenicity, less sweetness (45% that of sucrose)) are found with great application in the food industry and cosmetic industry. Therefore, we have studied the trehalose biosynthesis pathway in cold-adapted lichen-associated bacteria *Variovorax* sp. PAMC28711 to produce trehalose. Trehalose is typically extracted from yeast cells. However, due to its low yield and high cost, this technology is inappropriate for industrial manufacturing. In some instances, trehalose has been manufactured

industrially in Japan using microbial enzymes. Since starch is a very cheap substrate, using enzymes to make trehalose from it offers financial benefits because it could reduce production costs. These results indicate that our cold-adapted *Variovorax* sp. PAMC28711 possesses the trehalose-producing genes necessary for survival in a harsh environment like Antarctica. The identification of bacteria strains that can manufacture trehalose and the characterization of their metabolic pathways may also advantage from the results of this study.

2. Materials and Methods

In this study, we used in silico analysis to predict the trehalose biosynthesis pathways and associated genes. Furthermore, after making our prediction, we carried out a screening of the trehalose biosynthetic pathways utilized by our Antarctica isolate *Variovorax* sp. PAMC28711.

2.1. Prediction of trehalose biosynthesis pathways in *Variovorax* sp. PAMC28711

We retrieved a complete genome information of *Variovorax* sp. PAMC28711 from the National Center for Biotechnology Information (NCBI) genome database (<https://www.ncbi.nlm.nih.gov/>) for the trehalose biosynthesis pathway study. The GenBank accession number of *Variovorax* sp. PAMC28711 is NZ_CP014517.1 [5]. The KEGG pathway database (<http://www.kegg.jp/> or <http://www.genome.jp/kegg>) [6] and MetaCyc database ([MetaCyc.org](http://www.jgi-psf.org/kegg/)) [7] were used to predict trehalose biosynthesis pathways in the complete genome of *Variovorax* sp. PAMC28711.

2.2. Screening of trehalose biosynthesis pathways in *Variovorax* sp. PAMC28711

As a growth medium, Reasoner's 2A (R2A) and Luria-Bertani (LB) media were used. The addition of 2% (w/v) glucose provided the bacteria with the stress. The strain PAMC28711 was cultivated in several substrates containing 2% (w/v) maltose, starch, and maltodextrin that were added individually to LB media and were grown at a temperature of 25°C with 200 rpm agitation for 72 hours to determine the various trehalose biosynthetic routes. Centrifugation was used to separate the cells at 25°C and 12,500 rpm. Cells are permeabilized with 50% methanol and extracted for 30 min on ice. The mixture was mixed vigorously and centrifuged at 12,500 rpm for 5 min. The supernatant was assayed for trehalose by thin-layered chromatography on a silica gel plate with a solvent system consisting of the n-butanol/ethanol/water (5:3:2, v/v/v), and spots were visualized by spraying with 20% sulfuric acid and 5% ethanol followed by heating at 130°C as describe by Nguyen et al. [8].

3. Results, Discussions, and Conclusions

According to Tribelli and Lopez [9] Bringer et al. [10], both psychrophilic and psychotropic species have special adaptations that improve an enzyme's capacity to be active in a cold environment while still maintaining metabolism and growth. They utilize special cold-adapted proteins and cold active enzymes, which are catalytically effective even at low temperatures, to maintain their cell cycle to survive in the harsh environment. The growth of our cold-adapted strain PAMC28711 was found to be psychrotrophs and was able to thrive from psychrophilic temperature (15°C) to mesophilic temperature (37 °C). It possesses the genes necessary for living in a cold climate. The genes associated with a low temperature is highlighted in a [Table 1](#).

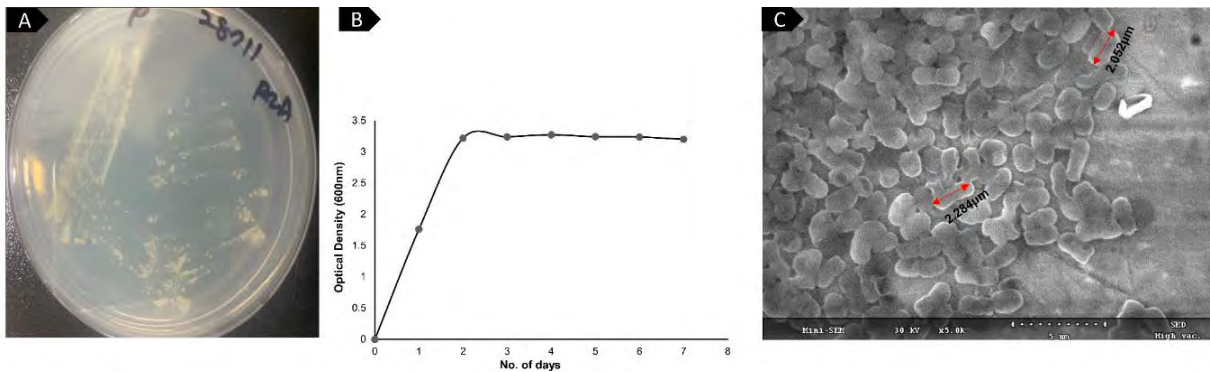
Table 1. Genes associated with a low-temperature lifestyle identified in *Variovorax* sp. PAMC28711

Temperature	15-37 ^o C
Response to low temperature	
Membrane fluidity	Fatty acid desaturase
Compatible solutes and antifreeze proteins	
Trehalose biosynthesis ^a	TS; TreY; TreZ; TPS; TPP
Glycine betaine ^b	OpuD
Oxidative stress and low-temperature response	
Cold shock response ^c	GyrA; Dead; PpiC; RecA; RbfA; Pnp; NusA; ClpB
Oxidative stress ^d	Grx; Ahp; SOD; Prx; BtuE

^a TS, trehalose synthase; TreY, maltooligosyl-trehalose synthase; TreZ, maltooligosyl-trehalose trehalohydrolase; TPS, trehalose 6-phosphate synthase; TPP, trehalose 6-phosphate phosphatase ^b OpuD, Glycine betaine transporter ^c GyrA, DNA gyrase; Dead, DEAD-box RNA helicase; PpiC, peptidyl-prolyl cis-trans isomerase; RecA, DNA strand exchange and recombination protein; RbfA, ribosome binding factor; Pnp, polyribonucleotide nucleotidyltransferase; NusA, transcription termination factor; ClpB, ATP-dependent chaperone ^d Grx, glutaredoxin; Ahp, alkyl hydroperoxide reductase; SOD, superoxide dismutase; Prx, peroxiredoxin; BtuE, glutathione peroxidase.

Variovorax sp. PAMC28711 is composed of circular chromosomes of 4,320,000, bp with GC content of 66%. colonies showed yellow, slimy, and shiny on R2A media (Fig. 1A) when grown at 15 °C for 7 days. Growth was monitored at 600 nm by using spectrophotometer (Fig. 1B) and found to be rod shaped with the size of ~2µm (Fig. 1C).

Fig. 1. A. Morphology colony of *Variovorax* sp. PAMC28711 in R2A agar. B. Microbial growth curve of *Variovorax* sp. PAMC28711. C. Microscopic observation of *Variovorax* sp. scanning electron microscope (SEM). Magnification at 5000x.



There are several carbohydrate metabolism pathways found in *Variovorax* sp. PAMC28711. One of them is trehalose metabolic pathways. Trehalose can be used as an alternative carbon source in microorganisms [11]. On the prediction of trehalose biosynthesis pathways in our Antarctica isolate *Variovorax* sp. strain PAMC28711, it showed two TPS/TPP (enzymes such as trehalose phosphate synthase and trehalose 6-phosphate phosphatase) pathway enzymes and two TreY/TreZ (enzymes such as maltooligosyl-trehalose synthase and maltooligosyl-trehalose trehalohydrolase) pathway enzymes, TS (trehalose synthase) pathway enzyme (Fig. 2 & Table 2) [12]. Similarly, it has reported by Delorge, and his colleagues that cold-induced trehalose biosynthesis genes (*otsA* and *otsB*) were present in *E. coli* [13]. Thus, it gives assurance that under stressful conditions, extreme microbes are capable of synthesizing trehalose.

Fig. 2. Left: The three routes for trehalose biosynthesis observed in *Variovorax* sp. PAMC28711. Right: A map created with the use of the CGView Server (<https://cgview.ca/>), showing the complete genome. The Prokka annotation and CDSs are represented by the blue arrows, while the outermost rings are VirSorter and Alien Hunter, respectively. The black plot represents GC content, while the green and magenta plots, respectively, represent CG skew+ and -. The metabolic pathways for trehalose in *Variovorax* sp. PAMC28711 are identified.

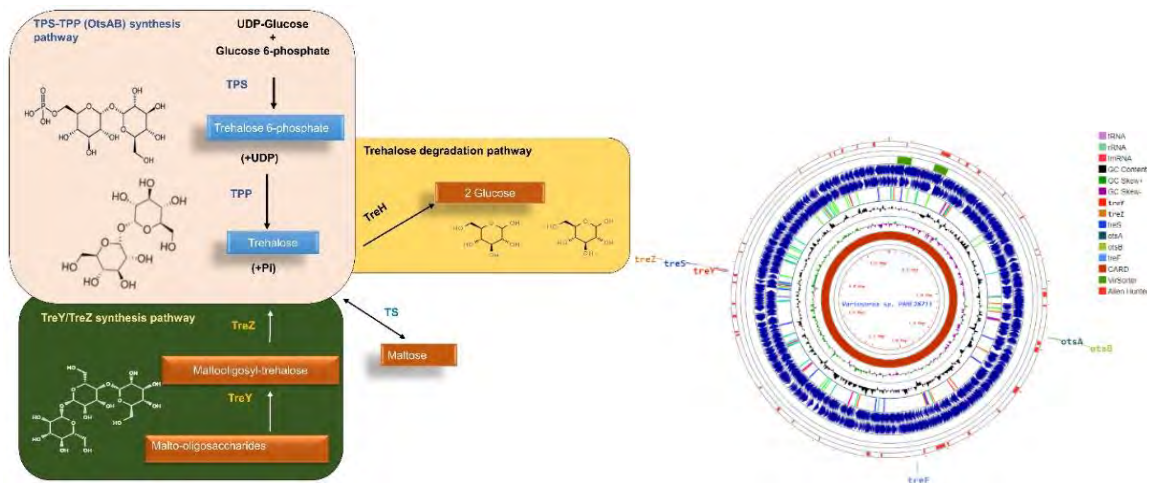



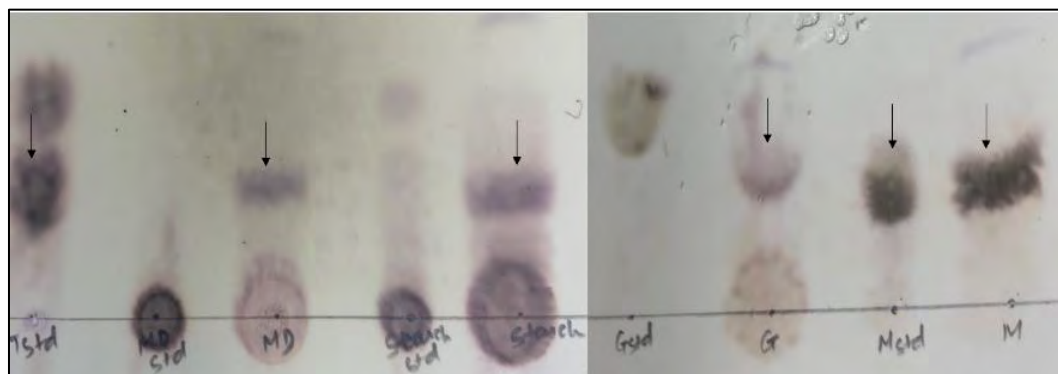


Table 2. Distribution of the trehalose biosynthesis genes extracted from RAST and MetaCyc annotation database and its gene clusters in *Variovorax* sp. PAMC28711. The forward arrows indicate the genes in the positive strand, while the backward arrows indicated the genes in the negative strand.

Gene	Feature ID	Length (bp)	Function	Gene cluster
<i>otsB</i>	fig 1795631.8.peg.1307	1389	α,α -trehalose-phosphate synthase [UDP-forming] (EC 2.4.1.15)	
<i>otsA</i>	fig 1795631.8.peg.1306	753	Trehalose-6-phosphate phosphatase (EC 3.1.3.12)	
<i>treS</i>	fig 1795631.8.peg.3315	3354	Trehalose synthase (EC 5.4.99.16)	
<i>treY</i>	fig 1795631.8.peg.3313	1830	Malto-oligosyltrehalose trehalohydrolase (EC 3.2.1.141)	
<i>treZ</i>	fig 1795631.8.peg.3312	4059	Malto-oligosyltrehalose synthase (EC 5.4.99.15)	

The intracellular trehalose was carried out by TLC. As shown in Fig. 3, the spot corresponding to glucose, sucrose, maltose, starch, maltodextrin, and trehalose on the TLC plates were detected from the samples subjected to respective substrates treatment, suggesting that the cell extract contained trehalose. Since, it was confirmed that strain PAMC28711 has potential to produce trehalose through three (*otsAB*, *TreY/Z*, and *TS*) pathways. Natural microorganisms could utilize a wide range of nutrients and have a high capacity for environmental adaptation. One method used by live microbial cells to deal with nutritional deficiencies is the intracellular storage of carbohydrates for usage as carbon and energy sources [14].

Fig. 3. Qualitative analysis of trehalose -producing from screening strain PAMC28711. Tstd: trehalose standard; MDstd: Maltodextrin standard; MD: maltodextrin, Starch std: starch standard; starch, Gstd: glucose standard; G: glucose; Mstd: maltose; M: maltose.



4. Conclusions

In this study, we reported that cold adapted lichen associated *Variovorax* sp. strain PAMC28711 has potential to produce trehalose via three pathways (*OtsBA*, *TreY/Z* and *TS*). We anticipate that the exploration of trehalose biosynthesis pathways in *Variovorax* sp. PAMC28711 revealed regarding the role of trehalose production at low temperatures and can be employed for biotechnological, industrial, and pharmaceutical applications.

Acknowledgement

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Comparative genome analysis of bacteria isolated from cold environments into cold adaptation through the whole CAZyme pattern provides new insight

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Abstract

Recently, microorganism studies increases have provided potential applications and challenges for all organisms. Understanding how the microorganisms' diverse metabolisms have an essential effect on other organisms is crucial. Isolated bacteria from cold environments and has the potential to play various roles at low temperatures. The genetic pattern analysis of carbohydrate-active enzymes (CAZymes) in isolated bacteria from cold environments can help to determine how they adapt and survive in extreme environments. In a genome sequence-based, this study provides insights into the diversity of redundant patterns of CAZyme for finding new compounds and active enzymes that can endure the cold environment of microbial. Genome-wide comparisons confirmed that AA3, AA4, CE1, CE4, CE9, CE14, GH3, GH13, GH23, GT2, GT4, GT51, and CBM48 families of CAZyme were highlighted from isolated bacteria genomes from the cold environment. The CAZyme pattern of cold environment microbial can infer that energy is obtained from polysaccharides found in crustaceans, algae, and grasses in cold environments, such as glycogen, cellulose, hemicellulose, and chitin. These overall results explained the genome sequence based CAZyme pattern analysis of cold environment microbial. The most visible patterns were groups of enzymes that could degrade the main components of a fungal cell wall or the shell components of crustaceans. Thus, in this study provides a way for isolated bacteria from a cold environment to utilize polysaccharide or carbohydrate degradation as an energy source to generate energy in cold environments and provides a foundation for understanding survival adaptation mechanisms under cold adaption.

KEYWORDS: Complete genome sequence, CAZyme, Cold environment, Cold adaptation

1. Introduction

Cold environments cover around 75% of the earth's surface, and research into the characteristics of cold environments can reveal previously unknown microorganisms and their evolution in a cold environment [1]. An extreme environment like the polar area means extreme conditions, low temperatures, intense UV radiation, and an undeveloped habitat [2]. We can know that psychrophilic microbes living in extreme conditions have inhabited all permanently cold environments, from the deep sea to mountains and polar areas, as previously reported [3]. Microorganisms isolated from polar areas utilize diverse metabolic pathways to adapt to cold environments. In general, when microorganisms in cold environments detect a drop in temperature, they express cold-associated genes, which are necessary for their ability to adapt to low temperatures and grow well at low temperatures [4]. In addition, cold microorganism generally has the fastest growth rates above 15 °C, whereas psychrophilic organisms grow faster at a temperature of 15 °C or lower. However, these strains cannot grow above 20 °C [5]. Polar area-associated microorganisms isolated from cold environments have a particular character, such as cold-adapted organisms or psychrophiles. In addition, almost components of the microorganisms' cells, from membranes cells and transport systems to intracellular solutes, nucleic acids, and proteins, are different from bacteria in the general environment because the low temperature significantly impacts microorganisms' life cycles [6]. Thus, polar microbial must alter the essential cellular functions of metabolism, replication, transcription, translation, and microorganisms to adapt to the low temperature.

The carbohydrate-active enzyme (CAZyme) is involved in carbohydrate biosynthesis, binding, and catabolism, including the structure of the complex polysaccharide [7], and these enzyme groups can separate into 6 groups based on catalytic activity: Glycoside hydrolase (GH), Carbohydrate esterase (CE), Polysaccharide lyase (PL), Glycosyltransferase (GT), an Auxiliary activity (AA), and Carbohydrate-binding module (CBM) [8]. Polysaccharides are the most abundant source of natural organic energy and consist primarily of phenolic polymers like cellulose, hemicellulose, and pectin [9]. Already been reported that several microorganisms have a series of synergistic enzymes able to degrade plant cell walls, resulting in the release of free glucose, which feeds microbial metabolism to maintain growth [10]. Among them, the most representative polysaccharide, starch, is an excellent source of carbon and energy for microorganisms that use an enzyme dedicated to extracellular hydrolysis [11]. In addition, bacteria with glycogen metabolism manage various decided physiological functions, including energy storage by glycogen synthesis or pathways like starch degradation [12]. Some studies have shown glycogen metabolism's physiological impact on bacterial survival in cold environments [13]. These microorganisms can adapt rapidly to constantly changing environmental conditions by accumulating energy storage compounds in

response to transient depletion times [14].

This study has the CAZyme gene pattern based on the genome information of the bacteria associated with the cold environment. These results predicted survival and adaptation strategies might be essential for subsisting in the extreme environments of the Arctic and Antarctica for cold-associated bacteria. Likewise, comparative genome analysis of bacteria isolated from cold environments and CAZyme gene patterns can comprehend how adaptation to survival might be accomplished in extremely low-temperature environments.

2. Statement of Contribution/Experimental/Methods

2.1 Isolation of bacteria from cold environment

Each bacteria strain (cold-adapted bacteria) was isolated from a natural source (Lichen, soil, and cryoconite) from the Arctic and Antarctic using sterilized scissors, mortar, pestle, and 0.85% NaCl solution. Then, vortexing for 1 min and spread the crushed natural source solution over the R2A medium (MB cell Ltd, Seoul, Korea). Until when the appears the strain colony is stored and observed at 15 °C. Each strain was cultured in 100 ml R2A liquid-type media at 15 °C for 5–10 days before being used in experiments. Each pure strain colony was isolated and stored at –70 °C in a 20% glycerol solution.

2.2 Genomic DNA extraction and Genome sequencing

The genomic DNA was extracted from each strain using the QIAamp DNA mini kit (Qiagen Inc., Valencia, California, United States) for complete genome sequencing. After the DNA quality was confirmed by agarose gel electrophoresis, the concentration and purity of the DNA (A260/A280) were measured by a spectrophotometer (Biochrome, Libra S35PC, UK). In addition, the quantity and purity of genomic DNA were determined using an Agilent 2100 Bioanalyzer (Agilent Technologies, Santa Clara, CA, USA). The genome sequencing was performed with PacBio RS II single-molecule real-time (SMRT) sequencing technology (Pacific Biosciences, Menlo Park, CA, USA). After that, raw sequencing data were generated and assembled de novo using the hierarchical genome assembly process (HGAP) protocol and RS HGAP 2 Assembly in the SMRT analysis software (ver. 2.3; Pacific Biosciences, <https://github.com/PacificBiosciences/SMRT-Analysis>). Finally, coding DNA sequences (CDS) were predicted and annotated by Rapid Annotation using the Subsystem Technology (RAST) server.

2.3 Profile annotation and CAZyme annotation of the cold-adapted bacteria genome sequence

The predicted genomes sequences information was translated and searched against the National Center for Biotechnology Information (NCBI) non-redundant database, the Clusters of Orthologous Group (COG) database, and the Kyoto Encyclopedia of Genes and Genomes (KEGG) database to identify their characteristics. In addition, we present the genomic features as a circular map of the cold-adaption bacteria's complete genome created by the CGView comparison tool [15]. Predicted CAZyme gene analyses were carried out by running HMMER3 [16] scans using a hidden Markov model (HMM) profile downloaded from dbCAN2 HMMdb (version 7.0). The e-value cutoff was 1e-15, and the coverage cutoff was >0.35. In addition, we used DIAMOND [17] (e-value < 1e-102) and Hotpep [18] (frequency > 2.6, hits > 6) to improve the prediction accuracy.

3. Results, Discussions, and Conclusions

3.1 Genome information for cold-adapted bacteria

To check the CAZyme pattern analysis, Table 1 shows the complete genome sequence information of bacteria isolated with the Arctic and Antarctica. It was isolated from a cold environment, and we have already uploaded 26 strains from the previously submitted genome information to the NCBI genome database. First, we isolated 13 bacteria strains from the Polar lichen, showing that each genome size ranged from 3.26 Mb (*Burkholderia* sp. PAMC28687) to 7.5 Mb (*Streptomyces* sp. PAMC26508). Second, isolated 7 bacteria strains from the Polar sediment, soil, and rock showed that the size of each genome ranged from 3.32 Mb (*Psychrobacter alimentarius* PAMC27889) to 7.05 Mb (*Paenibacillus xylanexedens* PAMC22703). Finally, isolated 6 bacteria strains from the polar cryoconite and freshwater showed that the size of each genome sequence ranged from 4.17 Mb (*Arthrobacter* sp. PAMC25564) to 7.02 Mb (*Pseudomonas* sp. PAMC25724). In addition, we chose the 3 strains (PAMC25724, PAMC25886, and PAMC21119) from cold environments because we need more genome information for comparative genome analysis. However, they are draft genome sequences type in the genome information. Despite the draft genome sequence type, they previously mentioned about studied many results to low-temperature information.

Table 1. Genome information of isolated 26 bacteria strains from cold environment

Strain Name	Isolation	Species	Size (Mb)	GC%	Protein	Gene	Replicons
26640	Artic	<i>Mucilaginibacter</i>	5.61	43.3	4,757	4,890	CP014773.1
26642	Artic	<i>Bosea</i>	5.5	65.2	5194	5,330	NZ_CP014301.1

26628	Artic	<i>Hymenobacter</i>	5.28	63.1	4498	4,675	NZ_CP014304.
26561	Antarctica	<i>Burkholderia</i>	3.4	60.2	2990	3,106	NZ_CP014306.1
26508	Antarctica	<i>Streptomyces</i>	7.53	71.1	6364	6,600	CP003990.1
26554	Antarctica	<i>Hymenobacter</i>	5.24	60.9	4530	4,638	CP014771.1
28705	Antarctica	<i>Rhodococcus</i>	4.73	62.1	4148	4,324	NZ_CP039254.1
28707	Antarctica	<i>Rhodococcus</i>	4.73	62.1	4149	4,325	NZ_CP039253.1
28687	Antarctica	<i>Burkholderia</i>	3.26	60.1	2927	3,060	NZ_CP014505.1
28711	Antarctica	<i>Variovorax</i>	4.32	66	4025	4,220	NZ_CP014517.1
28760	Antarctica	<i>Shigella</i>	4.56	50.8	4104	4,399	NZ_CP014768.1
28766	Antarctica	<i>Fronthabitans</i>	4.35	68.8	3891	4,192	NZ_CP014513.1
28756	Antarctica	<i>Microbacterium</i>	3.54	70.4	3329	3,422	NZ_CP014313.1
20917	Artic	<i>Colwellia</i>	4.68	37.9	3856	4,034	NZ_CP014944.1
26386	Antarctica	<i>Pedobacter</i>	4.8	38.2	4061	4,175	CP060294.1
21119	Antarctica	<i>Psychobacter</i>	3.51	43.3	2784	2,899	ASM24749v2
27495	Antarctica	<i>Pedobacter</i>	5.95	38.8	4918	5,040	NZ_CP014504.1
22703	Artic	<i>Paenibacillus xylanexedens</i>	7.05	46	5883	6,135	NZ_CP018620.1
20958	Artic	<i>Halocynthiibacter arcticus</i>	4.33	53.2	3844	4,206	NZ_CP014327.1
27889	Antarctica	<i>Psychobacter alimentarius</i>	3.32	42.8	2670	2,760	NZ_CP039251.1
27494	Antarctica	<i>Pseudomonas antarctica</i>	6.44	59.8	5797	5,956	NZ_CP015600.1
27463	Antarctica	<i>Janthinobacterium valbardensis</i>	6.27	62.1	5431	5,646	NZ_CP023422.1
25564	Antarctica	<i>Arthrobacter</i>	4.17	66.7	3644	3,849	NZ_CP039290.1
25724	Antarctica	<i>Janthinobacterium lividum</i>	4.98	60.6	4222	4,488	GCA_000242815.2
25886	Antarctica	<i>Pseudomonas</i>	7.02	61.2	6285	6,414	GCA_000242655.2
28499	Antarctica	<i>Sphingobium</i>	4.88	64.5	4445	4,585	NZ_CP039248.1

3.2 CAZyme encoding in cold-adapted bacteria

We annotated through dbCAN2 and studied interesting CAZyme gene patterns in cold environments. DbCAN2 is a computational tool for predicting CAZyme coding genes and identifying to classify the CAZyme family in a complete genome sequence. It is based on protein function CAZyme patterns derived from genome sequence annotation. Specifically, dbCAN2 detected the CAZyme family encoding GH, GT, CE, AA, PL, and CBM. Based on predicted CAZyme results, numerous genes associated with degradation to polysaccharides impairment have been annotated, and detailed results are summarized in Figure 2. In this study, the genome sequence and comparative genome analysis of bacteria associated with a polar area revealed several genes pattern related to carbohydrate products' synthesis (GT family) and degradation (GH, PL, and CE family). In addition, a particular type of genome information has been found to contain CAZyme encoding for initial redox enzymes that act in conjunction (AA family) and a CBM family. Figure 1 shows the distribution of CAZymes in cold environments from bacterial genome sequences. For example, it revealed 108 CAZymes genes, including 9 AAs, 30 GHs, 47 GTs, 1 PL, 11 CEs, and 10 CBMs in the *Bosea* sp. strain PAMC26642 genome. For comparative genomes analysis, the genomic sequence of 26 strains was also annotated using the dbCAN2 tool, including the HMMER 3.0 package (<http://hmmer.org/>).

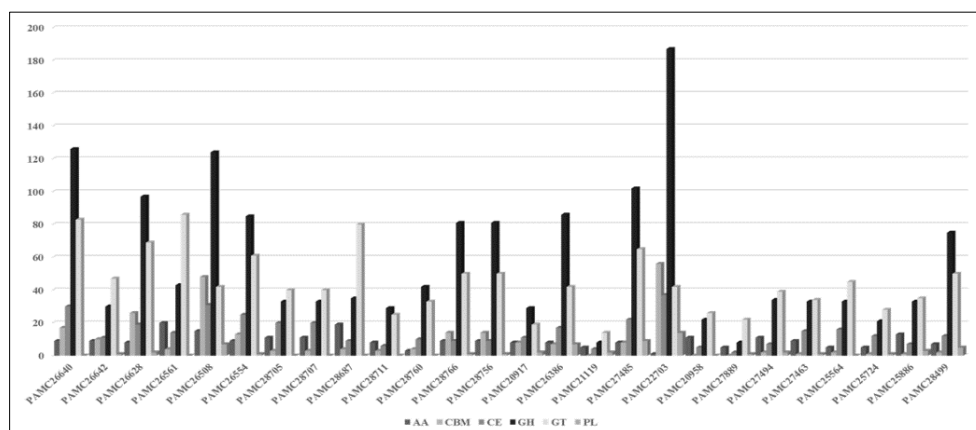


Fig. 1. Comparative CAZyme-encoding genes were found in the genome of 26 isolated bacteria from a cold environment.

3.3 GH family of CAZyme pattern in a cold environment bacteria genome

The GH family catalyzes the hydrolysis of glycoside bonds of complex carbohydrates, and it is essentially involved in carbohydrate metabolism [19]. In addition, the GH family is a common enzyme family that degrades the most abundant complex carbohydrates that source biomass, such as cellulose, hemicellulose, and starch [19]. At the results, we can confirm the GH pattern in the CAZyme family, and CAZyme annotation indicates that there related a total of 105 families of GH in the Polar microbial genome: GH1, GH2, GH3, GH4, GH5, GH6, GH8, GH9, GH10, GH11, GH12, GH13, GH15, GH16, GH17, GH18, GH19, GH20, GH23, GH24, GH25, GH26, GH27, GH28, GH29, GH30, GH31, GH32, GH33, GH35, GH36,

GH37, GH38, GH39, GH42, GH43, GH46, GH48, GH50, GH51, GH52, GH53, GH54, GH55, GH57, GH62, GH63, GH64, GH65, GH67, GH71, GH73, GH74, GH75, GH76, GH77, GH78, GH79, GH81, GH84, GH85, GH87, GH88, GH89, GH92, GH93, GH94, GH95, GH97, GH99, GH102, GH103, GH104, GH105, GH106, GH108, GH109, GH112, GH113, GH114, GH115, GH120, GH123, GH125, GH126, GH127, GH128, GH129, GH130, GH133, GH135, GH136, GH141, GH142, GH144, GH145, GH146, GH147, GH149, GH151, GH153, GH154, GH158, GH159, and GH164. Significantly, the GH3, GH13, and GH23 families were prominent in 105 of the total GH families, and the GH13 family has all the isolated bacteria genome information from the cold environment. GH13 families are the major enzyme acting on substrates containing α -glucoside bonds. And they have various preferred substrates like the α -amylases prefer polysaccharides of the α -1,4-glucan type, such as amylose and amylopectin. Additionally, able to degrade the supramolecular structures represented by starch granules and glycan particles [20]. The degradation of cellulose requires a particular class of enzymes that can prevent the degradation of the glycosidic bonds of cellulose. These enzymes family are strongly related to those necessary for the degradation and processing of glycogen. In general, both cellulolytic and amylolytic bacterial activities are induced by complex polysaccharides. However, several bacteria's highly available carbohydrates obtain energy through polysaccharides such as starch and plant cell walls [21]. The mechanisms regulating the synthesis and cohesion of cell surface complexes remain uncertain. Moreover, other studies indicate that bacteria require glycogen as a source of energy for survival, colonization, and virulence. Nevertheless, the catabolism of glycogen in bacteria remains unknown, although it has been well-studied in eukaryotes [22]. This study provides a foundation for understanding Polar-related microbial genome survival adaptation mechanisms under cold environmental conditions through the GH13 family pattern.

3.4 Discussions, and Conclusions

The study of its complete and draft genome of 26 isolated strains revealed genes involved in CAZyme. These results provided the genome sequence based CAZyme pattern analysis of isolated bacteria from a cold environment. In addition, our results offer new insights regarding the features associated with its adaptation to the cold environment. Currently, few studies have been conducted on the interaction between CAZymes and gene patterns specific to extreme environments such as polar areas. We predicted that the CAZyme gene's reserve supports establishing a symbiotic relationship between diverse bacteria species and other organisms or natural products in the various source from the natural, which is further facilitated by their capacity to adapt to changes in the extreme environment. Overall, our study provides new insights, which may be helpful in environmental adaptation and environment, and can identify future diagnostic, prognostic, or environmental prediction targets.

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THE ENVIRONMENTAL KUZNETS CURVE THESIS APPLIED TO THE DEMOCRATIC REPUBLIC OF CONGO

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Abstract

The Democratic Republic of Congo is a “geological scandal.” It is one of the richest country in the world. Its reserve in minerals is estimated to 24 trillion USD dollars without taking into consideration its national parks and its rivers. Yet paradoxically, the DRC is classified among the poorest country in the world. It has failed to take off economically. As the country strives to take off, it relies heavily on the exploitation of its natural resources with a corollary of environmental degradation. This paper will briefly highlight some of the background, analyses and critiques of the EKC theory. It will then attempt to apply the theory to the Democratic Republic of Congo (DRC). We shall look at two key sectors, namely the mining and forestry sectors. The objective is to see if we can confirm the EKC hypothesis and see if a preliminary conclusion can be drawn about the connection between income and environmental quality in the DRC. The paper gives some recommendations.

KEYWORDS: Environment, Environmental Kuznets Curve, Economic growth

1. Introduction

The Environmental Kuznets Curve (EKC) hypothesis is named after the economist Simon Kuznets (1901-1985). Kuznets developed a hypothesis where he argued that as economies develop, the level of inequalities first rises, then it decreases, following an inverted “U” form. This theory was, later on, applied to environmental studies by Grossman and Krueger in 1991. They were the first to do an empirical study that established a connection between the economic growth and the environmental degradation. In 1991 they wrote a scientific paper for the National Bureau of Economic Research (NBER). Their work was taken up by the World Bank in 1992, which popularized the EKC hypothesis (Stern 2004). In 1995 Grossman studied the consequences of the economic growth on the environment (Grossman 1995). These consequences are known as the “scale, composition and technology effects.” When these three effects are put together, they produce an inverted U-shaped relationship known as the Environmental Kuznets curve (Bakehe, 2018). Since 1995, there have been a considerable number of research and publications on the connection between the economic growth and its consequences on the environment. (Bakehe 2018).

The EKC theory suggests that, as a country is developing, it needs to rely on the exploitation of its natural resources. This has a negative consequence on the on the environment. As the GDP grows, countries begin to care of the environment. At this level there is a decrease in environmental degradation and pollution. However, relationship patterns vary between countries. This does not mean the that connection between income and environmental quality, in a certain context, is causal. In some cases, as well as in some countries, there is no evidence that supports the traditional hypothetical EKC inverted U-shaped link between economic growth and the degradation of the environment.

Most of the studies, according to Nkwetta (2018), use aggregate measures like the GDP income per capita and ignore other sectors of economic activity. There are a number of researches that show that the GDP per capita is not the only indicator to use in evaluating the link between the growth of the economy and environment degradation. There are other factors, such as political will and strength of institutions, that inform the relationship (Todaro & Smith, 2015). It has been demonstrated that elements such as political rights, civil liberties as well as the level of literacy have strong effects on environmental quality in low-income countries

(Torras and Boyce (1998). Suri and Chapman (1998) mention the trade between the industrialized and industrializing countries as a factor that influence the EKC while for Panayiotou institutions and policies can play a significant role in mitigating the impact of environmental degradation at low income levels. They can also accelerate the improvements at higher income levels while economic policies can flatten the EKC and reduce the environmental price of economic growth (Panayiotou 1997).

2. Theoretical background

The Kuznets curve theory inferred that as nations go through the development process, they would shift away from agriculture to increased mechanization and industrialization. Rural economies would decline as more and more agricultural workers migrate to urban centers as they look for limited jobs, thus leading to inequalities and exploitation of workers by the owners of the sectors of production. However, as income rises, the state would reach a level where it is more able to invest in the welfare of its people, and this would lead to more equality. (Yandle et al. 2002).

Critics of the Kuznets curve, however, have pointed out that the theory does not apply to all countries. They argue that Kuznets based his study on middle-income countries, such as the Latin American countries, which historically have high levels of inequality. A number of studies have shown that, rather than leading to inequalities, industrialization has immediately lifted millions out of poverty and led to more equality from the start. Joseph Stiglitz (1996) presented evidence how East Asian countries defied the Kuznets curve, which argued that growth leads to inequality at least initially. These countries managed to industrialize while simultaneously decreasing inequality and ensuring that the benefits of development reach their entire population. They have done that through effective policies on land reform, price controls, income redistribution and investment in health and education.

Unlike the Kuznets curve, the EKC appears to have had a wider application. Grossman and Kruger (1991), for example, applied the EKC to analyze, across 42 countries, the consequence of economic growth on air pollution. They found for instance that sulfur dioxide and other toxins in the air as indicators of air quality first worsened then improved as income levels rose. Similarly, Ogundari et al. (2017) have applied the theory to countries South of the Sahara using the degree of deforestation and the emission of greenhouse gas from agricultural activities as indicators of environmental change. They found that growth reduced agriculturally-related greenhouse gas emissions, while it increased the rate of deforestation. Here one can argue that many sub-Saharan African countries have not yet reached their turning point in development. Cropper and Griffith (1994) examined deforestation in 64 countries in Asia, Latin America, Africa. They found out that although many of those countries have not reached a turning point in their development, there is a clear indication that as income levels go up, the rate of deforestation decreases.

According to Nkwetta (2018), exploitation of natural resources is a liability to the environment rather than an asset. He tested the validity of the EKC hypothesis for total natural resources depletion in 26 Sub-Saharan African Countries. His study demonstrated, contrary to the EKC expectation, that there is no inverted U-shaped link between rents or gains from these resources and the depletion of natural resources (Nkwetta, 2018). At any rate, patterns would understandably vary across countries and ultimately these patterns can only show correlations, not causation. There likely are other intervening factors, such as the role of education and awareness in putting a stop to environmental degradation. As people become more aware, they demand better regulation and protection of the environment. For example, research has indicated that as more and more Americans become environmentally aware, they began demanding better regulation from the government and forced corporations to be more environmentally responsive if they wish to market their products to the public (Stern, 2004). Strong institutions also play a role as bad institutions can lead not only to cause damage to the environment, but also to chronic low income per capita of a population in a given country. Moreover, the focus on countries can detract attention from the tragedy of the global commons as pollutants like greenhouse gases do not know borders (Todaro & Smith, 2015). Many countries may claim better environmental quality within their borders while they cynically export deforestation and other environmental problems to more vulnerable countries that don't have voice in the global order (Stanford News, 2015).

2. The Environmental Kuznets Curve Theory applied to the Democratic Republic of Congo

The DRC, a former Belgian colony, is part of the Congo Basin region that covers six countries, including Equatorial Guinea, the Republic Congo, Gabon, Cameroon, and the Central African Republic. The Basin is a mosaic of forests, savannas, rivers, swamps and flooded forests. It is rich in bio-diversity. It is the harbor of some of the rare species on the planet. The Congo forest is the second lung of our planet after the Amazon forest. It holds 8 % of the forest-based carbon in the world. The forest taps the carbon emission and protects the world from severe climate change. If the forest were to disappear then it would release the tapped carbon into the air with grave consequences on the environment.

The Democratic Republic of Congo with its 2, 345, 000 sq Km, is the second biggest and largest country in Africa, and the first in Sub-Saharan Africa. It is blessed with natural resources and has been described as a "geological

scandal.” The country is rich in biodiversity with rare species of tropical plants, animals and birds. About 45% of the country is covered by the tropical rain forest. It has 13% of the total hydro-electric power in the world. According to the estimates, the DRC has 24 trillion US dollars of untapped mineral deposit. These minerals include cobalt, copper, diamond, tantalum, tin, gold, zinc, lithium and coltan. All in all, it is estimated that the DRC has half of the forest and water reserves in Africa (UNEP, 2011). The DRC has all it needs to spearhead the country’s economic development as well as Africa’s economy. With its minerals and natural resources, the country could become the engine for Africa’s economic development. But these riches are not translated in economic growth and wellbeing of the population. According to the 2011 UNEP report, “increased deforestation, species depletion, heavy metal pollution and land degradation from mining, as well as an acute drinking water crisis which has left an estimated 51 million Congolese without access to potable water.” Most of the Human development indices (HDI) put the DRC on the lower human development category. Though the country is endowed with natural resources wealth, it has a poor economic performance. According to the HDI 2019 report, the DRC ranks 179 out of 189 while according to Multidimensional Poor Index (MPI) 74% of the population is considered as multidimensionally poor. (Human Development Report 2019). These are just few indicators which vividly show that high mineral wealth is no guarantee of development success (Todaro and Smith, 2015). As a matter of fact, instead of being a blessing for the prosperity of the country, these rich endowed natural resources are called “curse of natural resources.”

Given such a poor economic performance the DRC as a whole and its population in particular, rely mostly on the natural resources to boost its economy and for the economic development take off the country and its survival. The country relies heavily on its natural resources to pay off its external debt. Minerals also attract a lot of foreign interest and are often fuel conflicts in the country, mainly in the Eastern part. All these factors put pressure on the natural resources and have grave consequences on environmental sustainability, as poverty remains pervasive and is exacerbated by armed conflict and deadly epidemics. The socio-economic conditions remain poor as the country’s infrastructure is dilapidated and its external debt unsustainable.

“Transparency and accountability in the management of natural resources are major challenges facing DRC. A 2011 decree requiring the Government to publish all mining, oil, and forestry contracts has not been fully applied. Audited financial statements of some state enterprises are not available to the public. The IMF will be conducting a governance assessment mission in October. The business climate remains difficult due to a wide range of factors, notably the complexity of taxes, and judicial vulnerabilities. Weak infrastructure results in high production costs.” (IMF Country Report 19/285 of September 2019)

Even though there is an abundant literature on the link between economic growth and environmental degradation, very little study has been done on the African continent concerning the Environmental Kuznets curve hypothesis. Among the few studies we can refer to Bakehe Novice Patrice (2018); Nkweta Ajong Aquilas (2018). Bakehe study focuses on the Congo Basin in general while Nkwetta focuses on the Sub-Saharan countries in general. To the best of our knowledge there is no specific research done in the DRC that links environmental degradation indicators as well as environmental quality to economic growth. We will use the available data provided by the Human Development Report (HDR 2019), and the UNEP Post Conflict Environmental Assessment (UNEP, 2011). Using Grosman and Krueger scale, composition and technology effects (Grosman and Krueger 2011), we will try to establish if there is evidence of the Environmental Kuznets Curve. The best tool to use in this case is the Environmental Performance Indices (Olena, 2011). This paper focuses on two key main sectors of DRC’s economy, namely mining sector and forestry.

3.1 Mining Sector

The mining sector is a key sector in DRC’s economy and the biggest source of export income for the country. Most of the mining was done at a small-scale mining. But for the last two decades there has been an increase of foreign companies in the extracting sector, with little transparency in the process of awarding the mining contracts. It is a sector which depends on the international market price. There are over 100 mining projects across the DRC most of them owned by more than 25 foreign companies. In 2002 the government signed a mining code. Since then private investors have poured money in the country but locals have not benefited much as the DRC remains one of the world’s least developed countries on the planet. The country faces many challenges. It needs to settle huge debts. But the country is also plagued by corruption, poor governance and mismanagement of public funds, complete absence of institutions, weaker institutions, weaker terms of trade, difficult domestic conditions. All these factors contribute to the degradation of the environment and depletion of national resources. Even though, efforts are being made to mitigate these challenges. The DRC’s mining sector is a significant factor in the world's production of precious minerals. According to the IMF report 2019, “minerals accounted for over 90 percent of total exports over the last five years, leaving the country highly vulnerable to external shocks. Price volatility, exemplified by falling prices in 2015-16, highlights the need to build buffers and diversify the economy to mitigate the impact of external shocks.” such as cobalt, copper,

diamond, tantalum.

If we were to apply the Environmental Kuznets Curve, The DRC is still at the stage where it needs more of its natural resources for its economic growth, thus causing more damage to the environment. Given that the exploitation of the environment and mineral riches of the country has not led to marked improvements in people's income and welfare and following the studies that have been made elsewhere, the DRC needs strong institutions that can develop good policies and have the means to enforce them. Among the recommended actions are:

- Strict application of the revised mining code
- Revision of licenses of mining companies
- Enforcement of the legal system
- Increasing environmental awareness
- Adoption of environmentally-friendly technology
- Adoption of sustainable development policies
- Transformation in both the agricultural and the industrial sectors
- Diversification of the economy
- Good governance

3.2 Forestry Sector

The DRC has the largest and greatest extent of tropical rainforests in Africa, which covers more than 100 million hectares and constitute about 45 percent of the country. The country harbours large ecosystem diversity and rich biodiversity. It is the second largest tropical forest in the world after the Amazon. According to the UNEP report on DRC's Post-Conflict Environmental Assessment (2011), the country's "extensive forest resources are in good condition." Unfortunately, they "are being lost and degraded at an increasing rate." This has been mainly observed "in critical areas such as gallery forests in the west and hilly landscapes in the east." Though, "the overall national deforestation rate remains relatively low, at 0.2 percent, in some parts of the country", the deforestation rates are much higher. The country's forest plays a great role, at the national as well at the international level, as it stores carbon and slows down global climate change while providing a number of ecosystem services such as climate regulation and water purification. Moreover, the DRC's forest helps regulate one of the world's largest river basins.

The DRC forests are being depleted for the following economic reasons. The first reason concerns the need for energy. The forest continues to be depleted to meet fuel requirements. According to the estimates, more than 90 percent of the total volume of wood harvested in the Congo Basin is for wood fuel. One cubic meter of wood fuel, on average, is required per person per year (Marien 2009). Both rural and urban households consume wood fuel leading to a spike in the deforestation rate. The second reason is about agriculture. The FAO estimates the Agricultural land in DRC at 11.56 % of the total area. According to the International Fund for Agriculture Development estimates, about 70 percent of the employed population of the DRC is engaged in agriculture, mostly for subsistence. Only about 10 million of the country's 80 million hectares of arable land are used for cultivation. Studies show that shifting agriculture cultivation and population density enhances deforestation. Among many other reasons, farmers are driven into forest land because of environmental degradation, land tenure, and customary rights issues associated with large-scale farmland acquisition. Legal and illegal mining are the third factor that have contributed to the depletion of the Congo forest. They have placed immense pressure in the DRC forest. According to the Institute for Environmental Security report (2008), illegal coltan, cassiterite and gold mining are the main causes of forest degradation and deforestation in the eastern part of the DRC. Other studies show that mining operations are poorly monitored with little consideration to environmental impact. Fourthly, industrial and illegal logging have been a major cause of deforestation in DRC. An analysis report of forests in post-conflict DRC states that almost half of the Congolese forests (43.5 million of a total 108 million hectares) were earmarked for industrial logging. The country is locked up in a 25-year contracts awarded before and during the war. The last reason concerns the infrastructure. Dams, roads and other forms of infrastructure have also contributed to deforestation as forests are cleared to facilitate access for farmers and new forms of the use of land.

To stop and possible reverse the depletion of DRC's forest, the country needs to develop strong governance that will not only legislate progressive policies but also develop the mechanisms to enforce such policies. In that regard, the following steps are recommended:

- ❖ Develop and implement sound environmental management policies to mitigate environmental degradation.
- ❖ Strengthen the legal regime and build the capacity of the environmental management institutions.
- ❖ Advance economic alternatives for the poor and foster use of alternative energy like gas.

- ❖ Promote sustainable wealth creation, boost the business environment and raise the economic status of women.
- ❖ Encourage proper policies on the use of the land in order to check the clearing of forests for small scale farming.
- ❖ Diversify the economic sector

Conclusion

The Environmental Kuznets Curve theory advances that as a country is developing, it would tend to exploit the environment in a harmful or less efficient manner until it reaches a certain level of income and capacity where it would begin to take better care of the environment. The paper explored the EKC in the DRC, a developing country still growing its industrial sector. It focused on DRC's mining and forestry sectors and showed that environmental protection is not being prioritized at this stage of development in the country. The economy of the DRC is recovering from a series of conflicts (World Bank, April 2019). The bouncing back of the economy is largely due to the recuperation in mining activity and strong world copper and cobalt prices, following an increase in global demand for these products. Industrialization and infrastructure development tend to increase the level of employment in turn contributing to reduction of poverty but the exploitation by the mining industry and the overexploitation of natural resources in DRC has not led to marked improvement in the peoples' income. This exploitation has been a liability to the environment rather than an asset for the people. However, since the county is still on its trajectory of development, further research is required on the industrialization and environmental degradation in the DRC to definitively establish the causal relationship in the inverted-U slope of the Environmental Kuznets Curve theory.

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Critical Effects of Climate Crisis on The African Poor

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Abstract

The global scientific and policy community has agreed that climate change is already a reality. Poverty in Africa has worsened since the climate change debate started and now more than 100 million facing a acute water, food and nutritional crisis. The continent is at risk due to its reliance on rain-fed agriculture and donor support for more than three decades. Farmers in Africa routinely engage in the practice for subsistence, rather than agribusiness. Environmental degradation associated with unregulated land use, drought, and inadequate safety net policies has negatively impacted vulnerable communities and hence difficulties to achieve the SDGs goals and objectives of poverty reduction. In this paper, we shall be examining, how climate change has affected the poor in Africa with objective of advocating for pro-poor policy that will enhance their adaptability, social transformation and resilience. Previous studies and experience on the effect of climate change suggests that the best way to address climate change impacts on the poor is by integrating adaptation responses into development planning. Such development programming can be easily promoted in the poor environment rather than relocating them. Poor people in African can be categorized into three classes: -1) rural poor directly connected to their natural environment and its resources, 2) urban poor directly depending on the labour skills, 3) women because of their extreme burdens. We shall share the experience gained through literature reviews and scholarly observations in communities in Africa. In order to carry out the purpose of this study, the effect of climate on the poor in Africa was examined in relation to water, energy, food, shelter, governance, institutions, and infrastructures. It is argued that climate effect on the poor in Africa impact most the rural poor and women because of their high exposure. This calls for honest debates, discussions and pro-poor policy on climate change adaption in order to support a multidisciplinary, transdisciplinary and multifaceted approaches to drive adaptability, social transformation and resilience of the poor.

KEYWORDS: Adaptation, adaptation strategies, climate change, climate crisis, mitigation, polluter pays principle

1. Introduction

The global scientific and policy community has agreed that climate change is already a reality. Africa in most cases suffers from colonial relic infrastructure or development model which were never design for the challenges of climate change. The continent is at risk due to its reliance on rain-fed agriculture and donor support for more than three decades. Poverty in Africa has worsened since the climate change debate started and now more than 100 million facing a acute water, food and nutritional crisis. In this extended abstract, this section will highlight the climate crisis in Africa, the impacts and consequences on the rural poor, urban poor and women. Previous studies and experience on the effect of climate change suggests that the best way to address climate change impacts on the poor is by integrating adaptation responses into development planning. Such development programming can be easily promoted in the poor environment rather than relocating them. The Africa climate vulnerability has been increasing pushing more than 100 million into extreme poverty. Africa government development policies and their implementation are always empty words with no focus, strategies and or seriousness. For example, here in Kenya, mega projects to shield the poor against climate vagaries are always the centre of corruption including water harvesting damas of Aror, Kimwarer, galana Kulalu irrigation schemes, fertilizer scandal, sugar scandal and maize scandal.

2. Method

In order to carry out the purpose of this study, poor people in Africa are categorized into three categories. Other approaches used to gather data included literature reviews and scholarly observations in communities in Africa..

3. Results, Discussions, and Conclusions

As for the rural poor directly connected to their natural environment and its resources, it is important to mentioned that the ecosystems are no longer functioning and supplying ecological goods and services required by the people, livestock and natural environment. This problem is attributed to the increased environmental degradation, soil degradation, diseases, drought, climate change, loss of biodiversity, migration crisis and human insecurity. The Africa rangelands has been degraded beyond the recovery point. This is the reasons, why it can longer support livestock grazing, pasture production, sufficient water supply, increased food scarcity and nutritional deficiency. The urban poor in Africa, has subjected to difficulties in supply chain, increased water, energy, food prices and nutritional deficiencies. Increased health costs are also a problem due to the increased health burdens associated with water born diseases. Both surface and ground water resources are severely affected. Pregnant women,

elderly and under-five children remained the most vulnerable. These factors have potentials to lead to skyrocketed inflation. Africa livelihoods systems are highly exposed to extreme climate conditions that includes rainfall fluctuations; temperature fluctuations, drought, famine, floods, heat, and pests and diseases.

Increased forest loss, environmental degradation, immigration, conflicts and energy crisis, where all these implies that vulnerability of fragile populations in Africa to climate change and natural disasters is much higher than many parts of the world. Although development aid has been active in Africa in the area of enhancing social resilience, the adaptative capacity of the vulnerable communities has always remain low. The majority of the continent poor also consist of youth who are unemployed and this can lead a number of consequences. Africa poorest people are frequently hungry, have limited access to education, do not have access to light at night, and have poor health [1]. Africa is heavily reliant on rain-fed agriculture and is already subject to droughts and floods, both of which kill crops and reduce yield [2]. According to Dinar et al., [3], the climate crisis has the potential to disrupt entire African ways of life, affecting people in both rural and urban areas. Rural populations are frequently relocated to urban areas as a result of rural crises, forming huge informal settlements like those seen in South Africa and Kenya. Slums house up to 70% of Africa's urban population. Because of relative wealth levels, a lack of economic development in cities to match the rate of urbanization, unemployment, poor access to services, and resentment that occasionally erupts in xenophobic violence like in South Africa, living conditions in these urban areas are poor [4]. The urban poor, like in Nairobi's Kibra slum, live in overcrowded, unsafe informal settlements with insufficient electricity, water, and sanitation services. Many wind up in areas prone to environmental hazards, such as floodplains. Poor land-use practices and building materials trap heat, adding to the urban heat island effect. Rising temperatures and overcrowding put communities at risk from an increasing number of heatwaves [4].

In a study conducted in 2017 involving the Democratic Republic of Congo, Hassan and Tularam found that according these countries are experiencing water security issues, causing a large number of people to migrate to urban areas. Variations in rainfall and temperature, according to the study, have exacerbated people's movements from rural areas. It is noted that agricultural production in Sub-Saharan Africa has not improved over time, and has actually decreased due to many farmers' migration away from rural areas [5]. As a result, the climate crisis affects all aspects of African life, including drinking and farming water, health, housing, and infrastructure. The ongoing drought, which has resulted in the loss of millions of livestock, and flooding in Africa, which is frequently accompanied by deadly landslides, are just two manifestations of the climate crisis.

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Environmental Air Pollution, Metabolic Disorders and COVID-19 Fatality: Interlinkages that Jeopardize Health Sustainability in the Pandemic Era

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Abstract. COVID-19 pandemic is impacting environmental, socioeconomic and health determinants worldwide. According to a recent WHO's report, 90% of world population are annually exposed to high air pollutants levels, which impairs cardiovascular, respiratory and metabolic health in humans, causing approximately 4.2 million premature deaths. Airborne particulate matter with aerodynamic diameter less than 2.5 μ m (PM_{2.5}), which exerts severe toxic effects in the respiratory tract. Exposure to ambient air pollution (AAP) increases sensitivity to certain respiratory pathogens. Furthermore, coronavirus disease 2019 (COVID-19) can induce metabolic disorders such as diabetes, a condition known as high risk factor for severe COVID-19. This study explored the associations between COVID-19 epidemiological indicators, atmospheric PM_{2.5} and metabolic disorders among 38 countries of the Organization for Economic Cooperation and Development (OECD). Freely accessible and anonymous databases from WHO, "Our World in Data" and OECD website were used and analyzed with the use of Stata statistical software. Analysis of variance (ANOVA) was employed for regional comparisons in regard to outcome variables (case fatality rate (CFR) and years of life lost due to COVID-19 (YLLs)), whereas multiple regression and logistic regression analyses were performed to determine country-level predictors of COVID-19 fatality in 2020. Mean population was 35,875,100 (+/-9,641,900) for a mean GDP *per capita* of 40,246.5 (+/-23,826.9) USD; there were 1,559,488 (+/-4,253,585) COVID-19 cases reported and 43,579.5 (+/-19,386) deaths for a CFR of 2.12 (1.3)% and YLLs of 566.8 (556.3) per 100,000. Mean annual atmospheric PM_{2.5} and NO_x were relatively high, 13.3 (6.2) and 6,033 (1,331.9) μ g/m³. Overweight and obese population rate was 60.1 (3.7)%, and diabetes prevalence rate, 6.9 (0.4)%. In the multivariate regression analysis, rate of overweight and obese population (p<0.05) and diabetes prevalence (p<0.01) were positively associated with CFR, whereas the latter was positively associated with PM_{2.5} (OR=1.68 (1.6); p<0.05) and diabetes prevalence (OR=1.98 (1.5); p<0.01) in the logistic regression analysis. COVID-19 YLLs were associated with diabetes prevalence only (OR=1.4 (0.2); p<0.05). There is need for an integrated preventive approach that also includes targeting AAP and metabolic diseases in order to reduce COVID-19 fatality worldwide.

KEYWORDS: Air pollution, COVID-19 fatality, Health sustainability, Metabolic disease.

1. Introduction

SARS-CoV-2, which is the virus that causes coronavirus disease 2019 (COVID-19) can induce metabolic disorders, such as hyperglycemia and diabetes; and these conditions are nowadays reported to be one of the high-risk factors for the development of severe COVID-19 and "long COVID-19 syndrome". The pandemic has been impacting the health, environmental and socioeconomic determinants worldwide. According to a report from the World Health Organization (WHO), 90% of the world population are exposed to high air pollutants levels, and that ambient air pollution (AAP) causes 4.2 million premature deaths annually. AAP is a complex mixture that varies, in terms of concentration and composition, including particulate and gaseous primary pollutants, e.g. carbon monoxide (CO), sulfur dioxide (SO_x) and nitrogen oxides (NO_x). In the literature, there are evidences on the adverse health effects of AAP and climate change. Airborne particulate matter with aerodynamic diameter below 2.5 mm (PM_{2.5}) exerts toxic effects in the respiratory system. It is mostly emitted in dust storms, construction sites, industrial and artisanal mining, as well as in forest fires, and other anthropogenic activities such as fossil fuel combustion. Chronic environmental exposure to air pollutants increases the sensitivity of the respiratory system to respiratory pathogens (viruses, bacteria), a condition that increases the risk of developing lung diseases such as pneumonia. Furthermore, AAP causes cardiovascular diseases and metabolic disorders (hyperglycemia, diabetes); and preexisting metabolic disorders increases the susceptibility to inflammatory effects of PM exposure, and the risk of severe COVID-19. Obviously, both long-term PM_{2.5} exposure and metabolic disorders exacerbate the severity of SARS-CoV-2 infection. In the present study, we searched to explore the associations between country-level COVID-19 epidemiological indicators, average annual atmospheric PM_{2.5} concentration and the prevalence of metabolic disorders, occurring in the first year of COVID-19 pandemic, across 38 OECD countries.

2. Methods

2.1. Study design, data sources and outcome variables

We conducted an ecological study using epidemiological databases related to 38 OECD countries. Data on COVID-19 statistics for the first year of the pandemic (2020) included years of life lost due to COVID-19

(YLLs), demographic and economic indicators, as well as country's rates of metabolic disorders. They were extracted from freely accessible OECD, WHO and "Our World in Data" databases. Based on data related to cumulative COVID-19 cases and deaths (as of 31 December 2020), COVID-19 case fatality rate (CFR) was calculated for each country as we reported previously, with the use of the following formula:

$$\text{CFR (\%)} = \frac{\text{Number of COVID-19 deaths} \times 100}{\text{Number of COVID-19 cases}}$$

2.2. Data analysis

Mean (SD) values are used to present data related to continuous variables. For the purpose of statistical analysis of the data, OECD countries also grouped in three regions: (1) Asia and Pacific region: Japan, South Korea, Australia, New Zealand; (2) Region of the Americas (north, central, south America): USA, Canada, Mexico, Costa Rica, Chile, Colombia; (3) Europe and Middle-east region: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, England. Given that explanatory variables were not normally distributed, linear regression analysis was performed in order to determine environmental and metabolic factors associated with COVID-19 fatality. Explanatory variables (diabetes prevalence rate, overweight/obese population rate, diabetes prevalence) were dichotomized, with countries having values lower than the means being as "low PM_{2.5} countries", and those with values higher than the mean values being "high PM_{2.5} countries", for example. Thereafter, logistic regression analysis was performed to determine strengths of their association with outcome variables. All epidemiological data related to country profile, COVID-19, air pollutants and metabolic disorders used in this study were freely accessible and anonymous; thus, informed consent was not applicable.

3. Results, Discussions, and Conclusions

Sociodemographics, health system, COVID-19-related health indicators and environmental pollutants

Table 1. Sociodemographics, health system, health indicators and air pollutant levels across 38 OECD countries in the year 2020

Characteristics / indicators	Mean (SD)	Minimum	Maximum
<i>Sociodemographics</i>			
Total population (x 1,000)	35875.1 (59436.8)	339	329,065
Elderly population rate (65 years or older; %)	17.4 (4.3)	7.2	28.1
Higher education completion rate (%)	44.9 (10)	23.6	69.8
GDP per capita in 2020 (USD)	40,246.5 (23,826.9)	6,428.7	114,705
<i>Health system & Health indicators, Air pollutants</i>			
Number of nurses per 10,000	8.6 (4.1)	1.3	17.9
Number of doctors per 10,000	3.4 (0.8)	1.9	5.2
Overweight/obese population rate (%)	60.1 (13.9)	26.7	75.2
Cumulative COVID-19 cases in 2020	1559488 (4253585)	2,304	2.60e ⁺⁰⁷
Cumulative COVID-19 deaths in 2020	43579.5 (91,386)	577	439,439
Case fatality rate (CFR; %)	2.12 (1.3)	0.48	8.51
Years of life lost due to COVID-19 per 100,000	566.8 (556.3)	6	2,055
PM _{2.5} (µg/m ³)	13.3 (6.2)	5.6	27.4
NOx (µg/m ³)	603.3 (1,331.9)	15.3	7,243

Table 1 shows the means, minimum and maximum values of sociodemographics, health system and health indicators, and environmental air pollutants. Mean population was 35,875.1 (59,436.8) x10³; elderly population rate of 17.4 (4.3)%, higher education completion rate of 44.9 (1.0)% and a GDP per capita of 40,246.5 (23,826.9) USD in the year 2020. Moreover, cumulative COVID-19 cases was 1,559,488 (4,253,585) and cumulative COVID-19 deaths was 43,579.5 (91,386), for a CFR of 2.12 (1.3)% and YLLs of 566.8 (556.3) per 1,000. Furthermore, regarding environmental air pollutants, country-level ann

ual average of PM_{2.5} and NO_x were high, 13.3 (6.2) and 6,033 (1,331.9) µg/m³, respectively.

Regional distribution of outcome variables (CFR, YLLs) and their association with the covariates

Highest CFR was observed in the Americas (north, central and south America), 3.6 (1.2)%, followed by European region (1.9 (0.2)%) and Asia-Pacific region (1.6 (0.4)%; $p < 0.05$ by ANOVA test). Similarly, COVID-19 YLLs were relatively high in the Americas, 1,337 (307.6) and low in Asia-Pacific region, 115 (70.3) per 100,000 but not significantly (not shown).

Table 2. Association between COVID-19-related health indicators (CFR, YLLs) and environmental air pollution and metabolic disorders across OECD countries in 2020 by logistic regression analysis (n=38)

Covariates	CFR (%)			YLLs per 100,000		
	OR (SE)	95% CI	p	OR (SE)	95% CI	p
Overweight/obese pop. rate (low vs. high)	123 (0.4)	0.56-268	0.611	101 (0.0)	0.99 - 190	0.319
Diabetes prevalence (%; low vs. high)	1.98 (1.5)	1,803.1	0.003	1.4 (0.2)	1.00 - 1.90	0.041
Average PM _{2.5} level (low vs. high)	1.68 (1.6)	1.84-4.52	0.027	1.21 (0.1)	0.99 - 1.31	0.392
Average NO _x level (low vs. high)	1.36 (0.7)	0.53-3.47	0.517	1.01 (0.0)	0.99 - 1.01	0.851

*Notes: OR, odds ratio; %, percentage; PNM, particulate matter; NO_x, nitrite oxides.

In the linear regression analysis, it was observed that COVID-19-related YLLs were positively associated with elderly population rate (beta coefficient: 19.6 (24.5); $p < 0.05$), rate of overweight & obese population (beta coefficient: 24.9 (12.8); $p < 0.05$) and annual average of PM_{2.5} (beta coefficient: 21.3 (15.1); $p < 0.05$). On the other hand, when using the covariates as dichotomized variables, the logistic regression analysis showed positive association between CFR and diabetes prevalence (OR=1.98 (1.5); $p < 0.01$), CFR and annual average of PM_{2.5} level (OR=1.68 (1.6); $p < 0.05$), and COVID-19 YLLs and diabetes prevalence (OR=1.4 (0.2); $p < 0.05$) as shown in Table 2.

This study is the first that shows inter-linkages between COVID-19 fatality, AAP (PM_{2.5}) and metabolic disorders, obesity and diabetes in particular, across OECD countries. Thus, we would recommend an integrated anti-COVID preventive approach that includes tackling environmental air pollution and metabolic diseases in the fight against the pandemic, in addition to hygiene measures and vaccination, in order to reduce the health and socioeconomic burden of the pandemic, and the disease fatality as well.

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Ownership of health data as the new frontier for the future of Africa

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Abstract

The digital architecture in which data is siphoned to Europe and the US creates a situation in which Africa is not in control over sovereign decision-making relating to the health of its citizens and cannot access the data that pertain to its subjects as a resource for information, knowledge and development.

Methods: The study was carried out using a case study approach with four health facilities in Kenya, to help identify the contribution of the FAIR data concept to producing a sustainable outcome for health data management in Kenya, while also discussing the potential challenges that may need to be overcome to realize the full potential of FAIR data for a sovereign management of the health data in Kenya.

Expected finding is for this article to present the experience of reversing this trend by using guidelines to make data Findable, Accessible (under well-defined conditions), Interoperable and Reusable (FAIR) as a basic architecture in health data. The data is created and held in the facility where the data is produced under the regulatory framework of the county and national state jurisdiction. This delivers a resource in which the data remains as an asset for the health facility, both in terms of providing improved health care as well as contributing to other use of the data. The discussion features the economic aspect of this data also is geared towards where the data is produced in Africa to generate (self-)employment and benefits in Africa.

KEYWORDS: Digital architecture, FAIR Data asset, improved health and sustainable outcomes

1. Introduction

The state of the post Covid-19 pandemic in Africa calls for new paradigms of thinking around data ownership. Data ownership is now an emerging key contributor to country specific economic development and sustainability. World Health Organization (2018) estimated that global spending on health was reaching US\$8.3 trillion, which is about ten percent of global GDP. It underlines why there is a growing need for an organised system of health data collection and storage. Research by Royal Bank of Canada (RBC, 2022) shows that data generated by health care industry is growing faster than manufacturing, financial services, media and entertainment sector. Thirty percent of the world's data is generated by healthcare industry and during the Covid-19 pandemic the demand for data continued to grow. The RBC research teams (2022) and Financial Times (FT) at the same time revealed that Big Tech companies have seen an opportunity to harness the ever-growing amount of information in advance from various countries to champion and pioneer new innovations and light up the health care revolution. RBC research revealed that by June 2021, the venture capital divisions of Amazon, Apple, Facebook, Google and Microsoft had invested more than \$7 billion in healthcare start-ups. Africa Private Equity and Venture Association (AVCA, 2021) agrees with the RBC statistics by adding that funding African start-ups is growing fast with venture capital deals reaching \$3.5 billion by mid-2022 (Foto, 2022).

Thabiso Foto (2022), while writing for the Independent, a leading East African online research journal, confirms the current research by Google, that healthcare infrastructure development has come out as a significant opportunity, for ensuring equitable access to quality healthcare among all the 54 Countries of Africa. The pandemic created this necessity for accelerated development of healthcare solutions by tech entrepreneurs. In another study by Salient Advisory, cited by Thabiso Foto (2022) for the Independent online journal, states that while the pandemic itself had a negative effect on ordinary health of millions of people, Africa is home to 1,276 health tech start-ups that are supporting health care delivery and distribution. By 2020 over 60% health tech start-ups had already been founded. In 2020 alone over 22% of the companies were founded as the pandemic surged. The question arising from this data is who owns and controls this sensitive health data. Once tech start ups take control of data there is the big privacy question and security challenge to individual health data.

If tech start-ups are not under an organized government health data infrastructure, then governments would lose any potential revenue and also surrender their health data security to rogue organizations. The VODAN-Africa research reveals that the 54 countries of Africa do have developed the right capacity and technological advancement experts in the development of health data infrastructure to make sure data is in residence of its collection point, within health facilities where patients are treated from. Peter Clardy, the senior clinical advisor at Google, was able to demonstrate that patient data infrastructure development would have a comparative advantage when data is collected and curated at respective country specific health facilities (RBC, 2021; Silver et al, 2021)

2. Statement of Contribution

Virus Outbreak data Network (VODAN) Africa has identified a gap in the digital architecture development in Africa by making a strong case that while Africa has been open to improving its digital health infrastructure, most donors and sponsors for advanced technology do not mean well for the continent. Most of the digital health data collected is easily siphoned to Europe and the US, thus creating a situation in which Africa is not in control over sovereign decision-making relating to the health of its citizens. The unjust and poor centralised control of data has denied subjects access to data as a resource for information, knowledge and development.

The Virus Outbreak Data Network (VODAN)-Africa is making a strong case for health data to be controlled by the government under the Ministry of Health and curate who accesses this data. To do so, requires an organized and updated health data infrastructure system to realize the full potential of FAIR data for a sovereign management of the health data in Kenya.

This article explores the potential for advanced new methodologies for enhancing health data as a public good that can contribute to improved health outcomes in Africa, and how such potential can be unlocked to contribute to the development potential of the continent. The study was carried out using a case study approach with four health facilities in Kenya, to help identify the contribution of the FAIR data concept to producing a sustainable outcome for health data management in Kenya, while also discussing the potential challenges that may need to be overcome to realize the full potential of FAIR data for a sovereign management of the health data in Kenya.

The Paper concludes by showing why digital innovations, are key to data collection and storage but also creating room for economic advantage unlike the past when data could be siphoned out to the developed world.

In summary, the main question is an investigation of the current data handling and value of the health data in Kenya and demonstrate how VODAN-Africa is offering an alternative architecture for handling health data by using three health facilities in Kenya as case studies, with extended data across 88 health facilities across Africa. The discussion and conclusions made the case, why having advanced systems for data collection, storage and curation within the facilities under Ministry of health can contribute to job opportunities for a sound economic development in Africa.

To answer the research question, the paper has given key problem area, a methodology to investigate the current data handling and value of the data, the health data policies in Kenya. The study then discusses the implementation of an alternative architecture in three health facilities by VODAN-Africa.

Experimental/Methods

The research included (i) a desk study analysis of the current health data infrastructure in Kenya; (ii) an investigation of an implementation of an architecture to curate patient data as Fundable, Accessible (under well-defined conditions, Interoperable and Reusable (FAIR)).

The desk study was carried out in a systematic desk review involving all relevant policy statement of the Government of Kenya. The study was able to refer to journal papers from WHO and policy statements by the Kenya Government on health data and infrastructure development. The paper identifies policy directions proposed to realize the full potential of data for a better management of the health data in Kenya. The different government policy papers around FAIR equivalency to demonstrate the available potential in making sure health data is secure at locality of access and under the arm of the Ministry of Health as discussed in Ester Thea Inau et al, 2022.

2.1 Simulation

In order to carry out the purpose of this study, using case study of three health facilities in Kenya. These were Zambezi Hospital (private hospital and Pumwani Hospital (under Nairobi County Ministry of Health) and Beacon of Hope (private an in Kajiado County). The Kenya Medical Research Institute (KEMRI) was also involved in the study to assess the outcomes. The research followed a case study approach implemented in a natural setting. It included the various stakeholders and took an interdisciplinary approach. The ICT technical teams, electronic and computer network engineers, medical doctors, nurses, social scientists, policy makers, social workers and health data stewards.

3. Results

Economic benefits of health data

The above data presentation and discussion shows the importance of data for the economic benefits of each country in Africa. While we see the importance of health data for economic development, we need to review what Africa needs to do to catch up with the developed nations. The gap now being occupied by tech start-ups can be domesticated by each country and open more space for individual persons to in. Each country can curate the data for its own economic development and job creation especially in ICT technology. The data presented by Royal Bank of Canada (RBC) June 2021, shows the \$7 billion invested by the venture capital divisions of Amazon, Apple, Facebook, Google and Microsoft had invested more than \$7 billion in healthcare start-ups. By 2022 the Africa Private Equity and Venture Association (AVCA,2021) data shows a growth in African start-ups with

venture capital deals reaching \$3.5 billion by mid-2022 (Foto,2022). It means the more the investment in health tech start-ups, the more there will be requirement for innovations in the infrastructure development that add value to the growing tech start-ups.

Therefore, WHO, (2021) made some fundamental recommendation points around long-term economic benefits of health data, with particular attention focused on Africa.

The Council on the Economics of Health for all comprised economists and experts in health under WHO (2021) laid a clear vision on how to develop a new understanding and a new narrative about the deep interconnectedness between health and the economy. (UCL,2021; Torrele et al,2021). The vision focus of WHO Economics Health Council was to give direction on intertwined core themes for countries to adopt as follows.

- There has to be measurement and valuing health for all.
- This calls for capacity strengthening of the public sector in building resilient capacities and creating partnerships to deliver health for all.
- A key strategic support pillar is finance. This is core to strategic, long term, and transformative finance for all. It calls for
- Governing Innovation towards health for all and very important the governance of innovation, which has been identified as the critical building block of healthy economies.
- The governance of health innovation ecosystem lays a good foundation upon which radical changes are needed to ensure it delivers Health for All (WHO 2021).
- The long-term vision of WHO Economics Health Council is to offer guidelines on the establishment of new, end-to end health innovation ecosystem that shapes how the public and private sector in health delivery can work together throughout the innovation chain to deliver equitable access to much needed vaccines, therapeutics, diagnostics and other important health supplies
- The health innovation ecosystem should be governed towards common good of all by also creating purpose driven innovation through mission-oriented approach. It means reshaping knowledge governance for the common good, reforming corporate governance to better reflect stakeholder value in the long term.
- This council also sets goals for building resilience and diverse manufacturing capacity and infrastructure development as now done by VODAN-Africa.
- Lastly, the call is for introducing conditionalities for public investments to build symbiotic public private partnerships, and strengthening the capacity of the public sector in health innovation.

Therefore, the WHO Economics Health Council gives a global vision on how countries can move towards health data economic benefits by allowing multiple actors and investors in this sector. It also gives guidelines to governance issues so far ignored by private tech start up innovators. Health innovation ecosystem should be governed towards the common good of all within specific countries where health data is generated from (Yamey et al 2021). Above all the WHO Economics Health Council agrees with direction VODAN-Africa has taken on developing digital architecture to allow Africa governments to be in control over sovereign decision-making relating to the health and allow its citizens access the data that pertains to its health subjects as a resource for information, knowledge and development. This is to challenge the commercial imperatives and charitable efforts where vaccines continue being the exclusive control of private companies through intellectual property and manufacturing capacity monopolies, resulting in fatal vaccine inequity (Torrele et al 2021). The fierce competition that existed during the pandemic for wealthy countries 14 The fierce competition by wealthy countries to buy up the vaccines even before they were product buy up all vaccines and deny poor countries access can be avoided when respective countries of Africa control their own health data and agree to enter strong equal partnerships with the rich nations and private donors.

To make a point for this future investment agreement, the IMF has evaluated existing agreements focusing on 2025 where US\$50 billion has been put aside from donors and national governments to strengthen existing mechanisms, with attention put on ACT-A and including vaccine purchase and distribution facility COVAX, could generate US\$ 9 trillion of additional global output. IMF estimates that sixty percent (60%) of gains would benefit developing countries, especially Africa.

The World Health Organization (2020) report on Global Vaccine Market Report reiterates lack of resilience and limited geographic spread to manufacturing infrastructure before the pandemic where ninety percent (90%) of all vaccine production was concentrated with four companies GSK, Pfizer, Merck and Sanofi). In terms of volume the Serum Institute of India (SII) was the lone largest producer with 28% of estimated 5.5 billion vaccines produced by 2020 (WHO,2020; Allen et al,2020; Nayak RK et al,2019)

The demand for vaccine manufacturing capacity for covid19 vaccines has shown limitations to global manufacturing infrastructure, with relatively little vaccine capacity able to produce at large scale outside of major vaccine corporations and SII, and a high dependency on a very limited number of producers (Robertson & Travaglia,2021).

The entry of VODAN-Africa into the space of data infrastructure will develop the much-needed capacity within each country to collect, store and curate much needed data to induce investment into manufacturing of vaccines. WHO (2021) reports that 99% of its vaccines are imported. It means with available data Africa will be able to produce its own vaccines and compete among emerging global players in vaccine production alongside China, Russia to help diversity the global manufacturing.

The World Health organisation (WHO,2021) also identifies knowledge barrier as an area which continues to stifle innovation, especially when it comes to the availability and use of vital health technologies and data. Knowledge generation and sharing are critical for medical research and public health is limited. The current system incentivizes innovation through monopolies, in which governments allow the privatization of biomedical knowledge through granting patent protections is not adequate. There is need for availability and use of vital health technologies and data.

WHO (2021) called for redesigning health ecosystem for the common good, by shifting from a model where innovation is seen to be driven by market forces, to a model that is collectively governed in public interest. It means each country should embrace innovations that support all aspects of healthcare. To achieve this requires proper tools for health data collection and local storage. This the key contribution by VODAN-Africa. With the entry of VODAN-Africa data research teams, sharing data on medical research and public health.

Therefore, African governments can find worthy investors in their own data production and data infrastructure systems. For instance, the United Operation Warp Speed alone has invested over US\$10 billion in the R&D of six promising vaccines and US\$2.5 billion for Moderna and US\$ 1.5 billion for Johnson & Johnson (Cross S, Rho Y, Reddy H, et al (2021). The German Government invested US\$450 million to BioNTech (Reuters,2020; Nayak et al,2019). WHO (2021) reports that 97% of financing to develop the AstraZeneca/Oxford Vaccine came from public funds including the European Union and Governments of United Kingdom and Northern Ireland (WHO,2020; Baker & Koons,2020; Pacheco,2021; University of Oxford, 2021; Whitfill,2021). Mazzucato et al (2021) have criticised this approach and suggested covid19 patent rights should be mutually binding among collaborating nations.

African countries with the support of African Union are challenged to join hands and set aside funds for more data research and data infrastructure development.

Health data resource the new gold

VODAN-Africa ventured into understanding the demand for Covid-19 data and its local availability, the major gap was data infrastructure development. The lack of interoperability and reuse of data in parallel health structures was weakening the value of digital data health solutions. The commercial use of that data will create distrust without a sound data collection point in the health facilities. This is why VODAN-Africa understands the purpose of having different regulatory frameworks for data capture and handling with a renewed vision on how to handle data analysis in the continent compared to others.

The opportunity generated by ownership of health data opens a new frontier for the future of Africa. Just as the past centuries the world went through different economic development models that dominated the exchange of merchandise and capital goods using gold and silver, today data production and storage is taking over as the 'new gold' in terms of its importance to being the source for economic development. Finn & Giraldez (2002), provide an in-depth analysis of the past centuries to demonstrate how this exchange of merchandise dominated trade in Europe, Asia, and America from the sixteenth to the twenty first century. Finn & Giraldez argue that countries which could produce their own gold, silver, oil and other minerals created a competitive advantage over the others in the global economy. From this competition then, Adam Smith was quick to observe that the abundance of minerals would make those metals cheaper and push nations to look elsewhere for better means of economic dominance (Adam Smith 1776, p. 415; Melitz, 2019).

In our case then, data production and storage in the local country, within health facilities, is starting to influence a new form of economic dominance which could benefit not only nations without any minerals but also become a beacon for offering job opportunities in the ICT sector in developing countries of Africa. Taking for example, the recent covid19 pandemic data, which is well curated will contribute to vaccine production and stimulate marketing opportunities for nations where covid19 pandemic was dominant. The importance of having up to date machine infrastructure for data production and storage has stood out as an important entry gap for VODAN-Africa. The nine African countries that participated in the maiden research in digital health can attest to the fact that many

opportunities have arisen for well-trained data stewards, health records officers (HROs) and put demand to hospital administration to develop good health infrastructure systems which can keep this important data under lock and key within the country and in health facilities. Instead of relying on data collected and sent abroad with less access by patients and administration, a window of opportunity beacons for African countries to compete and be the custodians of their own data.

Therefore, without data being curated at its point of production most developing countries without the advantage of minerals, would continue in their poverty perpetuity. De Jong & Van Reisen (2021) make a fundamental point by challenging existing paradigms on value creation, which still operate in the Adam Smith lens that minerals have better economic advantage over any other mode of market exchange. Their critique is that developing countries of Africa and Asia should not see value creation only in term of applying paradigms of the last centuries to welfare creation. Doing so, would lead to irreversible problems, where social unrest, economic inequalities prevail with schisms growing between the rich and the poor, extreme poverty would push more people to migrate and exacerbated by climate change conditions, life would become unmanageable. The dominance of the neo classical capitalism, thus becomes irrelevant today when we consider new paradigms that could revive and reenergise developing countries through new innovations in data curation.

The digital architecture in which data is siphoned to Europe and the US creates a situation in which Africa is not in control over sovereign decision-making relating to the health of its citizens and cannot access the data that pertain to its subjects as a resource for information, knowledge and development.

The difference between health tech start-ups and innovation by VODAN Africa

The outbreak of covid19 pandemic made it necessary for countries to look into the whole digital architecture as far as data management was concerned. Until 2020 most health data in Africa was siphoned and extirpated to Europe and the US. One good example was when in 2016 Ebola virus was discovered in West Africa and parts of Central Africa, many well intending agencies from the West came into collect data and treat victims of Ebola infection. After six months the data could not be traced in countries where the Ebola virus had struck.

With the emergence of coronavirus pandemic, most countries of Africa were cautious about keeping data locally for new vaccines development and improving quality of health. The creation of Virus Outbreak Data Network (VODAN)-Africa in 2020 was to give answer to the much-awaited clinical data production with concerns for data ownership and improving on what had been until 2020, limited use of health data for quality treatment at point of care (Van Reisen et al 2021)¹. There are four important observations that made VODAN-Africa move towards data ownership in the local facilities.

First, it is true that during the pandemic health tech start-ups grew by 22%. Some companies and individual people made a lot of money from the vaccine development and distribution. If this is what is called entrepreneurship in health tech innovation, then it failed humanity miserably. Anna Marriot, Oxfam's Health Policy Manager, while speaking on BBC same time (November 2021), criticized vaccine producers for boasting to have the experience and expertise of vaccine development, production and manufacture life-saving medicines and vaccines, but have nothing to show of how they were helping developing countries to have enough doses for their populations.

Second, that time only 3% of Africa had been vaccinated while the rich nations were hoarding vaccines. Oxfam had estimated from available records that Pfizer, BioNTech and Moderna would make pre-tax profits of \$34 billion by end of 2021 between them. It meant over a thousand dollar per second, \$65,000 per minute and \$93.5 million per day.

Five new Billionaires had been produced from these monopolies during the pandemic, with a combined net wealth of \$35.1 billion (Oxfam,2021; Torreele et al 2021).

Third, the Director-General of the World Health Organization, Dr. Tedros Adhanom Ghebreyesus appreciated the call and added that 'vaccine nationalism threatens to prolong the pandemic'. While responding to this debate on vaccine inequality, WHO Brief No.1 (2021) states that the vaccine manufacture was a rapid triumph for science but the vaccine availability deployment were highly uneven and suboptimal. WHO (2021) reports that over 2.06 billion vaccine doses were administered in the world within 18 months into the pandemic, where over 75% went to just 10 countries. By June 2021 only 32 million vaccine doses had been administered in the whole of African continent for a total of 1.36 billion people. The call for Africa to take over the control of data infrastructure development to compete favourably with the rest of the science world heavily relying on health data for vaccine development. (WHO, 2022).

¹ Design of a FAIR digital data health infrastructure in Africa for COVID-19 reporting and research

Therefore, the missing link here was that most African countries were behind in coming up with their own data collection mechanism to allow important data on covid19 be linked to vaccine development.

Fourth, most African countries had weak data infrastructure system for storage and curation at point of production, especially in health facilities. Most countries in Africa had foreign owned data infrastructure. District health information system (DHIS2) is installed and used by most countries of Africa without the knowledge that this application is foreign owned. It means any patient data collected may not be kept locally but banked abroad. From this data collected it was possible to develop vaccines and sell at exorbitant prices to the very countries they siphoned data from.

This experience made the formation of VODAN-Africa with the mandate of reviewing the whole data infrastructure in Africa and seek for a better solution to the existing exploitative system. As expressed by Oxfam earlier, tech companies and individuals were taking advantage of the poor policies and existing health data infrastructure to take away data from the continent.

The \$193 Billion pocketed by Pfizer, BioTech, Moderna, and the five individual new billionaires wracking in \$35.1 billion, this money should have been shared equally among the 54 African countries affected by covid19 pandemic (Foto, 2022).

It was evident that countries of Africa were not in control over sovereign decision-making relating to the health of its citizens and cannot access the data that pertain to its subjects as a resource for information, knowledge and development. VODAN-Africa developed an architecture to record clinical health data and research data collected on the incidence of covid19 Pandemic, by producing human and machine-readable data. This architecture supports analytics at point of care. Through data revisiting, across health facilities, for generic analytics. An algorithm was run across FAIR Data Points to visit the distributed data and produce aggregate findings. The FAIR data architecture was deployed in Uganda, Ethiopia, Liberia, Nigeria, Kenya, Somalia, Tanzania, Zimbabwe, and Tunisia. It was evident that the context required to be explored by framing the problem at hand (van Reisen et al, 2022).

Data control policy in Kenya

The Kenya Constitution (2010) and Vision 2030 development blueprint requires the country to provide the highest attainable standard of healthcare through adoption and use of ICT and the Ministry of Health developed the Kenya Health Policy (2014-2030) to fulfil this mandate. This comes at an important time when the health sector is implementing far reaching reforms to achieve universal coverage. This concept is anchored on the achievement of Vision 2030, whose overall goal in health is to have an “equitable and affordable healthcare at the highest achievable standard” to her citizens. It is informed by the strategies and results emanating from the implementation of the Kenya Health Policy Framework, 1994-2010, the health sector strategic plans and the e- Government and Shared Services Strategies implemented through the e-Government Directorate and the ICT Board respectively.¹⁵

In the past thirty years the Kenya government has come to understand the value of developing policies that would address the importance of data generation, findability, accessibility, interoperability and reuse. However, the gap remained how to make sure that data is controlled by the government through respective ministry of health and local health facilities.

The data is created and held in the facility where the data is produced under the regulatory framework of the county and national state jurisdiction. This delivers a resource in which the data remains as an asset for the health facility, both in terms of providing improved health care as well as contributing to other use of the data. The discussion features the economic aspect where the data is produced in Africa to generate (self-)employment and benefits in Africa.

The Kenya Health Policy, 2014-2030 gives directions to ensure significant improvement in overall status of health in Kenya in line with the Constitution of Kenya 2010, the country’s long term development agenda, Vision 2030 and global commitments. It demonstrates the health sector’s commitment, under the government’s stewardship, to ensuring that the country attains the highest possible standards of health, in a manner responsive to the needs of the population. This policy is designed to be comprehensive and focuses on the two key obligations of health: realisation of fundamental human rights including the right to health as enshrined in the Constitution of Kenya 2010 and; contribution to economic development as envisioned in Vision 2030(Republic of Kenya,2015,2019).

However, to achieve this milestone, the Kenya Government set up an authority to monitor and direct all data information and especially health data. The Kenya ICT Authority was created in 2019 to lay out a platform for better policy implementation and monitoring to make sure the Kenya government

Under this authority then, it is understood that the specific mandate is to ensure coherence and unified approach to acquisition, deployment, management and operation of ICTs across the public service, state agencies, with the aim of promoting service integration, adaptability, and cost savings through economies of scales in ICT investment. Compliance to this state policy will bring about an efficient and effective service delivery to citizens (GOK,2016, Kenya Health Enterprise Architecture. ICT Authority Government ICT standards. first edition 2016). Table 1 below give a summary of the policy consideration towards data access, control, storage and curation.

It lays a good foundation for making sure data is stored in Kenya for better use and support to wellbeing of the country. However, the weak area not address with this ICT Authority mandate is the discussion of FAIR data and curation. It remains vague on how health data can be stored, controlled and shared, for research while allowing any independent agency to access, control and use patient data. The examples in mind are the tech start-ups which are not under an organized government health data infrastructure. This is an identified gap VODAN-Africa has a found a way of helping respective governments especially Kenya Government ICT Authority.

The case study of three health facilities

In 2020 the covid19 pandemic affected the whole world. A group of researchers involving nine countries of Africa came together to address data from covid19 for future use and storage in local health facilities. These countries were Kenya, Uganda, Tanzania, Somalia, Zimbabwe, Ethiopia, Nigeria, Tunisia and Liberia. The study teams from these countries looked at the existing data infrastructure systems in each country. The common among them was district health information science (DHIS2). Countries like Kenya later adopted DHIS2 to Kenya Health information system (KHIS). But the key gap remained the same. Working within the framework of the health ACT (2017, revised in 2019,2021 the Health Act Section XV, article 104, which directs the Ministry of Health to administer health information banks, including interoperability framework, data interchange and security (GOK MOH,2021).

The Vodan-Africa Kenya team led by Tangaza University College, Nairobi, supported by the Vodan-Africa technical teams in Mekelle University, Leiden University Medical College, and Stanford University, they were able to understand why data interoperability is not enough. The whole computer infrastructure required a big overhaul. There was need to upgrade existing machines to allow a new application which would be tested on how data can be collected, stored and curated by local health facilities.

One of the key outcomes of the VODAN-Africa was data infrastructure development. A clear explanation of this outcome was well captured by Samson Yohannes, one of the researchers He explains that Africa Health Data Space curates fair quality ethical Africa health data for pandemic preparedness and quality of care for vulnerable populations. Inspired by the European health data space which aims to regulate the transmission and sharing of health data across the EU for both private individuals and researchers or policy makers, the African health data space will have a similar role for Africa. in order to unleash the full potential of health data for the individuals and society in Africa a health data space should be developed in parallel to the European Health data space being developed at this stage. It aims to foster health research, reduce health care costs and produce quality data following FAIR principles. So far nine countries have joined and the health facilities participating in VODAN-Africa. The African Health Data Space will lay the foundation to ensure that the services are contributing to better informed health care. Health facilities will benefit from the use of data in the health facilities and the data analytics across the facilities. The objective is to create a better representation of patients in remote and vulnerable settings. It stimulates a data space which is set up with inclusiveness (including data from facilities in remote and vulnerable settings). The innovation of digital health solutions is expected to be better adapted to patients in these settings. This will serve to improve health outcomes. Hence, it should help provide solutions for the following problems:

1. Lack of data-ownership on the African continent and migration of data away from care providers and data subjects
2. Lack of data-use and reuse, including for quality of care at the level of health facility
3. Inadequacy, lack of representation and poverty-based bias of data from Africa in global health analytics, impeding pandemic preparedness
4. Poverty-based bias in health data from African which lead to further exclusion of people living in poverty, which are poorly represented in the development of digital AI based health tooling innovation
5. Lack of interoperability of data for the use of health care providers, due to vertical digital upstream solutions that do not integrate at the level of point of care and preventative medicine

An African Health Data Space is based on health data curated as Findable, Accessible (under well-defined VODAN-Africa conditions), Interoperable and Re-usable (FAIR) that is machine-actionable, and creates a space for strong high quality and ethical data for analytics, with the following characteristics:

- Data can reside in the health facility where the data is produced (just as the patient records do), or held under control of the facility;

- Data is useable for analytics within the health facility and can contribute to quality health services at point of care;
- Data can be visited for de-identified computational analytics across health facilities and across borders through algorithmic data visiting;
- The creation of an inclusive data pipeline across larger and smaller areas and facilities in connected and remote areas will increase representativeness of the data, and remove poverty-based bias and assist in pandemic preparedness;
- The creation of interoperable health data will increase the relevance of digital health innovations and assist in horizontal integration of these innovations.

The mission of VODAN-Africa is to create open-source innovation by African engineers and health workers for health data interoperability problems in Africa. The VODAN-Africa works closely with researchers from Europe, Asia and the Americas and is linked in to the research carried out at Leiden University on the use of FAIR Data for improved health outcomes. The outcomes from the VODAN-Africa community of practices are leading to the wider perspective in creating Africa Health Data space.

The case of Kenya was looked into based on this overall problem identification. The policy behind health information data, in reference to the five problem areas above.

When we look at Pumwani health data for instance, there was good covid19 data coming through the hospital system. But there was plenty of health data and wellbeing of patients not entering the Pumwani DHIS2 data collection system. Social workers would record health issues around trauma caused by loss of employment, daily revenue due to social distancing, domestic violence, rape and child pregnancy. By concentrating on covid19 control and treatment, other areas of health were forgotten like pre-natal, and post-natal support to mothers, and even forgot HIV+ treatment. The VODAN-Africa approach was very comprehensive and supportive of Kenya government policy on interpretation of SDG3 within the wider health sector. Then it meant identifying a proper health infrastructure tool which would store data in hospitals and outside hospitals safe for research and patient treatment.

Discussions

The paper has given a good overview on the efforts put together by VODAN-Africa research teams in establishing the potential of creating an African Health Data Space. Some of the research team members were Samson Yohannes, Getu Tadele, Ruduan Plug, Tesfit Gebremeskel, Aliya Aktau, Putu Hadi Purnala Jati and Mirjam van Reisen.

The establishment of the Virus Outbreak Data Network (VODAN)-Africa, was triggered by past experience on the Ebola crisis in West Africa, 2016. The international Community resolved to assist with a great investment in diverse digital data.

The moment the crisis was solved, the digital capacities migrated, leaving behind a weakened health infrastructure. The diverse health digital data quickly moved with the experts to Europe and USA. The accessibility of data was not there.

When the global fraternity started experiencing the COVID-19 pandemic, there was immediate concern not to repeat the mistake of 2016, when all data left with the digital capacities. There was immediate demand for global health data when the COVID-19 pandemic broke out. The realisation that data from Africa was not reflective of many remote or accessible areas nor included people who did not access health testing centres.

Then another challenge emerged, as observed by the VODAN-Africa research teams. The work undertaken in health facilities in Africa on digitisation of patient data, where this data is highly structured, rich and digitised, is normally exported for analysis by Ministries of Health and then sent to Europe and USA for further use. Once the data leaves health facilities it could not be traced nor accessed. The data remained mostly aggregated, with no allowance for more complex interoperability and reuse.

Most health facilities in Kenya used District Health Information System (DHIS)-2. This system had many limitations.

Limitations of using DHIS2

The Kenya Health Data Act defines "health data" as data related to the state of physical or mental health of the data subject and includes records regarding the past, present or future state of the health, data collected in the course of registration for, or provision of health services, or data which associates the data subject to the provision of specific health services.²⁰ We shall use this definition of health data for this discussion.

The Constitution of Kenya states the right to health is a fundamental human right and provides that every person has the right to the highest attainable standard of health, including the right to health care services.²¹ This is also

reflective of the Sustainable Development Goal (SDG) 3 which aims to ensure healthy lives and well-being for across all stages of life.²² The Government of Kenya (GOK) has identified ICT as a catalyst to attaining efficiency in healthcare service delivery and picks out ICT as a major catalyst for achieving efficiency in the multiple facets of better health service delivery.

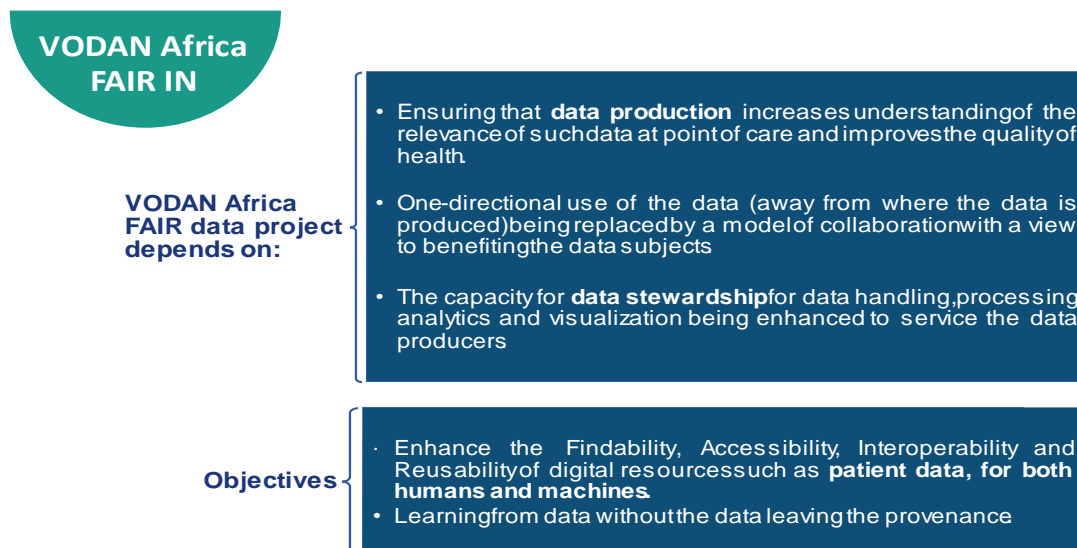
The researchers quickly observed that the widely used District Health Information System (DHIS)-2 as a resource used in Africa set up as a digitally standardised system of patient data in Africa and Asia. The notable experience were the wide gaping shortcomings of DHIS2. Other than the DHIS2 serving as a platform for Health Management Information System Software for routine aggregated health data from the lower health facility up to the Ministry of Health, DHIS2 could not capture all business processes starting from registration up to medication dispensation. The limitation experienced was in collecting patient level data. It was immediately observed for the need for interoperability between Electronic Medical Recording (EMR) systems with DHIS2. Kenya is one of the countries that has a policy around preparing national Health data standards and interoperability guides. The Kenya Government created a Kenya ICT Authority in 2016, which covers health data too.

Under this authority then, it is understood that the specific mandate is to ensure coherence and unified approach to acquisition, deployment, management and operation of ICTs across the public service, state agencies, with the aim of promoting service integration, adaptability, and cost savings through economies of scales in ICT investment. Compliance to this state policy will bring about an efficient and effective service delivery to citizens (GOK,2016, Kenya Health Enterprise Architecture. ICT Authority Government ICT standards. first edition 2016).

While most countries are preparing for national health data standards and interoperability guide lines like Kenya's ICT Authority, there is limited practices on the ground.

At the completion of the VODAN-Africa study and implementation, over 88 health facilities used as part of the study and with 77 able to produce data in residence. The Integration of the health data life cycle called for enhancing quality of care in health facilities by enabling reuse. And interoperability of data by health workers while also assisting with analysis of health data across health facilities for various purposes and use cases based on different algorithmic-pathways.

Therefore, to realise this there was the development of a technical infrastructure to enhance Findability, Accessibility, interoperability and Reusability, usually referred to as data FAIRness of digital resources such as patient data, for both human and machines, called FAIRification, which allows learning from data without data leaving the residence or placed of provenance. The outcome should be data ownership, localisation, and regulation compliance (OLR), which is described as FAIR-OLR. This Figure1 below demonstrates the process followed by VODAN-Africa to key objectives of the research and data presentation.



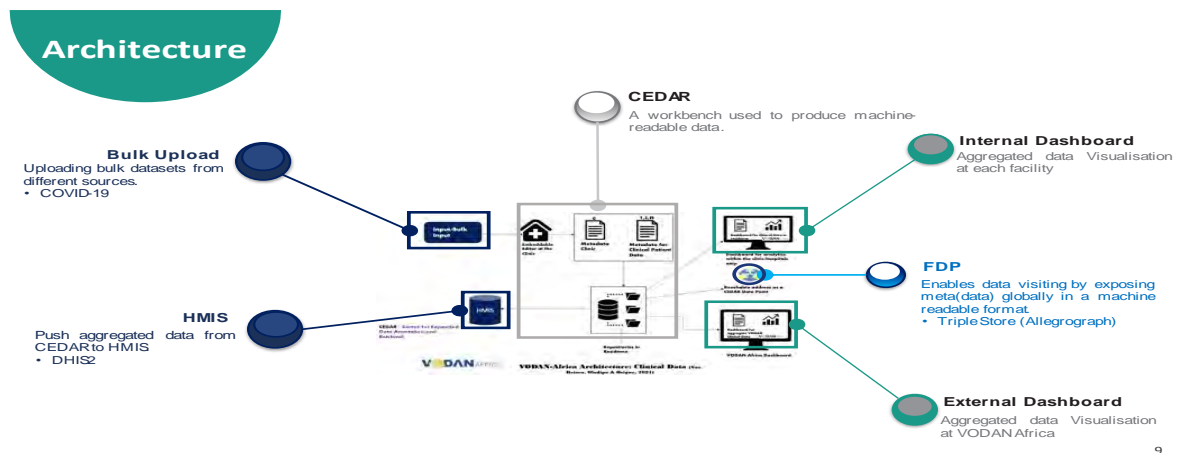
7

Figure 1 above gives a synopsis of an elaborated architecture for data ownership and retention in places where data is produced. To implement data as FAIR VODAN-Africa added three qualities:

- Ownership of data in the place where it is produced
- Localisation of data, to make sure provenance is retained
- Regulatory compliance based on specific requirements in the location where data is produced and

reposited.

Then VODAN-Africa research technical teams were able to create an architecture which could be used for scientifically obtained data and make sure data sets are interoperable, by using the same VODAN-A-Portal (same bio portal resource). See Figure 2 below



In Summary, the discussion of the findings by the VODAN-Africa research team has given a rich argument why data needs to remain in residence of its production.

Therefore, the VODAN-Africa built a platform which comprises a network of systems fitted with sets of tools to produce, use and reuse FAIR data. This system builds on the globally known and widely used standards that allow FAIR Data management and reuse. By the time the project was finished in 2022, 88 health facilities had been accessed included and 77 producing data in more than nine countries across Africa.

By implication, VODAN-Africa has made a strong case that with proper investment and support to research centres in Africa, it is possible to collect, store and access health data curated by respective health ministries.

Conclusions

The paper has made a good analysis because the continent of Africa will no longer be spectators to and be strongly represented at the global health level. Without data being curated at its point of production most developing countries without the advantage of minerals, would continue in their poverty perpetuity. Africa is now ready to lead in the emerging tech community. It means that growth in data intelligence should open opportunities for new innovations that can help developing countries dig into this untapped healthcare economic empowerment of its unemployed youth. There are various ways proposed to do this through digital innovations that are coming up (Silver et al 2021; Van Reisen et al. 2020; Mawere et al, 2019).

The paper has made fundamental points by challenging existing paradigms on value creation. The findings by VODAN-Africa show that developing countries are going to have a competitive advantage in health data production and sharing with the international community. By controlling their own digital health data, the shift in the paradigm of economic development in countries of Africa and Asia has just started, where now, health data can be traded and exchanged for money.

VODAN-Africa supports the channelling of research grants to local universities in Africa and build the expertise necessary to create and build data infrastructure. The expansion of expertise will bring in data stewards, unemployed youth and support the government concern for teaching in vocational education training (TVET) in data infrastructure development and knowledge transfer.

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UBUNTU: EFFECTS OF BLACK TAX

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Abstract

A large portion of South Africa's Black population remains restricted by intergenerational education and economic disadvantages. Just 10% of Black individuals have a high value qualification, and poverty is a daily threat for 76% of South Africans. This risk is greatest among the Black population. In the face of adversity, private transfers between family members are important in the provision of economic and social security. Media discourse on "black tax" has highlighted the responsibilities that individuals face to financially support their family networks.

The term typically refers to financial contributions that Black professionals are expected to make to less fortunate family members. While young white South Africans might enter the labor market with generational wealth and additional support from their parents, young Black South Africans face an additional "tax" on their income in the form of support offered to their families. The term, however, is contentious. A recently published book of essays on the topic, which delves into the lived experiences of the book's contributors and their kin, queries whether black tax is a "burden or Ubuntu". The contributors' stories are testament to the prevalence of private networks of support, although opinions vary about whether "black tax" is a burden or ubuntu.

The word ubuntu, common to many indigenous languages and cultures in South Africa, literally translates as 'humanity', but encompasses the idea that "I am because you are and since we are, therefore I am". My humanity is inextricably bound up in yours. We belong to a bundle of life. A person is a person through other persons. It largely speaks to concern for others and/or community wellbeing, which can in turn govern solidarity, mutual exchange and reciprocity. It is against this culture of humanity that opponents of the term "black tax" advocate for terms such as "collective family responsibility" instead

Economic development is the creation by which the economic wellbeing and quality of life of a nation, region, local community or individual are improved according to targeted goals and objectives. Individuals earn income from which savings are made and subsequently invested, expanding income earning bracket, leading to prosperity.

Ubuntu concept is critical rallying spirit of social integration and cohesion in black Africa without economic blue print. Ubuntu promotes high percentage of dependents compromising savings. A unifying spirit across the continent under different names including; "Ujamaa" in Tanzania, "Harambee" in Kenya, "Teranga" in Senegal, and "Gada" in Ethiopia. The concept develops the internality (inner person) at the expense of externality (economic wellbeing). The integration of the Internality and externality results in the holistic, leading to Interdependence, Mutual prosperity and Universal values.

KEYWORDS: Interdependence, Greater good, Mutual prosperity, Universal values, Living for the sake of others.

1. Introduction

The Genesis 14:17-20 theophany marks a turning point in human history and inauguration of tithe (religious aspect) and tax from (secular point) of view as Abraham gives Melchizedek a tithe. Melchizedek was a high priest symbolizing the invisible substantial world (tithe) and king symbolizing the visible substantial world (tax), thus, embodiment of the religious and secular leadership. This old Canaanite name Melchizedek means "My King his Righteousness." Holistic in Righteousness, an encapsulation of the cosmos. He was the King of Salem, probably Jerusalem. From this episode tithe and tax became legitimate and the order of the day. [1]

Thus tithe and tax was incepted and has withstood the test of time since then. Surviving kingdoms, empires, feudals, oligarchies, and Nation States and democracies. Tithe and tax have survived civilization revolutions, reformations and counter reformations .they have shaped religious foundations and social economical foundations Luke 20:24-25 Christ reaffirms payment of taxes to Caesar leader of the state (secular)

Types of taxes

Tax is a mandatory fee or financial charge levied by any government on an individual or an organization to collect revenue for public works providing best facilities and infrastructure .the collected funds is then used to fund different public types taxes on what you buy, taxes on what you earn and taxes on what you own.

Black tax

Term originates from south Africa for money that black people or colored professionals provide to their family every month outside of their own living expenses .usually out of obligation sometimes it is taken on subconsciously as a kind of payback for sacrifices made by previous generations or family member's .is it a burden or investment?

It is guided by universal law of sacrifice encouraged by the systemic philosophy - Ubuntu, guided by tenets of interdependence, mutual prosperity and universal values. According to Zankosi Dyomfana, many might see black tax as a burden on individuals on face value but it has a pivotal social economic. It lifts families out of poverty; uplifts communities and builds generational wealth. [2]

A large portion of South Africa's black population remains restricted by intergenerational education and economic disadvantages. Just 10% of black individuals have a high value qualification, and poverty is a daily threat for 76% of South Africans. This risk is greatest among the black population. In the face of adversity, private transfers between family members are important in the provision of economic and social security.

2. Simulation

Table 3: Average share of children in Black households whose education is supported by specific supporter types

	All	Children not residing with a graduate	Children residing with a graduate
Receives private support	0.81	0.78	0.89***
Observations	8 054	6 300	1 754
Receives support from [...]			
A resident in the household	0.92	0.92	0.94***
A parent	0.83	0.81	0.86***
A co-resident parent	0.72	0.70	0.78***
A graduate	0.16	0.00	0.58***
A grandparent	0.20	0.22	0.16***
A sibling	0.02	0.03	0.02
An aunt or uncle	0.06	0.06	0.06
Other family	0.01	0.01	0.01
Other non-family	0.00	0.00	0.00*
Observations	6 300	4 801	1 499

Notes: Data are weighted using post-stratification weights. Statistically significant differences in mean characteristics of children residing with at least one graduate and children not residing with any graduates are indicated by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The categories are not mutually exclusive, i.e. more than one individual can contribute to a child's education expenses.

In The philosophy behind the black tax is part of the culture of colored communities (black) through these unwritten ancient law of sacrifice and living for the sake of others - interdependence. The African child can change the course of their destiny. However the weight of it all can feel overwhelming- no matter your net worth: systemic inequalities and generations of poverty can be discouraging, it is more of social pact but not contract.

According to significant participants, the terminology "black tax" is not only a stereotype but also a foreign concept based on wrong narrative at least. It does not capture the spirit and intent of the philosophy It is premised on the selfish capitalist attitude of "me first" and majority Africans were not born, groomed and raised that way. For the African, what is important for the community is important for the individual, (the greater public good) and not the reverse. This is the epitome of shared values.

According to another significant participatory, "when I went to university my brother who started working right after college supported me during the difficult patches. Today we both have children, his child is mine and mine are his. This is not a tax or burden it is a family duty as blood brothers. What I do for family members up to a reasonable limit is not owed to me but for the great good. In this sense "black tax" is an ill-informed, flawed construct. This underscores the tenets of interdependence, mutual prosperity and universal values. . It is an aspect of African culture-"Ubuntu". The greater public good super cedes the person good. [3]

Ubuntu.

Ubuntu philosophy is common to many indigenous languages and cultures in South Africa in particular and rest of Africa in general, literally translates as 'humanity', but encompasses the idea that "I am because you are and since we are, therefore I am". My humanity is inextricably bound up in yours. We belong to a bundle of life/lineage. A person is a person through other persons. It largely speaks to concern for others and/or community wellbeing. Which can in turn govern solidarity, mutual exchange and reciprocity. - (imago Dei; image of god). This community includes those yet to be and the living dead. 'People are people through other people' human through

humanity of other human beings (inclusiveness/holistic). It is against this culture of humanity that opponents of the term “black tax” advocate for terms such as “collective family responsibility” instead. [4]

Ubuntu concept is critical rallying spirit of social integration and cohesion in black Africa without economic blue print as it is consumer driven. Ubuntu promotes high percentage of dependants compromising savings. However, it is a unifying spirit across the continent under different names including; “ujamaa” in Tanzania, “harambee” in Kenya, “teranga” in Senegal, and “gada” in Ethiopia. The concept develops the internality (inner person) at the expense of externality (economic wellbeing). The integration of the internality and externality results in the holistic/inclusivity, leading to interdependence, mutual prosperity and universal values.

Economic development is the creation by which the economic wellbeing and quality of life of a nation, region, local community or individual are improved according to targeted goals and objectives. Individuals earn income from which savings are made and subsequently invested, expanding income earning bracket, leading to prosperity.

Culture

What do we mean by culture? Simply put it is the way we do things around here. Which has been developed and learnt over time culture determines what is acceptable or unacceptable .it encompasses all learned and shared explicit or tacit assumptions, beliefs, knowledge, norms and values as well as attitudes and behaviors, dressing and language every group or organization has a culture. Define it or it will define you.

Concept behind “black tax’-Ubuntu

Ubuntu, the concept behind “black tax,” promotes the tenet of living for the sake of others whereby the giver exercises self-sacrifices and denial for the greater public good recreating the beneficiary. In so doing the giver grows and matures in that spirit and heart towards realizing self-actualization. Remember matters fatherhood is social and all men are social fathers since living for the sake of others is practiced on social dimension The concept breeds embodiments of social fathers/mothers, custodians of the community shrine.

The philosophy postulates that human beings are essentially spiritual and moral in nature. The framework of “black tax “is basically a spiritual and moral obligation. Spiritual in the sense of beings anchored on the sacrifices of previous generations and moral on the basis of reliving those sacrifices presently. Those sacrifices are being given new life in new age, cementing the bridge between the living, the departed and those yet to be born.

The concept teaches/educates the culture of a people in a pragmatic and holistic approach. The people (community) consists of the privileged and less fortunate but bound by cultural values and norms. The embodiment of norms give rise to virtuous citizens. The young man in the community looked forward up to the privileged rich man to provide cattle for his dowry. The privileged understood that incase (god forbid) he died, the young man will provide labor, digging the grave. This is mutual in accordance with the unwritten tribal law that governed in form of beliefs and attitudes. This is a very interesting mutual existence, bondage and reciprocity and true meaning of interdependence and mutual prosperity. Each give willingly and mutually inclusive of their duties and obligations. It is deemed that their dispositions is beyond human understanding. This enhances the basic virtues of cooperation, respect and diligence in work and facilitate to establish balance between the dependence lad with the independence and interdependent of an adult. The concept and practice behind “black tax” promote values such as courage, honesty, wisdom, kindness, reliability and generosity. Every traditional African society has its education system. Traditional African societies did not establish or construct schools and facilities for formal education. Education not rely on elaborate written symbols.

Education not merely abstract but active participation in community life and thus lay foundations for interdependence. Education starts at birth with mother strapping baby in her bosom next to the breast, source of nourishment, warmth and security. Infant faces the face of the mother as she goes about her chores, studying mother’s facial expressions, movement of the lips, the smiles and eyes of motherly love.

As the infant grow bigger, the mother moved the baby from bosom to back. Infant starts observing mother’s movement and learn to appreciate wider world of physical and social environment.

Later the child view the world from back of older siblings who help mother. As child starts to move-surrounded by expanding circles of significant kin and kith, begins to learn duties and obligations in wider society. Hence the saying “it takes a village to raise a child.” [5]

The term tax is not African but a foreign idea (ideology) superimposed by outsiders, especial the western world. It proved to be unmitigated disaster to African traditional societies. Indeed it had catastrophic repercussions giving rise to desecration of the sacred.

Africans have no word for “pagan “or “infidel. “There were no such characters in African societies.

The concept states that education process was transmitted naturally and freely through life. Its goals were as easily transmitted and caught as the mother tongue. Good and useful things and ideas best caught rather than taught. African educational truths, skills and values were more often caught than taught.

IMPACT

The guiding philosophy of “black tax is driven by universal law of sacrifice encouraged by the system; traditional

African society. It has a pivotal socio-economic impact that lifts families out of poverty, uplifts communities and builds generational wealth. Today many African countries are at the threshold of middle income level nations in the world, having surmounted the tag of least/low income nations. Indeed some wealthiest people in the world are from Africa. People who have weathered storms and challenges, rising from nothing to conquer the world.

Most of our pre-independence and independence leaders owe much of their education and subsequent success to “black tax”. At one stage or another on their academic or leadership journey they benefitted from black tax directly or indirectly. The independent schools in Africa were constructed and funded this way. The purpose of these schools was to provide education while preserving African culture under threat of western influence. Their educational funding is very much attributed to “black tax.” Consequently, graduates also encouraged the spirit and practice herein referred to as “black tax.”

Through “black tax” many drcountries raise their literacy rates implying improvement in sanitation and basic hygiene. This translated into better feeding (balance diet) that improved life expectancy as well as decline in birth mortality rate. Improved health meant improved work force and decline of child mortality. According to African beliefs, he who has life and children has wealth.

The entire creation viewed as sacred. The way we treat others and environment. Africans saw themselves as part of the creation-not over and above. Western Christianity beginning to realize. With basic ideal of communal solidarity rather than dominance of individualism. Life is basically communal, the language we speak, the roads we use, the houses we sleep in, the food we eat, the clothes we wear and every area of our life. Hence the end product of human community. “I am because we are and because we are, I am”

African heritage had very high regard to the ideal of justice and fairness. Africans did not live to satisfy “laws” and “regulations” but “do unto others as you would have them do unto you.” Today in modern western oriented law schools, Africans are busy learning how to legal exploit others and get away with it legally.

African education process emphasized relationships rather than abstract facts and information. Education process that we not only know and how we know it but also for what purpose such knowledge is required.

Sacredness of life. The increasing enhancement of life and the respect and dignity of persons especially seniors. Correct ‘Matatu culture’ - public transport ferrying people in rude and highly competitive manner. Other values for example honesty and hard work ethics have diminished. Cheating at work and in business as well as poor management of resources. Social responsibility is badly broken down.

3. Conclusions

The African is notoriously and incurably religious. Within Ubuntu there is secular nor sacred but interwoven. One goes to the market, river, place of worship, in transport, and even to the wash room religiously courtesy of Ubuntu. This education encourage attitudes like “the fear of the Lord is the foundation of wisdom.”

“Black tax” is a noble ideal within Ubuntu philosophy. It is a universal law of sacrifice guided by unwritten African tribal laws, rich in values like courage, honesty, reliability, wisdom, kindness and generosity. It embodies cultural attributes including; norms, assumptions, beliefs, knowledge, attitude, behavior, dress and language.

In Ubuntu, education emphasize relationships rather than abstract facts and information. Education process that we not only know it but also for what purpose such knowledge is required.

“Black tax” concept is guided and driven by the universal law of sacrifice encouraged by Ubuntuism. It has a pivotal socio-economic power. It has lifted up out of poverty, uplifted communities and built generational wealth.

Many pioneer and independence leaders were educated and raised courtesy of “black tax” and likewise promoted that philosophy in promoting literacy and economic emancipation. Many education, and health institutions established through “black tax.” Even with changing times “black tax” has secured a place in the annals of history. A unique sustainable and home grown solution in education and development.

Unfortunately the western world has stereo typed this noble concept terming it as “black tax.”.

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Potential and Actual Economic Gains of Restoring Degraded Lands: A Review

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Abstract

Land degradation is a significant challenge facing human beings in farming production and sustainable development. Proven strategies for the rehabilitation of degraded areas are urgently needed before circumstances become irreversible. Diverse forms of restorations have been commonly practiced to rehabilitate and restore degraded lands and other environmental problems. The aim of this study was to review the perceived and actual socio-economic benefits and challenges of restoring degraded lands. Rehabilitation interventions affected livelihoods positively by producing more forage for animals, wood products, and cash income through small-scale microenterprises and sale of forest products as well as avoidance of economic losses due to soil degradation. However, biophysical and institutional challenges, lack of clear and negotiated benefit-sharing mechanisms are the main limiting factors for sustainability. These constraints primarily call for the need to have practical and interactive community participation and involvement of the private sector in restoration projects. Immense examples in Africa, China, Australia, Europe and South Korea exhibit the power to enhance or deter development when restoration of degraded lands is taken seriously or otherwise. Hence effective restoration strategies accompanied by active involvement of the local communities and strengthening their subsequent management system is indispensable. Sustaining the positive impacts of restoration requires negotiating goals among stakeholders, developing contextualized management plan, enhancing economic returns beyond the restoration phase, and defining clear and negotiated by-laws.

KEYWORDS: Rehabilitation, restoration practices, socio-economic challenges, benefit, land degradation

Introduction

Land degradation is a worldwide phenomenon defined as a reduction or loss of the biological or economic productivity (United Nations Convention to Combat Desertification UNCCD, 2016). It leads to reduced food production, poor water storage and loss of biodiversity, soil organic carbon and ecosystem services (Gilbey et al., 2019). It affects an estimated 23% of the world's terrestrial area and is increasing at an annual rate of 5–10 million ha (Stavi & Lal, 2015). The costs of land degradation directly or indirectly affects everyone causing a global economic loss of ecosystem services estimated at US\$ 6.3–10.6 trillion (ELD Initiative, 2015). The underlying drivers of land degradation include expansion of crop and grazing lands into native vegetation, unsustainable agricultural and forestry practices, global consumption patterns and climate change (van Esch et al. 2017; Sutton et al. 2016). Other contributory factors include urbanization, infrastructure development and extractive industries, which are often associated with landscape alterations (van Esch et al., 2017). In an attempt to reverse this trend and attain the benefits, many efforts have been made in which the rehabilitation of degraded lands can take many different forms depending on the localities. Restoring degraded lands offer numerous environmental, social and economic benefits, from biodiversity conservation to job creation and improved agricultural productivity. Each US\$ 1 invested in restoring degraded forests yields US\$ 7-30 in economic benefits (Verdone & Seidl, 2017). This study aimed to review the status of land restoration, its associated potential and actual economic benefits and challenges. Such information can serve as key inputs for developing scaling up programmes responsive to specific socio-economic and ecological settings.

2. Methods

To find the most relevant papers Boolean operators AND, OR and NOT were employed using the indicated key words in the title in Google Scholar. After the selection of key literatures, 'Connected Papers' search engine was used to comprehensively fill up the reference library. To accommodate multidisciplinary nature of the sought review, the authors tried to expand to scientific papers in other fields with the same searching mechanisms. A series of searching across connections and sub-connections were exhausted until the authors were satisfied with the reference list. This method enabled the researchers to furnish the review with relevant, up-to-date and cover the topic in global perspectives to help scholastic community understand the subject.

3. Results, Discussions, and Conclusions

3.1 Significance of restoring degraded lands

One quarter of the world's land (2 billion ha), on which about 1.5 billion people depend directly, and two-thirds of African land is already degraded to some degree, the latter affecting at least 485 million Africans (Brasser & Ferwerda, 2015). Severely degraded and damaged land can neither attain ecosystem function nor render standard ecosystem services to society (Yirdaw & Tigabu, 2017). In developing countries, degradation is often associated with chronic poverty (Dasgupta & Maler, 1994) as it has enormous negative social and economic

dimensions (Gilmour, 2016) exposing people to serious food security risks in Ethiopia (Klein et al., 2013), Kenya (Wasonga et al., 2009) and globally (Sunderlin et al., 2005). Moreover, degradation of drylands is associated with a loss of land productivity and high costs of restoration resulting in a loss of income of farmers and pastoralists (Zika & Erb, 2009), human migration and politico-economic instability (Duraiappah et al., 2005). It represents a major threat to the wealth of the local populations and cultures when combined with biodiversity loss (Brasser and Ferwerda 2015; Birhane et al., 2006). Therefore, reversal of the degraded lands through integrated and sustainable land management while accounting for all ecological and socioeconomic aspects (Gilmour, 2016) is important. At local or village level there is a lack of watershed based integrated planning and implementation due to fragmentation and lack of hydrological linkages (Gebregziabher et al., 2016). At a global level there is a need to consider the complex social and ecological interactions operating in order to establish a common roadmap for the common goal of saving the planet (Bierbaum et al., 2018). However, by balancing ecological, social and economic priorities at landscape level (Besseau et al. 2018), additive and reinforcing global goals are achievable. The science, technology and finance are sufficiently mature to address the challenges (Kalhor et al. 2017; Mekuria et al. 2017; Gebregziabher et al. 2016; WRI 2016; Brasser and Ferwerda 2015; Lebedys and Li 2014; Nearing 2013).

When restoration schemes are established at larger scales and with clear natural, agricultural and economic zones the overall livelihood of the local people can be dramatically improved as evidenced from Abraha Weatsebaha in Ethiopia (Gebregziabher et al., 2016), Loess in China, Rugezi Wetland in Rwanda (Brasser & Ferwerda, 2015), Baekdu Daegan protected area and the four major rivers (Chung et al., 2018; Shin & Chung, 2011) and Cheonggyecheon urban restoration (Yoon, 2018) in South Korea. For example, South Korea's dense forest was destroyed during the Korea war to supply wood and fuel (Choi et al., 2019) which challenged the foundations for rapid economic growth and national development (Nam-choon, 2005). In order to protect the national land, four types of restoration and preservation plans were developed: the revision of road slope design criteria, the promotion of rooftop re-vegetation and enhancement of green space in urban areas, the revision of National Environmental Conservation Law, and the employment for the first time of environmental specialists (Nam-choon, 2005). As a result, Baekdu Daegan protected area (Nam-choon, 2005) became the centre of biodiversity of plants and animals and safe place of endemic and endangered species (Chung et al., 2018). Moreover, the highly diverse urban green corridor biosphere reserve of Cheonggyecheon was internationally recognized as an example of successful urban regeneration (Yoon, 2018). Such large scale restoration projects connecting different villages and administrative regions can further enhance integration of the natural, agricultural and economic zones, by avoiding restoration failures noted by Gebregziabher et al. (2016).

However, the duration to achieve intended goals varies greatly depending on the method of restoration and the severity of land degradation (Norton et al. 2018; WRI 2016). Many restoration projects either take conservation as the final objective, or fail to consider the severity of degradation which is crucial in designing effective methods of restoration and accurately predicting the return period (Mekuria et al., 2017). The extended gap before a local community gets benefits from the restored lands has a high level of socioeconomic significance and requires careful planning and the implementation of interim support schemes. For example, benefits such as Carbon Credits often require strict and long processes, only being accrued after successful restoration of degraded lands. The long time lag between the start of the project and delivery of benefits to the local community can result in demoralization of both the local community and experts involved in project delivery. Therefore, there must be an interim solutions to support communities to bridge gaps prior to attainment of successful restoration and payment of Carbon Credits (Barata 2016; O'Connor and Gaertner, 2018). The good news is that there are restoration projects that have delivered the desired outcomes within the planned time frame. The Loess plateau in China, met its objective in 10 years (Brasser & Ferwerda, 2015). In Tigray, northern Ethiopia, both Abraha Weatsbaha (Gebregziabher et al., 2016) and the Merere projects, delivered the desired outcomes within 5 and 10 years, respectively. At a global level, Ethiopia, Rwanda and El Salvador were mentioned as having leaders who have understood that restoration of ecosystem functions restores the economy (Brasser & Ferwerda, 2015). These are concrete evidences that Africa can move out of poverty and aid dependence by restoring its degraded lands.

3.2 Global movement to restore degraded lands

There is doubt, concern and uncertainty with regards to the ability of future food production to keep pace with the predicted increases in global population (Alexandratos, 2012) which is expected to increase to 8.6, 9.8 and 11.2 billion head by 2030, 2050 and 2100 respectively (UNDESA 2017). Land degradation and climate change could reduce the overall global crop yields by 10%, with declines of up to 50% anticipated in certain regions (Cardinale et al. 2012; Besseau et al. 2018). This implies increasing production will not be easier due to more stressed and scarcer water resources, soil degradation, salinization of irrigated areas, biofuel production and climate change (Alexandratos, 2012). The impact of unsustainable over-exploitation of natural resources (Iwujii et al., 2016) is also severe. The world is recognized as having entered the Anthropocene era, when human activity

has been the dominant influence on climate and the environment. Whilst enthusiasts celebrate this human role in shaping the biosphere, with plans for managing, and even reengineering the planet (Rolston, 2018), four of the nine so-called planetary boundaries, namely climate change, bio-sphere integrity, biogeochemical flows, and land-system change have already been crossed (Jaramillo and Destouni 2015; Johan Rockstrom and colleagues 2009). The planetary boundaries are the limits under which human being can thrive and prosper (Rolston, 2018). Extinction rate (one of two indicators for biosphere integrity), deforestation, atmospheric carbon dioxide (an indicator for climate change), and the flow of nitrogen and phosphorus sit at the forefront of the problem (Jaramillo & Destouni, 2015). These are global issues (Bhargava, 2006) that require global solutions (Sweeney, 2008) and demand local actions (Defensive environmentalism) to be taken to bring collective global effects (Altruistic environmentalism) Rudel (2011). Accordingly, there is an increasing trend to restore degraded lands globally (Gebregziabher et al. 2016; Brassier and Ferwerda 2015; Atkinson et al. 2018). Dramatic positive changes in contributing to address the ecological problems and improve the livelihood of the local people following well restructured restoration projects have been witnessed (Gebregziabher et al. 2016; Brassier and Ferwerda 2015; Le Houerou 2000). There are ambitious national and regional initiatives aimed at the restoration of a significant share of the total global land area by 2030. Outstanding commitments pledged include, The US Forest Service (15M ha); Ethiopia (15M ha); The Democratic Republic of Congo (18M ha); Guatemala (3.9M ha); Uganda (2.5M ha) and Rwanda (2M ha) as well as the Brazil Mata Atlantic Restoration Pact; El Salvador; Costa Rica; Colombia and Niger with 1M hectares each (Brassier & Ferwerda, 2015). Moreover, there are regional initiatives like the 'Initiative 20 x 20' that aspired to bring 20M hectares of degraded land in Latin America and the Caribbean into restoration by 2020 in response to the Bonn Challenge (WRI 2016; Atkinson et al. 2018). Other initiatives include AFR100, a country-led effort to bring 100 million hectares of degraded land across Africa into restoration by 2030 (Besseau et al 2018). In line with global goals, work is ongoing in Europe towards attaining the forest economic, social and ecological pillars (European Commission 2015; COM 2013), and in Australasia. In New Zealand there is the Reconnecting Northland, Banks Peninsula Conservation Trust and Trees That Count initiatives which targets one tree to be planted for every New Zealander increasing by 15% per year to reach 200 million trees being planted annually by 2030 (Norton et al. 2018). These restoration programs are all motivated by their actual benefits through enhancement of biodiversity, carbon sequestration, and agricultural productivity on top of the direct economic benefits of the restored lands themselves. Both academic researchers and program advocates emphasize the importance of holistic planning in such initiatives taking into account both ecological and economic factors (Yin and Zhao 2012; Cardinale et al. 2012; Brassier and Ferwerda 2015; WRI 2016; Mekuria et al. 2017; Bierbaum et al. 2018; Besseau, Graham, and Christophersen 2018). Unless conservation programs specifically target the integration of socioeconomic benefits (Brassier and Ferwerda 2015; Yin and Zhao 2012) in general and changing the lives of the poor in particular, then such programs undertaken to conserve biodiversity will have already failed (Rolston, 2018).

3.3 Economic implications of restoration on the local communities

Potential Economic Benefits of restoration

The potential gains of land restoration include income and capital gains (WRI, 2016) and community empowerment (Nelson & Sandbrook, 2000). In general, studies have shown that the economic benefits of restoration can far exceed the costs (Verdone & Seidl, 2017). WRI (2016) estimates the annual financial benefits from global restoration of degraded lands to be \$84 Billion. Analysis by Verdone and Seidl (2017) suggested that achieving the Bonn Challenge would generate a net global benefit between U.S.\$0.7 and U.S.\$9 trillion. According to WRI (2016), a successful effort to restore Latin America and the Caribbean's degraded forests, savannas, and agricultural landscapes—one with the scope and character of Initiative 20x20—would result in substantial net economic benefits by yielding an estimated net present value (NPV) of about \$23 billion over a 50-year period. For every single dollar invested in meeting the AFR100 initiative, a net income of \$35 is expected (IISD, 2018).

Additionally, benefits may indirectly accrue as the project progresses such as provision of a scenic environment, recreational pursuits and provision of clean air (Mitchell, 2010). Significant achievements in vegetation cover and biomass productivity (Mekuria 2013; Mekuria and Yami 2013; Yayneshet 2011; Houerou 2000), soil physical and chemical improvement (Yimer et al 2015; Gebregziabher et al. 2016), protection of downstream farmland, grazing land and water reservoirs (Haregeweyn et al., 2006) are all well recognized benefits of restorations that can be valued into monetarily. Land restoration has the potential to contribute to improved agricultural yields in degraded lands, contain biodiversity losses, increases in carbon stocks, and secure gains in soil and water quality which all can yield financial and economic benefits (WRI, 2016). This is because landscape restoration, management techniques, low-carbon and sustainable agriculture all offer opportunities to mitigate and reverse the losses associated with land degradation. WRI (Bhargava, 2006; WRI, 2016) estimated an annual NPV of 1140 USD/ha from restoring 20 million hectares by 2020 in Latin America and the Caribbean in terms of income from

ecotourism, agricultural production, avoided food security costs and carbon storage..

Actual Economic Returns from restoration

Balana et al. (2012) in their study in Degua Tembien Woreda of Tigray (The winner of Future Policy Award as the World's Best Land Restoration Policies), Northern Ethiopia, valued restoration of degraded marginal lands at NPV of 5620 ETB (200USD) per hectare. Their comparative study showed a 50% increase when a project was established in areas with a higher proportion of degraded lands against less degraded land. This provides considerable support for the establishment of restoration projects in highly denuded lands to become a source of income and thus poverty reduction. Yirdaw &, Tigabu (2017) reported that rehabilitation interventions affected livelihoods positively by producing more forage, wood products and cash income through small-scale microenterprises and sale of forest products. Similarly restoration in the Sikkim Himalaya watershed, India, showed a positive NPV (Prabuddh and Suresh 2013) and ensure economic sustainability for the resident community. Systemic ecosystem management in Tigray, helped recharge groundwater levels in downstream valleys which increased the irrigation by a factor of six from almost 5,000 hectares in 2000 to 30,000 hectares in 2008 thereby helping to expand agricultural production even in drought years, providing food security and steady incomes (Brasser & Ferwerda, 2015).

Tradeoffs and Challenges encountered in establishing restoration of degraded lands

Firstly, restoration of degraded lands has a varying degrees of immediate negative impact on local communities by restricting their actual benefits through grazing, firewood collection, harvesting of available edible wild fruits, harvesting of construction materials, and other goods and services (Yayneshet 2011; Nedessa et al., 2005) in areas they previously had free access to (Börner et al. 2014). This can affect the livelihood of natural resources dependent poor households (FDRE, 2012; TRBF 2010; Vedeld et al., 2007; DPPC, 2000). Poorer communities are less likely to adopt the ecological and socioeconomic changes associated with restoration, thereby leading to lower levels of sustainability (Fox et al., 2009). Secondly, restoration programs are challenged by other negative attitudes of the local people (Birhane et al., 2006; Tekalign, 2010) such as the failure to make significant contribution to household income (Getachew, 2017), and low community participation in the establishment and subsequent benefit sharing (Lemenih & Kassa, 2014). As a result, people may refrain from supporting their expansion (Getachew & Malke, 2015) and become involved in illegal animal grazing (Berhe, 2015; Getachew & Malke, 2015). Thirdly, even successful restorations of degraded lands have not been always economically beneficial to local communities. For example monoculture plantation of eucalyptus trees in Vietnam failed to earn returns to local people, and even triggered outbreak of pests and diseases (Brasser & Ferwerda, 2015). In Tigray, Ethiopia, it remains illegal to harvest any part of a tree for wood from lands enclosed 36 years ago, limiting the ability of local people to maximize the potential benefits of enclosures (Ubuy et al., 2018). Biophysical and institutional challenges, lack of clear and negotiated benefit-sharing mechanisms are the main limiting factors for restoration sustainability (Birhane et al. 2017). Fourthly, the business sector is not yet involved in restoration programs (Verdone and Seidl 2017; Cornell et al. 2016; Lemenih & Kassa, 2014; COM 2013), although Action 2020 was launched in 2013 by the World Business Council on Sustainable Development with 200 multinationals as members (Brasser & Ferwerda, 2015) whose action is not yet prevalent.

Conclusion

Restoration of degraded lands is socio-economically beneficial that can serve as way-out from poverty. Restoration approaches taken depend on a range of factors especially the level of degradation and socioeconomic settings. It is imperative that the restoration projects must encompass the objectives of the local communities and maximization of their potential and actual benefits. Failure of the private sector to contribute to restoration projects will have a negative impact both in terms of extending the restoration period and affecting its sustainability. Moreover, fair benefits distribution taking the poor households into consideration is inevitable. Tradeoffs include pressure and overexploitation on the remaining grazing lands, restrictions on the immediate use of restored areas by the local community, low contribution of restoration projects to the household income and low adoption rate of restoration initiatives by communities due to the long time lag before transforming benefits accrue.

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Migration and development- African Diaspora Remittances and Africa's development beyond Aid

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Abstract

The role diasporas in the development processes in the countries of origin has received significant attention in the academic and policy debates on the migration and development-nexus. In Africa, diaspora remittances have surpassed Official Development Assistance (ODA) and currently competing with Foreign Direct Investment (FDI) in terms of volumes, consistency and reliability, motives, mode of implementation and envisioned development outcomes in postcolonial Africa. African Diaspora remittances continue to serve as a major source of foreign exchange and, has acted as a buffer during economic crisis including recent impact of Covid 19 by playing an important safety net role for the most vulnerable populations. In some African countries, remittances have also emerged as a major share of the GDP compared to the main economic activities such as tourism, and resource exports. The significant socio-economic effects generated by diaspora remittances notwithstanding global economic crises, and the diasporas' ability to function in parallel to donor agencies in mitigating development challenges in the countries of origin, therefore, gives the impetus to explore the extent to which the remittances by the African diasporas could be leveraged to spur development in Africa beyond aid. The call to rethink Africa's development beyond aid is also underscored by the history of Africa's experiences with development aid and its outcomes 60 years on. Contrasted with the US Marshall plan for the reconstruction of Europe after the second world war, concerns have been raised about why aid is not working in Africa. What is different and what underpins this difference and indifference in the case of development aid in Africa and its outcomes? What kind of development intervention models would best serve Africa in its trajectory of development? An attempt is made in this paper to address these questions through juxtaposition and critical analysis of the features of Africa diaspora remittances and development aid.

KEYWORDS: Migration, Diaspora, Remittances Development interventions, Decoloniality, Development Aid, Africa

1. Introduction

Diaspora's development potentials have been acknowledged in much of academic and policy debates on the link between migration and development (de Haas, 2012; Newland, 2010; Brinkerhoff, 2008) owing to the large volume of remittances and its socio-economic impact (Ngoma and Ismail, 2013; Ratha, et al. 2011). In Africa, diaspora remittances have surpassed Official Development Assistance (ODA) and currently competing with the level of Foreign Direct Investment (FDI) in terms of volumes, while other remittances are spent on investments and entrepreneurship (Bodomo, 2013). In many African countries, remittances have emerged as major share of the GDP compared to other economic activities (tourism, resources exports). Diaspora remittances also serve as a major source of foreign exchange; it acts as a buffer during economic crisis and during Covid 19 (World Bank, 2021), remittances gave boost to the conditions of resilience and continue to play an important safety net role for the most vulnerable populations in many countries (Plaza, and Ratha, 2011).

The observed increased role of remittances in the continent makes it imperative to juxtapose its main features such as reliability, unconditional commitment, long term nature of involvement and areas of impact to those of FDI and official development aid to Africa (Bodomo, 2013). The significant socio-economic effects generated by diaspora remittances notwithstanding global economic crises, among other global social upheavals, the diasporas' ability to function parallel to donor agencies in mitigating development challenges in the countries of origin, therefore, gives the impetus to explore the extent to which the remittances by the African diasporas could be leveraged to spur development in Africa beyond aid. As observed at a recent African development bank meeting, diaspora's remittances, investment, and expertise is vital for Africa's future growth (African development Bank, 2022). This quest for a paradigm shift, is also informed by increasing calls for decolonising aid and development corporation (Partos, 2021). Moreover, the history of and the experiences with development aid in Africa and its outcomes 60 years on (Kremer, et al. 2009), calls for a re-examination of the models of development that Africa deserves (Opeskin, 1996). Contrasted with the US Marshall plan for the reconstruction of Europe after the second world war (Gerrett, 2018), concerns have been raised about why aid is not working in Africa (Moyo, 2009). What is different and what underpins this difference and indifference in the case of development aid in Africa and its outcomes?

2. Statement of Contribution and Methods

This paper contributes to the development discourse in Africa by rethinking the role of African diasporas in the local development processes in the continent. African diasporas have claimed the development space in Africa through individual and collective initiatives and remittances (Ong'ayo, 2019; Plaza and Ratha, 2011). Within the broader conceptualisation of remittances (financial, material, and social) (Levitt, 1998) African diasporas have been addressing development challenges such as poverty reduction (Newland and Patrick, 2004), through interventions that were hardly acknowledged within the development industry as well as development cooperation activities. However, this role has begun to receive some attention in both policy and academic debates where diasporas are increasingly regarded as key actors for change (International Organization for Migration, 2022), agents of change (Kleist, and Turner, 2013; Oguzie, 2011), development actors (Newland, 2010), or agents of development (Groot and Gibbons, 2007).

In this paper, I make three arguments. First, I posit that African diaspora involvement in the development processes in the countries of origin offers the possibilities to disrupts the old order of doing prescribed and conditional development. Doing so, serves the much-needed rethinking of development from a decolonial perspective (Gerrett, 2018) in which the understanding of development is underpinned by lived experiences and the agency of Africans but also based on a conscious choice of what works for them or not, while still being part of a globalized world. Second, I argue that the large volume of remittances by African diasporas offer the possibilities for homegrown solutions that are deeply embedded in the diaspora's strong connections which are maintained by their transnationalism and lived experiences of their multiple layers of belonging. The unconditional commitment by the diasporas which derives from close affinity and connections to the countries of origin provides development initiatives they facilitate with an anchor that transcends the dominant Eurocentric development paradigms and governance models currently underpinning development aid to Africa. Third, the diaspora involvement is inherently long term and sustainable in character due to the deep-rooted intergenerational connections through the diaspora youth whose multiple layers of belonging hold key to a sustained link to the local development processes. The aspirations, motivations, and capabilities of the African diasporas, as well as return and in between options in their transnational experiences, also create the possibilities for sustained remittances in all its various forms. Remittance-facilitated development initiatives informed by these factors offer an alternative development model in which African agentic responsibility, creativity, innovation, and self-mobilisation of resources becomes part of the radical rethink of the dependency model of development framework for generation of social transformation, beyond external help.

2.1 Diaspora transnationalism and development

Discussions on international migration highlight the various manifestations of human mobility under different conditions and the responses aimed at leveraging its development potentials. Within these debates, the role of diasporas constitutes a significant area of focus especially the financial, social, and material remittances. Most remittances often target those left behind such as family, next of kin, and friends as well as personal investments and philanthropic acts targeting wider community needs. Despite the recognition of the large volumes of diaspora remittances to Africa and their significant socio-economic impact at the national and local community levels, the position of diasporas as development actors among other development practitioners remain less prominent in the development corporation policy debates and framework.

In this paper, we seek to anchor the African diaspora within the development policy framework by tracing their positionality within the discourse on diaspora transnationalism, diaspora philanthropy, migration and development, and diaspora engagement (De Haas, 2012; Brinkerhoff, 2008). A more nuanced explication of the African diaspora transnationalism and development potentials thus calls for critical theoretical reflections on diaspora positionality in development interventions to adequately capture the extent to which diasporas engage with development issues in the countries of origin. At the same time, situating diaspora engagement within the development aid debate has significant relevance in terms of implications for policy and practice in the context of shifting conditions in development aid for Africa and increasing calls for decolonisation of development and international development corporation (Cullen, et al. 2022; Sakue-Collins, 2021; Wood, 2017).

Insights into African diaspora activities that target local development processes in the countries of origin can be drawn from diaspora transnationalism literature, which describes their formation (Brubaker, 2005), collective organising and transnational practices (Ong'ayo, 2019). Generated by a combination of both global and local social processes such as poverty, climate change, conflicts, labour migration, search for greener pastures (studies and work), family formation or reunion, diasporas continue to engage with people and places with which they maintain ties through transnational connections (Vertovec, 2001). Some of the close ties such as family, relatives, co-ethnic and friends inform a wide variety of motivations for diaspora individual initiatives and collective action.

2.2 Diasporas as development actors

Literature on the nexus between migration and development, acknowledge the centrality of remittances (Sørensen, 2016). Owing to the diverse nature of the remittances (financial, material, and social) sent by the diasporas, some of the remittances have a collective dimension in terms of the mobilisation strategies, which target a wide pool of resources (memberships, platforms, public institutions, and organisations), and implementation, which involves a wide variety of actors at different levels in the country of origin. The consideration of diasporas as development actors stems from acknowledgement of their contributions through remittances and role of their organisations in policy initiatives and programmes. These efforts have been pursued within the framework of diaspora engagement by government and development agencies. Diasporas as agents of development do function in spaces that are classically occupied by other development actors. Diaspora philanthropy which is seen as neglected third humanitarian space involves a wide variety of transnational practices and transfers, which are informed by a mixture of motives. Diaspora philanthropy often target community development projects in the countries of origin and in the process, bring the diasporas into contact with both state and non-state actors. While their role has been largely seen in the past as different from the mainstream Non-Governmental Organisations (NGOs) or as a 'David and Goliath' (Brinkerhoff, 2011), studies have shown that diasporas through different organizational categories (hometown associations, migrant development NGOs and umbrella organisations) inherently engage in transnational practices with development outcomes (Ong'ayo, 2019). In this sense they can act as intermediaries between international development organisations and local communities to which they belong.

A variety of diaspora organisations possess similar features as regular NGOs, and their contributions make a difference even if such initiatives are much smaller in scale and scope. The role of diasporas in development aid especially in relation to the development agencies, according to Groot and Gibbons (2007), derives from the knowledge and skills which can make aid more effective and sustainable. In this regard, diasporas potentials can either support, legitimise, and complement or replace other development interventions, if aligned with local development policies (Ong'ayo, 2019). In terms of their constructive engagement in local development, some scholars have noted that diaspora involvement can be challenged by fragmentation and interventions perceived as less professional. However, diversity as a feature of migration reality requires multiple lenses to flesh out its potentials (Ghorashi, 2006). As some studies have shown, there are different diaspora formations which can facilitate constructive engagement and implement development initiatives that are inclusive and have broader impact (Ong'ayo, 2019; Lacombe and Cloquell, 2014).

2.3 Methodological issues

This paper is informed by empirical findings from field studies undertaken in Ghana, Ethiopia, Nigeria, Uganda, and Kenya as well as studies among several African diaspora communities (Kenya, Ethiopia, Ghana, Eritrea, Somali, Uganda, South Sudan, Burundi) that are based in Europe (Netherlands, Germany, UK) (Ong'ayo, et al. 2020; Ong'ayo, 2019; 2016). As part of co-creation, the study involved a series of workshops drawing on expertise within the university, development NGOs, and diaspora communities, with an aim to strengthen the design of the study through reflexivity but also to gain insights into the subject under investigation from the perspective of the African diasporas. The first phase of the study in the countries of residence, entailed in depth interviews aimed and gaining insights into diaspora experiences and perspective on their contribution to development in the countries of origin and how they perceive of this role in the long term. The diasporas interviewed ranged from leaders of hometown associations, migrant development NGOs, Umbrella organisations and diaspora entrepreneurs (Ong'ayo, 2019). These are formations that engage in collective activities which function parallel to international development agencies and Western NGOs that operate in the countries of origin. Some of the diaspora activities that are facilitated by remittances complement public service delivery while others generate employment opportunities and kick start initiatives that are accessible to large number of local populations within the countries of origin.

The second phase of the study was undertaken in the countries of origin, where the nature of diaspora initiatives with potentials for broader impact could be verified through the projects they implement individually or collectively. The paper is also based on analysis of secondary sources especially recent studies that focuses on diaspora remittances at the continental level (AU-African Institute of Remittances; FAD's Financing Facility for Remittances (FFR)). A review of literature on international migration was also undertaken with a focus on diaspora transnationalism, diaspora philanthropy, migration and development, diaspora networks and diaspora engagement. The review sought to provide the necessary theoretical reflections on the role and place of diasporas in the local development processes. While the diaspora communities and countries of origin used in the paper are not representative of the wider African continent, they offer insights into the patterns and trends that are reflective of the continental dynamics, as observed in many recent studies (MobileRemit Africa report) and policy analysis (World Bank, 2021).

3. Results, Discussions, and Conclusions

The role of diasporas in development through transnational individual and collective activities are increasingly

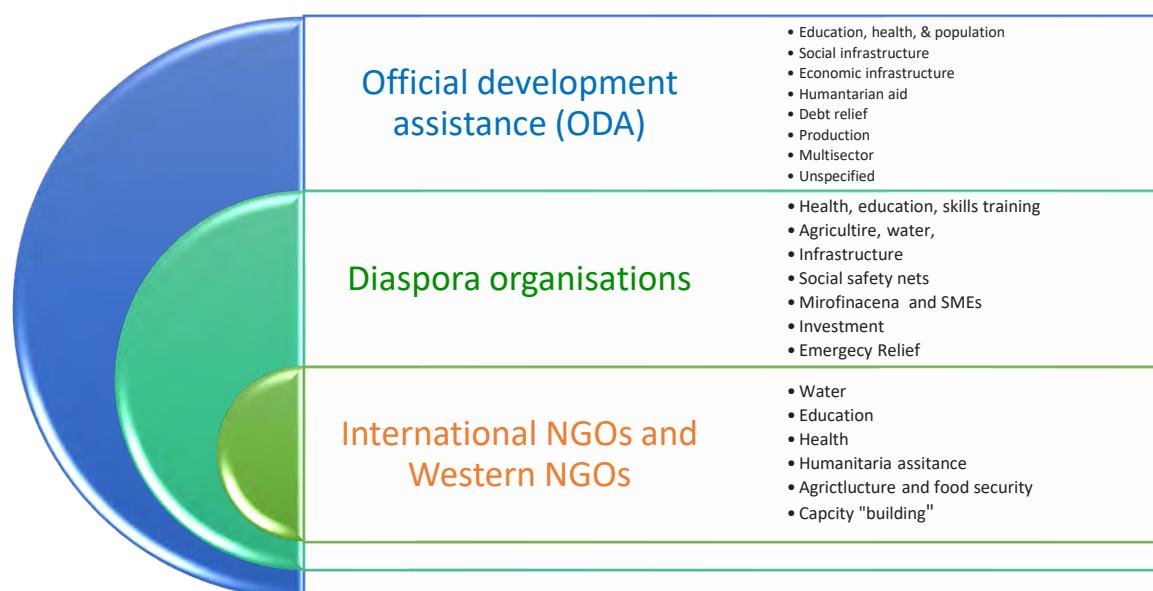
believed to have transformative effects (Ong'ayo, 2019; Lacroix, 2011). The recognition of the transformative effects of diaspora remittances have been followed by calls for increased engagement with, and support for diaspora groups. This call is not only informed by the acknowledgement of the volume of remittances but rather the likely areas of developmental impact in the countries of origin. The involvement of African diasporas in the development in the countries of origin takes different forms regardless of their backgrounds (conflict-generated, economic migrants or refugees fleeing political oppression). As shown in table 1, Diasporas in their individual and collective activities do engage in different remittance-linked initiatives with potentials for broad social transformation. Some of the activities i.e., charity and material goods target public services such as education, health or water systems affected by limited government investment or those delapidated by civil strife. This is illustrated in a study by Linden, Blaak and Andrew which looked at opportunities, challenges, capacity development, international cooperation, and partnership in the case of South Sudan (Linden, et al. 2013).

Table 1. Areas of remittance deployment in Africa

Type of remittance	Ares of deployment/spending							
Individual remittances	Essential Family needs	SMEs and trade	Health	Education and skills training	Real estate	Manufacturing and production	Funerals and cultural commitments	Charity
Collective Remittances	Public services	Agriculture	Health systems	Education	Skills training	Microfinance	Humanitarian relief	Infrastructure

Our study shows that African diasporas engaged in activities that are informed by a deeper understanding of the local challenges, which some of them had gone through, and are still experienced by next of kin whom they support in different ways. As shown in Figure 1, the thematic or topical coverage of interventions by both Official Development Assistance (ODA), International Non-Governmental Organisations (INGOs) and those undertaken by diasporas in their individual and collective activities are not different from each other in terms of their wordings. However, the intentions, motivations, levels of commitment (short or long term) and conditions of engagement or giving vary markedly. For example, the framing of programmes funded by ODA under the broad theme of production or infrastructure (social and economic) or unspecified (see figure 1), are likely to create conditions of ambiguity or unequal partnerships, while the framing by diasporas is very concrete and clear on the issues for intervention. Conversely, the question of motive, interests and intentions could equally apply to the African diasporas, donor agencies, and ODA, but they can also be argued to have very different sets of value systems that inform their constructs, especially the nature of socio-cultural connection to the local community.

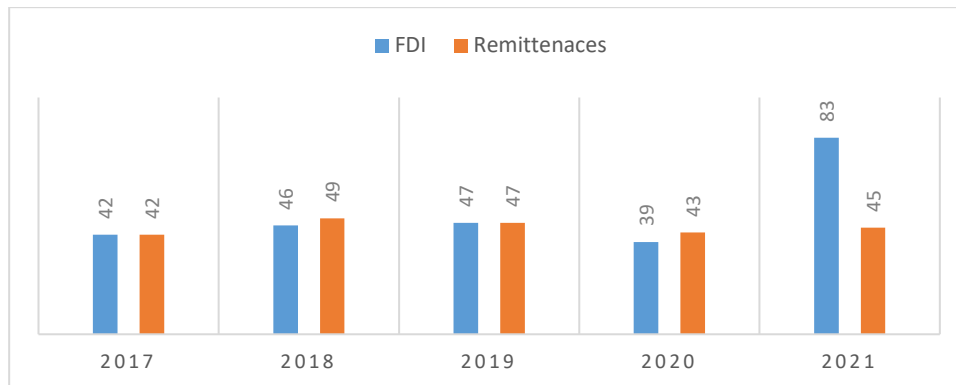
Figure. 1 Areas of intervention by donor community and diasporas in Africa



3.1 Diaspora remittances and Foreign Direct Investment to Africa (USD Millions)

The potency of African diaspora remittances linked to the large volumes derives from its many sources which includes other global regions as well as from within the continent. In addition to the remittances from outside the continent, Africa as experienced remittances flows regionally within the continent. This is in line with observed regional migration patterns within the continent (Adepoju, 2008). Combined with informal remittances that are hardly captured in the official figures, the large volume of remittance flows to the continent, currently competes with foreign direct investment and development assistance from the OECD countries. As shown in figure 2, African diaspora remittances are at par with FDI and in some periods such as 2018 and 2020, they overtook the FDI flows. Despite the impact of COVID-19 between these periods, and after, the volume of remittances sent Africa during this period demonstrate the resilience of remittances under economic shocks as well as the confidence it generates in the local economies in Africa.

Fig. 2. Foreign Direct Investment and remittances flows to Africa 2017-2021 (USD billions)

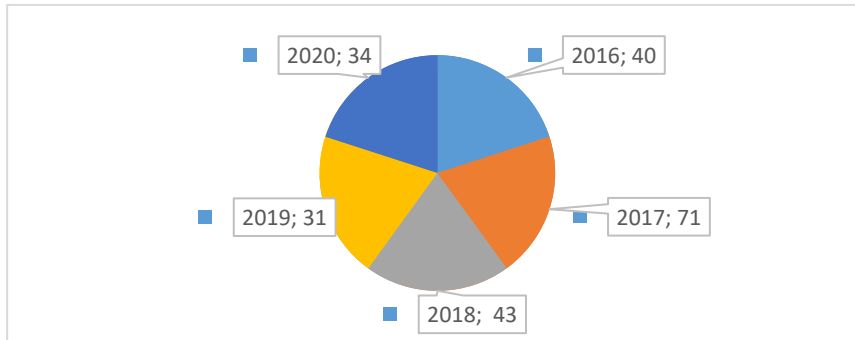


The large volumes of remittances to Africa as shown in figure 2, have continued to increase, despite the costs of sending remittances to the continent which are the highest at 7.8 percent compared to South Asia which as the lowest cost of sending remittances at 4.1 percent (World Bank, 2022). Equally, challenging for remittances to Africa, are bureaucratic bottlenecks especially the many questions that banks ask, network problems that hinder reliable communication with peoples for remittances meant for humanitarian assistance to places such as refugee camps and rural areas. Remittances sent via person to person also face challenges with safety/security of delivery as well as reliability and trust issues. Against the observed challenges, African diasporas continue to send remittances on a regular basis, and it is this regularity and consistency that positions remittances as a major contributor to development in Africa and informs the calls for rethinking remittances beyond development aid.

3.2 Development aid to Africa

Beside the foreign direct investment flows to Africa, major development intervention come from donor funding in the form of development aid which often takes the form of multilateral and bilateral disbursements by developed countries or international organizations and western NGOs. The explanation and/or justification of these interventions emanate from the discourses about development and discursive practices that seek to achieve what has been described as the “global yardsticks of modernisation, development and socio-economic parameters” (Parashar and Shulz, 2021, p.871).

Through the influence of Eurocentric discourses and discursive practices, development interventions from outside Africa are often outsourced to African NGOs who remain dependent on external financing (Hearn, 2007) and symbolic repertoires that shape and steer interests, mobilisation of support, and meanings given to actions. As shown in figure 3, the volumes of disbursements often vary based on priorities of the donor community and their own agenda. The volume of ODA in the respective years under consideration in figure 3. also demonstrate that remittances, are relatively stable and consistent at an average of USD 40 billion annually like the ODA. Once again, the strong showing of remittances against the ODA flows which are structural funds is another indicator of how remittances are already recalibrating the development paradigm in Africa.

Figure 3. Aid (ODA) disbursements to countries and regions [DAC2a] (USD billions)

3.3 Doing development in Africa

With development initiatives in Africa being undertaken by states and different non-state actors, it is important to examine the areas of convergence and divergence but also the nature of agenda setting, thematic choices, and relevance of actions. As argued by Sakue-Collins (2021), the practice of foreign aid, backed by neoliberalism, is primarily characterised by symbolic power relations between donors and recipients. Hence, the debate about development and initiatives targeting Africa often derive from perspectives deeply entrenched in Western values and world view about what should be. As shown in figure 4, Eurocentric views about developmental metrics tend to define development challenges in Africa and often take normative constructs and prescriptive tones in definition and articulation. The choice of activities and framing of the issues targeted with by western donor interventions thus implies that meanings attached to these interventions vary markedly with those issues given focus by the African diasporas who send remittances to the continent. For this reason, a crucial question linked to the call for rethinking development in Africa beyond development aid by focusing on remittances is what is different or not in the approaches, nature of engagement and their impact?

As noted in figure 4, the topical issues and activities of diaspora organisations are like those of other non-state actors involved in development interventions in the continent especially those activities linked to public service delivery, safety nets, social protection, and economic regeneration. The diaspora transnational activities which include different types of remittances have direct links to local development challenges and have the potentials to generate social transformation at different levels, even if there are no clear policy frameworks that guides the involvement of diasporas. This is because African diaspora remittances offer the possibilities for homegrown solutions that are deeply embedded in the diaspora's strong connections to the local communities in the countries of origin. The diaspora unconditional commitment which derives from close affinity and connections to the countries of origin provides development initiatives with an anchor that transcends the dominant development paradigms and governance models currently underpinning development aid to Africa. The Diasporas ways of working include multiple and parallel activities implemented directly and through multiples actors that constitute local stakeholders and direct participation of local communities.

Most of diaspora approaches to development are likely to fall outside the official frameworks consequently leading to limited acknowledgement by policy makers and traditional development practitioners. However, several diaspora collective activities especially those that target public service delivery, economic regeneration and social safety nets demonstrate their significant development policy relevance. The existence of different initiatives facilitated by diasporas remittances even if outside formal frameworks is therefore an indication of how diasporas can generate solutions to local development challenges from their own initiatives linked to agentic responsibility, reality of their multiple layers of belonging and positionality as policy entrepreneurs. This can be demonstrated in the dispersed nature of projects implemented by diaspora organisations in the migrant development NGO category which has the potentials to address regional development disparities because their initiatives go beyond single locations or regions in the countries of origin.

Conclusion

The argument for repositioning remittances sent by African diasporas into the development beyond aid emanates from its character in terms of resilience during economic shocks, levels of commitment, consistency, reliability, unconditionality in giving. At the same time, this repositioning is linked to constantly shifting aid conditionalities as well as dwindles in the levels of FDI to the continent compared to other global regions. The thematic focus of the development initiatives by both ODA and other forms of western development aid to Africa are like those targeted by African diaspora remittances, however their framings and approach are informed by different value systems that have serious implications for implementation and envisioned development outcomes. The discourses on development in Africa and discursive practices that underpin them are largely Eurocentric and due to the inherent imbalanced power relations, they continue to dominate most of the postcolonial development

discourses and paradigms, as well as frames of representation and meaning informing various interventions. Hence, it is within this context that the 60 years of external development interventions in Africa is questioned, owing to the levels of FDI and ODA flows and observed outcomes vis-à-vis the remittance flows, its current development impact, and prospects in decolonising development in Africa.

In terms contribution to social transformation in Africa, the involvement of African diasporas in the local development processes through remittances is deeply rooted in their affinity and connection to the people and places. Playing a crucial role in the difference in commitment to the local development agenda is diasporas multiple layers of belonging. For instance, diaspora investment back in the continent takes place in urban areas as well as rural areas where they relate and belong in different ways. Hence, diasporas as development actors, do not just come and go, because their identity, affinity as well as individual aspirations and motivations for migration are deeply rooted in the localities of intervention. These locations are strongly laden with values (socio-cultural and economic) that are intricately intertwined with their diasporic life (identity formation, construction and reconstruction and transnational practices) which includes simultaneous engagement, and possibilities for return.

Diaspora remittances are almost matching both FDI and development aid in terms of volumes. Even with fluctuations, caused by global or regional crisis in terms of the political and economic conditions in the countries of residence, diaspora remittances maintain sustained levels of consistency that has significant implications in the areas of intervention and lives they touch. The recognition of the development potential of remittances to Africa has heightened level of diaspora engagement policies by country-of-origin governments as well as continental policy measures to reduce costs of remittance transfer to Africa, which remains highest compared to other global remittance destinations such as South Asia.

In terms of the impact of remittances by African diasporas in the respective countries of origin, these contributions not only complement the existing government services but also fill the gaps where services do not exist. The consideration of diasporas as development actors stems from acknowledgement of their contributions through remittances. This is evident in the many areas impacted upon by remittances, such as sustenance and regeneration of local economy, provision of safety nets, employment creation, infrastructure, skills transfer, improved and increased access to public services. These are areas of interventions perceived as the domain of traditional development practitioners and partners, but the level of diaspora commitment and investment in them through consistent, reliable, and unconditional flows of large volumes of remittances makes it imperative to rethink the role of remittances in Africa's development beyond development aid. Such a paradigm shift responds to the increasing calls for decolonization of development through homegrown and funded solutions.

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Reconcept of Worship as Attendance

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1. Introduction

This paper is to reconstruct the concept and definition of worship suitable for the Completed Testament Age by examining the concept and definition of worship used according to the times. The nature of worship, "to give honor and glory to God," does not change, but it has been different according to the definition and form of worship. In order to realize this essence, the Old Testament era worshiped in the form of ancestral rites, Catholicism in the New Testament in the form of holy rites, and Protestantism in the form of declarations of words.

2. Concept of worship Services According to the Age

Mosim is a combination of "Samohal mo" and "Mam sim" as a noun for "Moshida"(being in attendance on a person) in Korean. It means 'heart of love and respect'.

The verb "moshida" means (1) support closely one's elders or esteemed someones, (2) settle a grown-up in a place, (3) have the meaning of holding a memorial service and so on.

Therefore, the worship of Mosim can be defined as "To hold a ceremony of respect and adoration for God in the temple of God." In this paper, 'Mosim' is defined and described as attendance.

The words used as worship in the Old Testament are "Abad" and "shachah". Abad means, "Just as a servant serves his master, a worshiper serves God as his master." As another concept of worship in the Old Testament, there is "shachah", which means "the act of giving in to the person you respect, lying down, and praising." Looking at the subconcepts of worship in the Old Testament, the meaning of 'attendance' is commonly implied. Attendance in the Old Testament is attendance as a servant. As a servant, expressing the act of obligatory obedience and submission becomes the form of ritual worship in the Old Testament.

In the New Testament era, the terms used for worship are Prosquineo, Latreia, and Leitugua. Through these subconcepts, as verbs, it has meanings such as 'serve', 'desperate', 'submissive', and 'serve'. The word expressing worship in the New Testament era through their subconcept also implies the meaning of attendance. attendance in the New Testament era is attendance as an adoptee. It is saved according to the degree of faith and trust of an adoptee. Therefore, worship in the New Testament era expresses 'Attendance in the position of adoptive parents as an adoptee.

The words for worship in English are 'worship' and 'service', and the word for worship in German is 'gottesdienst', which means serving God. The terms "worship" in English and German have the meaning of "giving the best value to God" and "serving God." Through English and German, worship can be said to be an act of 'serving parents with sincerity'.

In Korean, 예배 is a word of vocal notation for the Chinese character '예배拜禮'. The Chinese word, '예배拜禮' which means 'courtesy' is a combination of the meanings of '예禮' and '배拜' and has the meaning of 'bowing with courtesy'. The Chinese character '예배拜禮' has the same meaning as Hebrew Shachah and Hella Laytugia. It means bowing to God with worship.

Through the examination of the etymology and usage of the worship above, worship can be defined as 'an act of worshipping God'. The place of worship is called the Temple of God(성전聖典). The Temple is where God is enshrined. In the Temple, the ritual of worshipping God can be defined as worship. However, the meaning of the Temple should be discussed separately. It is a future task that is discussions on whether the temple means a chapel, which is a visible church, or whether everywhere with God can be a temple. This is because the form of worship also changes depending on the understanding of the concept of the temple.

3. Results, Discussions, and Conclusions

Worship is classified by content and form. The content of worship in the Completed Age is attendance, and the form of worship is a style that expresses attendance. The nature of worship called Attendance has not changed, but the form of worship has been different for each era. The form of worship is expressing attendance, and it has been different in the form of worship because each era has a different understanding of God and Kingdom of God

and a different understanding of the church.

In the Old Testament Era, the relationship between man and God was a master-servant relationship(主從). Looking at Isaiah, the Old Testament, the coming messiah was expressed as "a servant of God". Therefore, worship in the Old Testament era is an expression of the act of worshipping God as a servant.

In the New Testament era, the relationship between God and man was seen as the relationship of offspring, but it was not a direct descendant, but a relationship between parents and an adoptee(양자養子). The apostle Paul emphasized in the Roman book that Christian was adopted as God's adopted son. It means that man was adopted as God's adopted offspring by God's grace from the descendant of Satan demon due to depravity. Therefore, worship in the New Testament era can be said to be an act of adoptive parents as an adoptee.

When can a fallen human being be born as a direct descendant? It should come to the ground entirely as the Advent Messiah. All mankind must meet the Messiah, remove one's nature of degeneration, and be blessed by him and be reborn as a paternity. Therefore, when the Advent Messiah comes down, theology such as theology, salvation theory, Holy Spirit theory, and church theory should be re-established, and worship theory should be established on this theological basis, and the expression of worship as God's own child should be made.

4. Principle of expression of worship of Attendance

The service consists of four main structures: (1) 'a gathering worship' (opening worship) (2) 'a worship of listening to words' (worship of saying) (3) 'an acting worship' (response and participation worship) (4) 'a scattered worship' (decision and dispatch worship). The order of worship takes place within these four structures. In this structure, the meaning and behavior of attendance are implicated.

First, 'a gathering worship' is a ritual for worshipping God in the kingdom of God. Participating in worship in the kingdom of God, there is an order such as the origin of God's presence, gratitude and praise to God, confession of faith, prayer of a mediator and so on. Second, 'a worship of listening to words' is the worship that we attend upon God, who becomes a substantive word, and listen to the word. It is an order to receive the word of God through the preacher, who is the representative. It becomes an act of being in attendance on substantive words. Third, 'an acting worship' is a ritual that responds to God's words. The order includes praise for gratitude, dedication and so on. Finally, 'a scattered worship' is the service of dispatch and determination that God's people will go out to the world to realize God's will and deliver the words. The order corresponding to this is the praise and celebration of determination.

We can freely express worship, but we must follow some norms and principles. When expressing worship in the completed Age, there must be the following norms and principles.

First, we must follow the norms of doctrine and theology. A service containing the image and representation of attendance and norms such as theology, pneumatology, soteriology, and church theory should be expressed.

Second, we must follow the Messiah tradition. The Messiah showed us the epitome attending upon God. And "I'm the way, Truth, life and follow me" (John 14), as the saying goes, we must follow the example of worship shown by Messiah.

Third, we should follow the way of the audience's worship life. The audience not only worship officially, but also worship in daily life such as Hoon Dok Hae(a meeting to read the Word of God), a prayer meeting, bowing respectfully and so on. The worship that took place in this daily life should be sublimated into a service that the community holds together.

The service of the Completed Age is a celebration and feast in which the people of the completed kingdom of God thank God for salvation and blessing. It is not a service praying for the kingdom of God to come, but a feast of celebration in which God is attended upon in the kingdom of God. It is not to serve as a guest, but as a parent and as a sibling.

5. Conclusion

The Family Federation should create a new service based on its doctrine and theology. Of course, creation here means re-creation, which means that it must be renewed through the reform of existing worship. The core of the doctrine and theology of the family federation is the establishment of a relationship between God and humans as parents and children. Therefore, the worship of the family federation should express the worship with the implications of 'attendance'. The meaning of attendance should be implied in the order of four services: 'opening worship', 'worship of saying', 'response and participation worship' and 'decision and dispatch worship'.

The Family Federation is aiming for a Home Church. A family church refers to a large family church in which God is attended upon as a parent. The education and training of true love take place within the family church. The core of this education and training is attendance. The love of the three objects centered on God, that is, true love between parents and children and among brothers, should be based on attendance. Therefore, the content of the service of the feast where the people of the kingdom of God gathered should be attendance, and the form should

also be expressive of attendance.

A Study on Constructing a Global Ethic Oriented Universal Filial Piety through Integration of Religious Rules

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Abstract

This study intends to establish the precepts that people around the world can use as norms regardless of time and space. Modern people live in crashe and conflict between nations, races, religions, and generations. Most of these conflicts and clashes stem from differences in values and culture. Therefore, in order to resolve these conflicts and walk the path of reconciliation and unity among the people of the world, a common commandment that the people of the world can accept and abide by is necessary. In this study, the common human precepts seek to find common ones among the precepts observed by the world's mainstream religions and make them the world's common ethics. The common ethics is the idea of universal filial piety. There is filial piety in the precepts of Buddhism, Confucianism, and Christianity. This idea of filial piety goes beyond simply serving one's parents and extends to loving humanity and all things. In the doctrine and ideology of the Family Federation for World Peace and Unifiction(FFWP), the foundation and practice direction of cosmic filial piety are specifically instructed. The Family Federation's filial piety ideology is an integrated and universal filial piety ideology. In this study, based on the idea of universal filial piety of the Family Federation, I would like to suggest the establishment and practice of the ideology of universal filial piety that mankind should accept and practice.

KEYWORDS: cosmic filial piety, common ethics, precept, universal value, ethical norm

Introduction

This study is an idea to create world ethics through reinterpretation and integration of the precepts of traditional religions under the assumption that new commandments that can be applied to the situation of this era are required. The basis of this ethical composition is the cosmic filial piety thought of the three religions of Confucianism, Buddhism and Christianity and the filial piety thought based on the heart of the Family Federation for World Peace and Unification (FFWP). The world's mainstream religions have precepts that individuals and communities must abide by. Originally, this religious precept was enacted as a universal value that transcended the ethical norms to be observed by a religious order and transcended national, racial, religious, and generational boundaries. Buddhism has declared the Five Rules of Training, Confucianism has the Five Moral Disciplines, and Christianity has declared and followed the Ten Commandments. These commandments have not only led the ethical life of the community, but also become the standard of universal and global ethics and morality that the people of the world must abide by. However, since these precepts were enacted in the political, social, and cultural circumstances of the time, they should be reinterpreted and understood and applied to modern people today. The purpose of this study is to construct world ethics that the global community, one family of mankind, must abide by. I would like to present universal filial piety as a draft of the precepts to be followed in "one world under one God," which FFWPU founder Rev. Sun Myung Moon aimed for.

2. Methods - Composition and comparison of precepts of traditional religions

2-1 Structure of Buddhism, Confucianism, and Christianity

Buddhism	Confucianism	Christianity
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<p>The Three Jewels</p> <p>1) I take refuge in the Buddha</p> <p>2) I take refuge in the Dharma</p> <p>3) I take refuge in the Sangha</p>	<p>The Three bonds</p> <p>1) the bond between a king and a subject</p> <p>2) the bond between parents and children</p> <p>3) the bond between a husband and a wife</p>	<p>loyalty and devotion to God</p> <p>1) You shall have no gods except me.</p> <p>2) You shall not make yourself a carved image or any likeness of anything, You shall not bow down them or serve them.</p> <p>3) You shall not utter the name of Yahweh your God to misuse it.</p> <p>4) Remember the sabbath day and keep it holy</p>
<p>Five rules of training</p> <p>1) Refraining from taking life</p> <p>2) Taking What is not given so as to constitute theft.</p> <p>3) Sexual intercourse</p> <p>4) Lying speech</p> <p>5) Strong drink and sloth-producing drugs</p>	<p>Five Moral disciplines</p> <p>1) The human rule which has affection(or love) between a father and a son</p> <p>2) The human rule which has loyalty (or righteousness) between a king and a subject</p> <p>3) The human rule which has distinction (or discrimination) between a husband and a wife</p> <p>4) The human rule which has order between adults and children</p> <p>5) The human rule which has trust (or confidence between friend.</p>	<p>Commandment for Human</p> <p>5) Honour your father and your mother so that you may have a long life in the land that Yahweh your God has given to you.</p> <p>6) You shall not kill</p> <p>7) You shall not commit adultery.</p> <p>8) You shall not steal.</p> <p>9) You shall not bear false witness against your neighbour.</p> <p>10) You shall not covet your neighbour's house You shall not covet your neighbour's wife, or his servant, man or woman or his ox, or his donkey or anything that is his.</p>

2-2 Agreement between Buddhism, Confucianism, and Christian precepts

Buddhism	Confucianism	Christianity
1. do not kill	1. benevolence	1. do not kill
2. do not steal	2. righteousness	8. do not steal
3. other than marriage do not have sex	3. courtesy	4. do not commit adultery
4. do not lie	4. wisdom	9. You shall not bear false witness against your neighbor

3. Results

3-1 Cosmic filial piety as the foundation of world ethics

1) Buddhism's cosmic filial piety

It is often misunderstood that Buddhism emphasizes individual practice and does not emphasize the importance of the family. However, the Buddha never neglected the family and taught his disciples the importance of the family. In *Dīgha Nikāya*, the *Siṅgalakovadasutta*, the son of the firstborn son of a ratifier is told to observe six things: ① Serve your parents ② Do your duty to your parents ③ Tradition of the family ④ Successfully pass on the inheritance ⑤ After their parents died, they were asked to make an offering for them.

Buddhism aims for great filial piety. Not only the filial piety of the present one world, but also the past, present, and future three generations, one step further and expanded to the category of six paths. In Buddhism, it is said that filial piety to one's parents in this world is to be filial to one's parents in previous and subsequent lives. Also, being filial to one's neighbors and all sentient beings is to be filial to one's parents. This is because they may have been my parents during the process of reincarnation.

Buddhism transcends time and space and says to have compassion for sentient beings. This compassion is the higher concept of filial piety. Therefore, the filial piety of Buddhism can be said to be a cosmic filial piety.

2) Cosmic filial piety of Confucianism

The central thought of Confucius, the founder of Confucianism, is benevolence (仁), and the root of benevolence is filial piety. Yin is a superordinate concept of filial piety. Filial piety based on benevolence is true filial piety. Benevolence (仁) is the way to love all mankind. And the source of this love is filial piety, and when filial piety is practiced based on human beings, it becomes cosmic filial piety.

Confucius said that among the 3,000 kinds of punishment inflicted on human beings who committed sins, disobedience was the greatest sin. If you are filial to your parents, other commandments are automatically followed, so Mencius said that if you practice filial piety, the world will be peaceful. Filial piety is not limited to simply serving parents well, but filial piety to serve parents includes loving humanity and the world.

Therefore, the idea of filial piety in Confucianism should be understood from the original emotion of preserving life, it is an expression of gratitude to the parents who gave birth to me, and it is a great way that harmonizes the family, stabilizes the country, and connects me to the world. and is a great filial piety. The concepts of great virtue and great filial piety are included in the concept of cosmic filial piety.

3) Cosmic filial piety of Christianity

Ten to four commandments are commandments to be filial to God, and commandments 5 to 10 are commandments to be filial to one's physical parents. In Christianity, the relationship between God and human beings is viewed as a father-son relationship. I call God the Creator "Father," and I also call the person who gave birth to me "Father." Therefore, filial piety in Christianity includes two concepts: filial piety to God and parents. Also, do not separate these two effects. Those who are filial to God are also filial to their parents, and those who are filial to their parents are also filial to God.

Christian filial piety sees that loving God is loving mankind, and loving mankind is loving God. Apostle Paul said that being filial to your parents who gave birth to you is the first commandment to keep in your promise to

God (Ephesians 6:1-4). Jesus said that being filial to God is the first commandment and loving your parents is the second commandment. (Matthew 22:37-39). Combining the first and second commandments becomes cosmic filial piety.

3-2 Family Federation's idea of universal filial piety

1) Heart as a transcendental form of filial piety

The form(Hyeongsang) of the concept of filial piety contains heart. This is because filial piety toward parents is induced in the heart, which is the 'emotional urge to be happy through love'. Heart is a priori before the concept of filial piety is formed. In other words, as a human nature inherent in human beings before human awareness, the urge to be happy to love is inherent. Therefore, heart becomes a factor that triggers filial piety. The feeling of filial piety cannot be evoked unless the heart is triggered. Feelings of filial piety arise and practice filial piety. Cosmic filial piety is love that connects not only love for parents but also love for others and nature through the triggering of heart.

2) Three Great Blessing Ideology and Filial Piety

Since Unification Thought views the relationship between God and human beings as that of parents and children, the source of filial piety comes from faith in God. The idea of filial piety in the Family Federation is based on the three great blessings of the 「Principle of Creation」. The three great blessings are the three blessings that God created and bestowed on human beings. That is, the perfected individual, the perfected family, and the perfected subjectivity (Dominion of things).

The completion of the three great blessings is the completion of the three great relationships. The first blessing, the perfection of individuality, refers to the relationship between God and human beings, the second blessing, the perfection of family, the relationship between humans, and the third blessing, the perfection of subjectivity, refers to the relationship between humans and all things. These relative relationships are the relationships between the subject and the object, which imply ethics and responsibility for human perfection. The relationship between the subject and the object is not a relationship of rank or hierarchy, but a relationship of exchanging love and beauty, which basically contains the idea of filial piety.

Since human beings were born with heart as their nature a priori, they have the urge to love and please others. Filial piety is the practice of the relationship between parents and children that has been established through the triggering of heart. The perfection of individuality is when God and human beings become a father-son relationship of one heart. If human beings become one in heart and mind with God, they become one with God's will, one heart and one mind. The filial piety thought evoked from the heart includes and transcends all precepts.

Perfection of a family means perfecting God-centered three-object love: parental love, conjugal love, and sibling love. This three-object love is a relationship established through the relationship of heart. Because the world of family perfection is a society connected by heart, it becomes a society that does not require commandments. Jesus said, "Love is the fulfillment of the law (Romans 13:10). Similarly, universal filial piety based on heart encompasses and completes all precepts.

Discussions, Conclusion and Further Study

1) World ethics draft

The Universal Ethical Principles, edited by Minuel Angel Cano Jimenez, presents the requirements that constitute the new ethics as follows:

Characteristics of the universal ethical principle

- 1) They are the most reasonable, simple and accordance with common sense
- 2) They explain the greater number of phenomena and problems.
- 3) They are not dogmatic or irrational.
- 4) They are compatible with the current knowledge of science, without having to accept all its unfounded dogmas
- 5) They bring together the most universal of all cultural tradition.
- 6) They inclusive and conciliators
- 7) They build bridges between the ancient religious and philosophical traditions and the modern Enlightened and scientific traditions.
- 8) They serve to mediate between the liberal, and defender of individual rights,

Western tradition, and the communitarian, and defender of social order,
Eastern tradition.

9) They also serve to offer practical solutions to current moral and ethical problems

2) Cosmic filial piety thought and practice as a draft of world ethics

As above, the cosmic filial piety based on heart becomes the foundation of the composition of ethics in the world. In this study, it was explored that all religions have filial piety and that filial piety is a universal view of filial piety. In other words, filial piety should not simply serve one's parents, but should aim for cosmic filial piety to love God, mankind, and all things.

Human beings have a sense of filial piety can practice filial piety because humans have transcendental feelings. Since human beings have heart a priori, the will of benevolence, mercy, and love is triggered. With the triggering of this will, cosmic filial piety consciousness and practice can be achieved. The conclusion of this thesis is to suggest that the practice of cosmic filial piety should be the cornerstone of a new earth ethics.

Conclusion

To establish a draft of world ethics based on the idea of universal filial piety, first, the heart should be a virtue derived from transcendental nature, that is, the idea of universal filial piety based on benevolence, mercy, and love. Second, it must be a commandment that is applied in the commandments of Confucianism, Buddhism, and Zen religions. Third, it should be universally applied to the thinking and culture of modern people. The idea and practice of cosmic filial piety that meets these requirements will be the ethical foundation that can lead to world peace and happiness.

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A Theological Paradigm Shift Centering the Proclamation of the Only Begotten Daughter

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Abstract

A 'paradigm shift,' firstly introduced by Thomas Kuhn in 1962, is a widely known concept that when a leading scientific paradigm (normal science) is no longer able to explain new phenomena, a new paradigm arises to replace the old perspective. Theology also experiences a similar shift. Since any theology develops in communication with the spirit of the age, culture, and ultimate concerns in life, theology continuously changes as the times change, and especially when revelation as the source of theology is newly given or a new way of interpreting it is risen, theology goes through a big change that might well be called a theological paradigm shift. 'The Holy Community of Heavenly Parent' (otherwise known as the Unification Church) has been experiencing huge changes. The founder Rev. Dr. Sun Myung Moon passed away in 2012 and the co-founder and his wife Dr. Hak-Ja Han Moon has recently led the entire community. Before Rev. Moon passed on, Unification theology had mainly been formed by his words, but ever since the co-founder Dr. Han's words have been highlighted as the new revelation for theology. This means not only that the revelation as the source of the Unification theology is newly given, but also that a theological context that influences ways of interpreting the words is changing from 'the only begotten son' centeredness to 'the only begotten daughter' centeredness. Dr. Han's proclaiming herself to be the only begotten daughter acted importantly in this process. This paper aims to grasp a theological paradigm shift centered on the proclamation of the only begotten daughter and to reveal its meanings. By analyzing some differences between the only begotten son-centered theology to the only begotten daughter-centered theology, this paper tries to provide a complementary point of view to understand where and how the Unification theology evolves.

Dummy metal considering the quality factor of the inductor in CMOS semiconductor

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Abstract

Adding dummy metal is essential to secure a stable process for semiconductors. However, the dummy metal affects the RF characteristics so that the required characteristics are not obtained, so a design to prepare for them is required. In particular, the dummy metal around the inductor that determines the RF characteristics is a factor that prevents the characteristics of devices using the inductor. This paper aims to present a stable dummy metal implementation around an inductor that is essential by examining the characteristics of the inductor by analyzing the change of inductance due to the leakage current and parasitic capacity influencing the dummy metal structure. If the previous studies focused on the layer below the layer where the inductor is implemented, this paper analyzed and presented the dummy metal structure around the inductor. In the analysis, it was judged based on the inductance and quality-factor values of the inductor.

KEYWORDS: High Q, Inductor, dummy metal, loss, semiconductor, parasitic component, fabrication

1. Introduction

In the future mobility market, autonomous driving technology is being intensively developed due to the transition from internal combustion vehicles to electric vehicles, and high-performance and autonomous driving systems should be advanced by developing automotive semiconductors, which are key technologies for autonomous driving. The electronic device for determining the semiconductor characteristics is defined by the HighQ characteristics. Among them, an inductor is the device that has the greatest influence. It was also necessary to develop an inductor that performs a High Q operation that can maximize the efficiency of RF and Radar in automobile semiconductors. In addition, the application of dummy metals in semiconductor processes is an essential process. When dummy metal is not applied, semiconductor bending occurs, so there should be no empty metal in each layer of semiconductor. Dummy metal is being forcibly added to secure a stable process when designing semiconductors. However, since dummy metals affect RF characteristics and do not obtain the required characteristics, a design to prepare for them is required. In particular, the dummy metal around the inductor that determines the RF characteristics is a factor that prevents the characteristics of elements using the inductor. The inductance of the inductor, which has the greatest influence on the characteristics of VCO, is changed, and in particular, the High Q characteristics are degraded, and phase noise of the VCO characteristics is degraded. In order to solve this problem, research was conducted to analyze the dummy metal structure that can secure the stable process of semiconductors and derive the highQ characteristics of inductors. Research on the high Q characteristics of existing inductors has been conducted on how the pattern of the inductor affects the inductor characteristics, or there has been a study to analyze the Q coefficient according to this pattern. By calculating and analyzing the signal loss due to the resistance characteristics and eddy current loss of the inductor, we present a method that can significantly improve the Q coefficient by line width adjustment to the spiral inductor that performs the High Q characteristic action [1-2]. In addition, a method of reducing parasitic capacity after analyzing the Q coefficient by analyzing the optimal size of the inductor in the RF circuit was proposed. And with the application of differential evolution algorithms, the inductor size with maximum Q value at magnetic resonance frequency was adjusted [3-5]. Design analysis and research were conducted through the process of adjusting the loss of ohmic and board to achieve optimization of spiral inductors in silicon. When the inductor

was designed on a low-loss substrate, the optimized inductor obtained up to 60% improved Q values compared to the non-optimized inductor. In addition, the application of dummy metal, which is essential for semiconductor design, is pointed out as a factor that degrades the characteristics of the inductor [6-7]. To solve this problem, the Q value was the best when the dummy metal of each metal layer was not used, and the Q value was deteriorated when the dummy metal was used [8-9]. In this paper, we studied the characteristics of the inductor with high Q behavior and the dummy metal structure that can minimize semiconductor bending.

2. Statement of Contribution/Experimental/Methods

An inductor is a coil that induces a magnetic field in proportion to the amount of change in current. The inductor also serves to suppress the current when it starts to flow in the circuit. Due to these characteristics, the capacitor and the resonant frequency are formed and the characteristics of the VCO and the electronic device are determined. In addition, the characteristics of the electronic device using the inductor are determined by the high Q characteristics of the inductor. The inductance L may be expressed by Equation (1), and the Q value may be obtained by equation (2).

$$L = 1/(\text{imag}(Y(1,1)))/(2 * \pi * \text{Freq}) \tag{1}$$

$$Q = \text{imag}(Y(1,1))/\text{real}(Y(1,1)) \tag{2}$$

Q formula image(Y1, 1) is an image component of an input admittance, pi means about 3.14, and Freq means frequency. Real(Y(1,1) refers to a Real component of an input admittance. The inductance value of the inductor is a value affected by the parasitic component capacitance created by the surrounding environment. And real (Y(1, 1) is a component corresponding to loss and is a value obtained by being marked as Conductant. Therefore, to improve the Q value, it is obtained by maximizing the image (Y(1,1) value while minimizing the parasitic component capacitance, or by minimizing the loss and minimizing the real (Y(1,1) value. In this paper, based on the dummy metal structure, a dummy metal structure having a high-Q inductor structure was presented by investigating the ratio of the parasitic component capacitance of the inductor and the loss ratio. This paper aims to obtain the HighQ characteristics by presenting the characteristics of the inductor performing the HighQ operation and the dummy metal structure capable of minimizing the semiconductor bending phenomenon.

2.1 Simulation

Figure 1 shows a cross-sectional view of a semiconductor. M6 (Metal 6-layer) refers to the top metal of a semiconductor, and in order to minimize the loss of the inductor, a 2.7um thick metal is usually produced and implemented. M5 (Metal 5 layer) and GND Metal were 0.5 um. M2 (Metal 2 layer) was used as GND Metal, and M3, 4, and 5 studied the dummy metal structure of M5 because the dummy metal of M5 serves as a Dominant.

Fig. 1. Semiconductor Cross Section View



Figure 2 shows the inductor structure implemented in the top metal. Depending on the structure of the dummy metal, High Q characteristics should be prevented from bending of the semiconductor. When adding dummy metal, the semiconductor dummy metal space rule is 5um, and based on this, the M6 and M5 line widths and line widths of the inductors are 5um. In this way, a dummy metal pattern structure that must be added in the structure in which the inductor is implemented was researched.

Fig. 2. Inductor Structure for Top Metal



The characteristics of dummy metal were compared as follows by presenting six structures. The optimal dummy metal pattern structure for performing the High Q operation was analyzed. Figure 3 is a diagram showing six dummy metal pattern structures.

Fig. 3. Various Structure of Dummy Metal

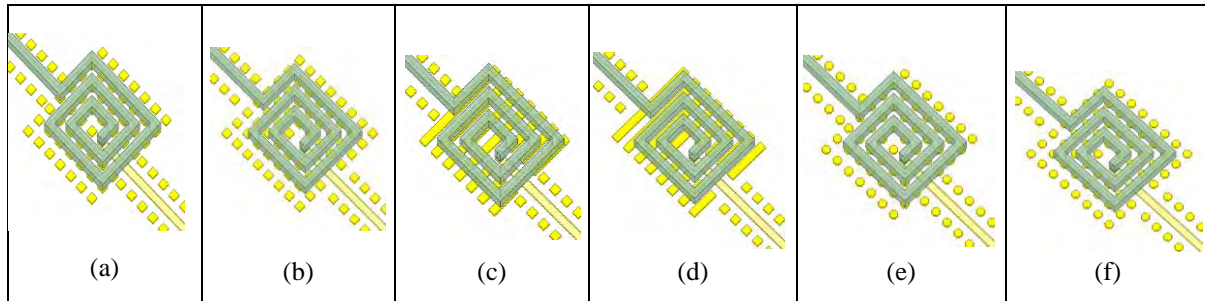


Figure 3 (a) shows that Rect. Pattern Dummy Under Inductor Line applied a square dummy to M5 below the inductor. (b) Rect. Pattern Dummy Under Inductor Space applied a square dummy to a space corresponding to the line width of the inductor. (c) The Line Pattern Dummy Under Inductor Line was placed under the M5 under the inductor of the M5 layer by applying a long vertical rectangular pile. (d) Line Pattern Dummy Under Inductor Space was applied to the space between the inductors of the M5 layer by applying a long pile of vertically rectangular shapes (e). Cross Pattern Dummy Under Inductor Line was applied to the M5 portion under the inductor of the M5 layer by applying a cross-shaped dummy. (f) Cross Pattern Dummy Under Inductor Space was applied to the space between the inductors of the M5 layer by applying a cross-shaped pile. In this structure, the results of return loss, insertion loss, L, and Q are shown in Table 1, and the results of the High Q characteristics are summarized.

Table 1. Result of the Research In Various Dummy Metal Structures.

Parameters		Inductor Without Dummy	Rect. Pattern Dummy Under Inductor Line	Rect. Pattern Dummy Under Inductor Space	Line Pattern Dummy Under Inductor Line	Line Pattern Dummy Under Inductor Space	Cross Pattern Dummy Under Inductor Line	Cross Pattern Dummy Under Inductor Space
Items	Unit							
Return loss	dB	-18.5	-16.8	-17.1	-18.5	-19.1	-16.4	-16.5
Insertion loss	dB	-0.51	-0.54	-0.53	-0.56	-0.56	-0.54	-0.53
	deterioration		4.4%	3.6%	8.8%	9.2%	4.2%	3.1%
L	nH	0.41	0.473	0.474	0.475	0.471	0.475	0.475
	increase		13.6%	13.8%	14.1%	13.1%	14.1%	14%
Q	Abs	5.5	7.1	7.0	6.1	5.9	7.323	7.355
		0%	28.8%	26.6%	10.5%	7.5%	32.3%	32.6%

Through this study, it was possible to secure an excellent improvement effect up to 32.6% by changing the structure of putting dummy metal. On the other hand, induction, which has become smaller due to dummy metal, requires a structure to be reinforced to secure an induction value required for design. Through this study, the optimal dummy metal structure that must be applied in semiconductors was secured.

Table 2. comparison with other research results

ref	[1]	[8]	[9]	This work
Structures	Improved line width structure	Dummy restructuring	Dummy restructuring	Dummy restructuring
Percentage of improvement of Q	35.5%	-20%	-20%	32.6%

It was compared with the inductor structure of other papers. [1] This paper obtained Q values by adjusting the line width, and [8] and [9] present a dummy structure that improves the prevention of bending phenomenon of semiconductors by adding dummy metal, and present the inductor with the best Q value. [1] In this paper, the inductor with variable line width increased by 35.5% Q value while hardly damaging the inductance. [8] This paper is a study to obtain capacitance components and high Q values to less affect the high frequency characteristics of the inductor, and defines the spacing of dummy metals and changes the dummy structure. The Q value has been reduced by -20%. [9] This paper presented a dummy metal structure to obtain stability in a semiconductor manufacturing process and applied a structure to obtain stability in a semiconductor process. This paper presents the research results of obtaining a Q value of -20%. In this study, it was possible to improve the value of 32.3% Q by placing the dummy metal structure with less signal loss by best solving the parasitic component according to the arrangement and shape of the dummy metal structure.

3. Results, Discussions, and Conclusion

Through this study, the optimal dummy metal structure that must be applied in semiconductors was secured. It was found that each structure of the dummy meta affects the high-Q characteristics of the inductor. Unlike other structures, the Cross Pattern Dummy Under Inductor Space structure has been confirmed to have a significantly low Insertion loss, and the results that can lead to the action of high-Q have been secured with low loss. Therefore, it was found that by applying the dummy metal Cross Pattern Dummy Under Inductor Space structure in a semiconductor, it was possible to improve the electronic device characteristics of the inductor along with 32.6% high Q improvement of the inductor. Through the study on the addition of dummy metal, this study supports a reliability process without bending of a wafer in the process, and at the same time, the characteristics of the inductor can be improved. The result of improving the Q value was ensured despite the application of the dummy metal by minimizing the loss compared to other papers. Other papers [1] are high-Q improvements without considering dummy metals, and applying our findings will improve the Q value of 67%.

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Establishment of self-driving laws and ethical standards at self-driving level-3

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Abstract

With the rapid development of self-driving of electric vehicles, it is showing limitations in legal systems and ethical standards as well as limitations in technologies that limit the development of self-driving technology.

This paper presents the level and limitations of self-driving technology on the basis of defining international classification standards for autonomous vehicles, examines laws and insurance systems in advanced countries along with ongoing self-driving technology, and compares papers in domestic legal systems.

Based on this, the responsibility of manufacturers and drivers considering the current technical limitations, legal system limitations, and ethical ambiguity, the direction of traffic culture development is presented by establishing a cooperative relationship between drivers and automated driving systems (ADS) level-3 at the current.

KEYWORDS: Automated Driving Systems (ADS), Self-driving level-3, Ethics standard, law, responsibility, traffic culture

1. Introduction

According to the Ministry of Trade, Industry and Energy's January 15, 2021 [1], South Korea will launch a new project of 1.1 trillion won worth of "autonomous driving technology development innovation project" to take the lead in autonomous driving, and aims to complete the commercialization base of Converged Level 4 autonomous vehicles 2) by 2027 [2].

As the definition of self-driving cars was revised in Article 2, No. 1 of the Automobile Management Act on October 8, 2020, the self-driving system was defined as automation equipment, software, and related devices that can operate automobiles by recognizing surroundings and road information without driver or passenger manipulation.

In order to go from Level 2 to Level 3 self-driving cars, which are conditional self-driving cars, to Level 4, self-driving cars should be established to define users, manufacturers, designers, service providers, etc. responsible for accidents. It is difficult to define the criteria for judgment by relevant laws, rules, or advance because various trolley dilemma situations such as "the few who obey the law or the many who violate the law" occur when an accident cannot be avoided while driving a self-driving car. However, the ethics guidelines apply to self-driving cars that are at the level of technology that drivers do not intervene in driving under certain conditions or do not intervene in all situations, which corresponds to driving situations in three or more levels of self-driving systems.

ADS needs to be fully prepared for situations in which control should be transferred to the user and legally stipulated that ADS should be able to respond to signals that inform the user of the crisis. In the event of an accident, the ADS needs to be kept, identified, and documented several times.

In the end, there is a cultural conflict between driver-centered road culture and future self-driving system-centered road culture, and until more than four stages of self-driving technology are commercialized, the era of safe and socially acceptable self-driving cars can come.

2. Laws and Ethics at the level 3 Self-driving

International classification standards for autonomous vehicles follow the classification system according to the level of autonomous vehicles in 2014 by the Society of Automotive Engineers (SAE), and other countries such as Korea follow it. It is defined as fig. 1.

Fig. 1. Semiconductor Cross Section View

레벨 구분	운전자 보조 기능			자율주행 기능		
	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
명칭	無 자율주행	운전자 지원	부분 자동화	조건부 자동화	고도 자동화	완전 자동화
운전주수	항시 필수	항시 필수	항시 필수	시스템 요청시	작동구간 내 불필요	전 구간 불필요
자동화 구간	-	특정구간	특정구간	특정구간	특정구간	전 구간
예시	사각지대 경고	차선유지 또는 크루즈 기능	차선유지 및 크루즈 기능	혼잡구간 주행지원 시스템	지역(Local) 무인택시	운전자 없는 완전자율주행

Level 2 is the level of utilization of its own built-in functions, such as lane keeping and cruises, when necessary, while performing the Dynamic Driving Task (DDT) consistently. It represents a partially automated "driver's assistant" from Level 0 to Level 2.

Level 3 automates the driver's "responsibility to minimize the risk" through DDT fallback during dynamic driving when the driver allows DDT of the system without having to take off the steering wheel, at an unexpected point, or at an unexpected accident.

In Level 4, the system performs DDT instead of the driver in Operational design Domain (ODD), the driver does not have to hold the steering wheel while driving, does not have to look forward, and the system is responsible for minimizing the risk of DDT fallback. It is an 'advanced automation ADS' that the driver only needs to restore control if it is out of ODD.

Level 5 is called "Full Automation ADS", which does not have ODD itself in the system, does not require passengers to look forward and hold handles, and the system also bears the responsibility of "risk minimization operation" through DDT and DDT Fallback for all operations.

In 2022, Volume 21 of the Korea Police Research, Comparative Law Review of Road Traffic Laws, it is difficult to secure traffic safety due to insufficient regulations on the obligations and responsibilities of autonomous vehicle drivers, and police officials are expected to have difficulties in law enforcement.

1. Absence of obligation to check whether the conditions of use of the autonomous driving system are met before operation
2. Absence of obligation to install and verify normal operation of the autonomous driving information recording device
3. Absence of obligation to store and submit driving records (data)

Although ADS will operate autonomous driving safely within the ODD, ADS will not be able to perform the designed functions if the user manages the vehicle and system to ensure that the ADS does not meet the conditions under which it can operate.

In 2022 Dongguk University's the east-west thought research, Level 3 self-driving cars have special situations that do not occur in other stages of self-driving cars, ADSs exchange control with each other, and safe control is always a technical problem to implement driver safety. It suggests that the focus should be said.

3. Results

It can be seen that Korea has already completed the Level 3 self-driving vehicle safety standards ('19.12) and insurance systems ('20.4). However, self-driving in three stages is not a perfect self-driving technology, but a technology with limitations. In addition to the limitations of the current technology, it is necessary to prepare a legal system that should be equipped at the current level of three levels of autonomous driving based on the responsibility of manufacturers and drivers considering the limitations of the legal system and ethical ambiguity. In addition, regulations on the 'duty and responsibility' of self-driving car drivers are very insufficient.

First of all, there is no obligation to check whether the conditions of use of the autonomous driving system are met before driving, and there is no obligation to install and verify normal operation of the autonomous driving information recording device, and to prohibit forgery and tampering. In addition, there is no obligation to store and submit operation records (data) in the event of an accident. This needs to be supplemented. Based on this, it is necessary to establish a transportation culture by establishing a cooperative relationship between drivers and autonomous driving systems, and the laws and insurance systems should be continuously changed along with the development of autonomous driving technology, and the ethical consciousness of drivers should be dealt with.

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Technology Cooperation Strategies in Future Automobile Field Based on Industrial Structure and University System in North Korea

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Abstract

Due to the influence of climate change, automobile technologies around the world are rapidly changing around autonomous driving technologies for electric vehicles. It analyzes the current level of automobile technology, predicts future automobiles to be developed, and presents the required R&D directions while deriving necessary technologies. In this global technology direction environment, North Korea wants to analyze North Korea's overall industrial structure, examine the level of automotive technology recognized as a key industry, and examine the proportion and impact of the automobile industry in the entire industry. It also analyzes North Korea's university system and research level in the automobile industry. In conclusion, I would like to present a win-win inter-Korean exchange and cooperation plan in the automobile field, and in particular, I would like to examine the meaning of exchanges between universities in the two Koreas.

KEYWORDS: Industry, Automotive technologies, Autonomous driving, University, College, Cooperation, Strategies

1. Introduction

It has been the general concept of inter-Korean cooperation in Korea that inter-Korean cooperation is needed due to the use of South Korea's capital and superior technology, North Korea's cheap labor, and abundant resources. However, from North Korea's point of view, it is a conventional wisdom that hurts North Korea's pride, and it is recognized as making inter-Korean cooperation more difficult as it gave the North an excuse to walk its own path under the guidelines for self-reliance. There is a need for a new win-win inter-Korean cooperation plan. To this end, while looking at North Korea's industrial structure, I would like to analyze the technology level of each industry, analyze its characteristics in meaningful industrial fields, and seek a cooperative model in the future direction. In particular, it is important to derive a win-win cooperation plan between the two Koreas considering the manpower training environment in terms of analyzing North Korea's research form and university education in terms of future technology based on the knowledge industry. However, due to the limitations of the division of the two Koreas, there is still a limit to drawing conclusions based on limited data on North Korea.

2. Industrial Structure and Human Resources Development Structure in North Korea

The cooperative model needs to be created based on the current status of North Korea's industrial structure and technology level. First, we looked at the industrial structure of North Korea, the current status of energy production, the level of automobile technology recognized as the worst industrial structure, and the growing future knowledge industry IT field. In addition, we would like to explore ways to cooperate between the two Koreas by examining the form of technological research and the status of education in North Korea.

2.1 North Korea's Industrial Structure

While South Korea recorded negative growth due to the COVID-19 crisis in 2020, North Korea has maintained its GDP level in 1990 due to continuous international sanctions against North Korea, and has continued to grow negative except for a weak 0.4% growth in 2019 [1]. Table 1 shows the industrial structure of the two Koreas in 2019 and 2020.

Table 1. Industrial Structure of South and North Korea 2019-2020 [2]

Classification	North Korea [%]		South Korea [%]	
	2019	2020	2019	2020
agriculture, forestry, and fisheries	21.2	22.4	1.8	2.0
mining industry	29.6	28.1	27.7	27.2
electricity and gas water industry	5.4	5.6	2.1	2.4
the construction industry	9.7	10.0	5.9	5.9

Service industry	34.1	33.8	62.5	62.4
Total	100	100	100	100

As can be seen in Table 1, until recently, North Korea has constituted an industry centered on agriculture, forestry, and fisheries, and South Korea has formed an industry centered on the service industry. And in the rest of the field, the industrial structure is generally formed at a similar rate.

In terms of energy production essential for industrial activities, South Korea generates 23 times more electricity than North Korea as of 2020, while South Korea obtains energy in the order of thermal power, nuclear power, renewable and hydroelectric power, while North Korea obtains energy in the order of hydro and thermal power plants [3]. Due to frequent power outages caused by insufficient new facilities and aging, North Korea has batteries and transformers in 80 to 90 percent of homes and uses electricity only for a certain period of time.

The worst industrial technology in North Korea produces 4,000 cars (4 million cars in South Korea) a year in Pyeonghwa Motors, Cheongpung Motors, and Cheongjin Commercial Vehicles. Production is known to be produced by Pyeonghwa Motors, which was established with the Unification Group of Korea as a joint venture between the two Koreas, and the technical level is evaluated as that of Korea in the 1970s. There is no electric vehicle or autonomous driving technology, or the technology level is in its early stages, and it is applied only to high-end vehicles as it was in South Korea in 2000. Since the 2000s, 90% of electronic devices have been highly dependent on China due to imports and technical support from China. Recently, from 2021, efforts have been made to secure technology while promoting the localization of core electronic devices. Table 2 summarizes North Korea's ICT technology.

Table 2. ICT Technology in North Korea

Classification		North Korea's Technology [4-5]	Descriptions
Smartphone users		7 million (as of 2019)	28% for mobile phone subscribers and 46% for fixed-line subscribers
mobile technology		3G	
a mobile carrier		Service by 3 telecommunication companies (Koryolink (Egypt joint venture), Kang Sung Net, and Star (Thailand joint venture))	
Smartphone technology	manufacturing technology	Import and sell old models of Chinese manufacturing companies in the form of finished products and parts	
	latest phone Spec	Azalea (Android OS, released in February 2020)	Samsung Galaxy A7 (low-end launch in September 2018) level
	SW technology	Operating system (OS), application (app), security, AI, etc. are self-developed	Only authorized apps available
artificial intelligence technology		AI speaker (voice recognition – Daedong-Gang), Facial recognition technology, Development of seven language translation programs [5]	Azalea Smartphone Equipped with AI and Voice Recognition [6-7]
Characteristics		Only some Wi-Fi networks can be connected	Various security and control functions to prevent access are installed on the smartphone itself [2][8]

The level of smartphone technology represented by ICT technology seems to be in the late 2010s in South Korea, and security and control functions are included to make limited use, and artificial intelligence technology is equivalent to South Korea. In terms of technology level of the North Korean industry compared to Korea, the machinery and electronic devices are at the level of the early 1990s, the IT level is in the mid-1980s, and the shipbuilding and automobile sectors are at the level of the early 1970s. On the other hand, the software sector is at the level of the late 2010s [2]. It shows the worst technology level in the shipbuilding and automobile sectors, which are recognized as national key industries. On the other hand, in the field of machine-based missiles, it has shown through recent missile launches that it has high-quality technology.

2.2 R&D and Human Resources Development in North Korea

North Korea's industrial type has an industrial structure centered on agriculture, forestry and fisheries, and the energy-based industry is poor. In particular, the technology level is much lower than that of Korea in the automobile and shipbuilding sectors, and efforts are being made to secure technology centered on IT. In particular, in the software sector, it is equivalent to Korea's technology level, and in certain areas, such as missile technology, there are areas that have an edge over Korea. Recently, North Korea has been focusing on fostering science and technology personnel. Next, we will look at the technology research form and the status of professional manpower training in North Korea. Table 3 summarizes international academic activities and research institutes in North Korea through Scopus papers published by North Korea until 2016, which informs the form of R&D in North Korea [9]. As for the annual status of North Korea's solo papers and international cooperation papers, it accounts

for 11.3% of solo papers and 88.71% of international cooperation papers, and the number of independent papers in North Korea is increasing. Among the papers on international cooperation, China and Germany account for 95.3% of the total 487 articles. In addition, Kim Il-sung University, Kim Chaek University of Technology, the National Academy of Sciences, Science University, and Pyongyang Machinery University are more than 90% of the total papers, and research and development is concentrated in specific institutions. Table 3 compares the university education system that trains North Korean professionals with the Korean education system.

Table 3. North Korea's University Education System

Classification	North Korea	South Korea	Etc
Educational system	a college, military college, vocational school	Universities, colleges (graduate colleges, industrial colleges, polytechnics), special universities (military, police colleges)	Since North Korea is centered on colleges and consists of less than 10% of humanities and social studies colleges, it is operated mainly by science and engineering. There is a concern that there is a shortage of humanities literacy talents.
The number of Univ. & colleges	more than 270	more than 440	
Majority forms of university	College of Science and Engineering	University	
University	Five (Kim Il-sung Univ., Kim Chaek Industrial Univ., Pyongyang Architecture Univ., Korea Sungkyunkwan Univ., and Kim Won-kyun Music Univ.)	more than 408	
a co-existence college of humanities and science and engineering	Kim Il Sung University	more than 400	

The R&D environment is a barrier to technological innovation in North Korea, but North Korea's higher education focuses on producing science and engineering professionals.

3. Results, Discussions, and Conclusions

North Korea has an industrial structure base centered on agriculture and forestry, and its technology level is inferior to that of South Korea throughout the industry. In particular, automobile technology, road infrastructure, and power energy supply are at the level of Korea's 1970s. However, it trains professionals through the education system of science and engineering colleges, and the missile and software fields are at the same level or higher than those of Korea. Recently, the automobile sector is changing from internal combustion vehicles to electric vehicle autonomous driving technology due to environmental climate change. Future cars are being reorganized around venture companies such as Tesla, opportunities are opening up for creative talent, and technologies in the machinery and software sectors where North Korea is competitive are becoming important.

In the 1990s, mobile communication technology became important, and as China intensively invested in mobile communication technology when communication technology was reorganized from wired communication to wireless communication, China's underdeveloped communication technology now has the world's No. 1 technology. The exchange of student technology between Sunmoon University's Future Automotive Engineering Department, established by the Unification Group, which established Pyeonghwa Motor Company in North Korea, and Kim Il Sung University's Electronics/Information and Dynamics Department could be a good opportunity for the development of future electric and autonomous driving technologies. If IT and semiconductor technologies of young Koreans and mechanical and software technologies of young North Koreans combine to open competitive future automobile technologies in the technology sector that has no ideological barriers, it can develop to a global level in the nation's key industrial sector. Moreover, the Republic of Korea can be a medium for promoting hopeful unification through a win-win cooperation system for young people from the two Koreas in the field of technology.

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A systematic study to unravel the potential of Antarctic *Burkholderia* sp. for pesticide biodegradation: Characterization and genome analysis

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An industrial revolution and urbanization era have led to the global environment being poisoned by xenobiotics in complex mixtures. These substances include chemical pesticides, belonging to category of chemicals used globally as herbicide, insecticide, fungicides, rodenticides, molluscicides, nematicides, and plant growth regulators. Positive aspects of pesticide application include the enhanced crop productivity. However, indiscriminate, and unregulated application can cause adverse effects to ecosystem and all life forms including humans. Many of them are toxic and carcinogenic to mammals also affecting the nervous system, respiratory system, reproductive system, immune system and so on. Moreover, their recalcitrant nature makes them extremely difficult to eradicate them from the environment. Currently, microbes mediated biodegradation and detoxification are promising approaches for recalcitrant waste removal. Antarctica, perceived as the last pristine place is also not free from environmental pollutants. Such, evidence have attracted scientific community in monitoring the polar ecosystem for pollutant biodegradation by microbial communities. In this study, lichen-associated bacteria isolated from the Antarctic region has been characterized focusing on biodegradation using *Burkholderia* species. The degradation products of pesticide were identified by HPLC-MS/MS. Genomic analysis of genes encoding for pesticide degradation identified using various bioinformatics tools. The results indicate that *Burkholderia* sp. are promising bacteria resource for biodegradation or detoxification of pesticide residues in the environment.

Machine Learning-Mediated Optimization of culture conditions for discovering promising biosurfactants from Antarctic *Streptomyces* sp.

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Synthetic surfactants destroy aquatic microbial populations and other aquatic life, such as fish, and reduce plant viability in addition to adversely affect the treatment of wastewater. Considering that global usage of surfactants are over 15 million tons annually, alternatives with less adverse environmental effects are urgently needed. Biosurfactants are expected to be used in a sustainable society due to their advantages of low toxicity and high biodegradability compared to synthetic surfactants. In order to explore potential biosurfactants, cold-adapted microorganisms have recently been proposed as promising producers of biosurfactants due to their extreme survival conditions. In this study, we report the successful extraction of a biosurfactant from Antarctic *Streptomyces* sp. PAMC26508. A large-scale fermentation of *Streptomyces* sp. PAMC26508 followed bioassay-guided chromatographic separation, which resulted in the isolation of a biosurfactant. Furthermore, culture conditions were optimized to increase the production of this compound, and machine learning were applied to reduce time and cost. As a result, optimal temperature, fermentation time, and media composition were obtained. These results suggest the potential of Antarctic *Streptomyces* sp. PAMC26508 as a biosurfactant producer and its application in environmental conservation. Additionally, the importance of improving experimental efficiency through machine learning was also demonstrated.

Complete Genome Sequencing and Comparative Genome Analysis of Polar *Mesorhizobium* sp. PAMC28654 to Gain Insight into Heavy Metals Resistance and Potentiality for Bioremediation

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Heavy metals contamination and health risk issues have been raised as one of the global environmental concerns. Bacteria, having heavy metals resistant gene and having potential for bioremediation have been reported and studied mostly near point source areas such as mining, foundries and smelters. However, bacteria that grow at low temperatures with heavy metals resistant gene and the potential for bioremediation received very little attention. In this study, *Mesorhizobium* sp. PAMC28654, a novel gram- bacteria belonging to genus *Mesorhizobium*, was isolated from a soil sample in the polar region of Uganda. *Mesorhizobium* sp. PAMC28654 was subjected to whole genome sequencing and comparative genomics in order to better understand the genomic features necessary to survive and thrive in the extreme conditions of low temperature and heavy metal exposure. Furthermore, various bioinformatics tools such as CGView server, MEGA6, KEGG database, and NCBI database were used for the comparison and analysis and were validated by using wet-lab experiments. *Mesorhizobium* sp. PAMC28654 has a chromosome of 6.7 Mb, GC percentage of (62.2%), protein-coding genes 6,178, and other genes are predicted as a hypothetical protein. The predicted total number of tRNA and rRNA are 54 and 6, respectively with Scaffolds. While conducting the genome analysis of *Mesorhizobium* sp. PAMC28654, heavy metals resistant genes were identified. The isolated strain demonstrated their growth at 15°C and 25°C temperatures and heavy metals resistant, particularly 1.0 mM of copper sulphate pentahydrate and 2.0 mM of cobalt chloride hexahydrate at 15°C. This study is very helpful to a better understanding of bacteria having potentiality to survive cold temperature as well as other stress, such as heavy metal toxicity and applied these bacteria for bioremediation, monitoring, and controlling of environmental pollutant such as heavy metals in eco-friendly and cost-effective way.

A Study on the Prospects and Tasks of the Future Church

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Abstract

Since the COVID-19 pandemic, various predictions have been made about the direction of the church. Some predict that the church will still be revitalized after the pandemic, but others predict that it will be difficult to return to before the pandemic. The purpose of this study is to examine the changes and their factors that are commonly proposed through experts' predictions and prospects for the church in the future era and to present an image of the church in the post-COVID-19 pandemic era.

Through the analysis of the COVID-19 pandemic situation and the church's SWOT, we analyze the strengths, weaknesses, opportunities, and threats of the current church, and accordingly, we want to find common ground by analyzing the consensus and differences of experts on future religion. Through these commonalities, I would like to present the direction and tasks that the church should move forward in the post-COVID-19 era.]

1. Introduction

Many priests expect the church, which was hit by the COVID-19 pandemic, to return to its previous daily life when the COVID-19 pandemic is lifted. It is expected that pastoral activities will return to before the pandemic and regain vitality and continue to grow. On the other hand, there is also a skeptical view of these expectations. The COVID-19 Pandemic has changed the consciousness and form of life of church members a lot, and it is doubtful whether it will ever be possible to return to the same routine as in the past.

Theologians or priests are giving prophecies or predictions about future churches. What most future church predictions have in common is that churches before and after the pandemic will be very different. In other words, the previous church during the "distancing" period due to the COVID-19 pandemic is different from the church after the distancing was lifted. It is predicted that the new norms and cultures of the church formed during the distancing period are different from the norms and cultures before COVID-19.

Tom S. Ranier, an American church researcher, said after the pandemic, "We need to consider whether the church and the newly formed norms and cultures were really fulfilled in the will of God." After the pandemic, God had already planned and envisioned a future church.¹ Talking about the fact that there are pastors who are trying to change the church while adapting well during the pandemic, the church will never be the same.

However, there is also an optimistic view that the churches will return to the churches before the post-19 pandemic. Some predict that if the COVID-19 pandemic is lifted, it will recover to the previous church. It is expected that it will be restored to the old church because it has the preciousness of the church space and the longing for a lively atmosphere due to distance.

The researcher believes that the atmosphere of the church or the consciousness of the church members will not be the same as before the COVID-19 pandemic. Books and papers with predictions and prophecies about the church in the post-COVID-19 pandemic era are pouring out. In this paper, the changes and factors commonly presented in these predictions and prophecies are considered, and the church image in the post-COVID-19 pandemic era is presented.

2. COVID-19 Pandemic Situation and Church SWOT Analysis

As the saying goes, "The crisis is an opportunity," the COVID-19 pandemic can be an opportunity for change in the church. Non-face-to-face churches and small group meetings centered on the laity, which appeared as a new phenomenon after the COVID-19 pandemic, are churches that should have already come, even if it is not for the COVID-19 pandemic. There is even a view that the new form of church that emerged due to COVID-19 is a church that should be in the midst of God's providence². COVID-19 has moved the future church forward to the present, and the new paradigm that the church is trying today is a scheduled step in God's providence.

Before the COVID-19 pandemic, the church was like a company based on the principle of the capitalist market, the direction of the growth-oriented pastoral, the pursuit of the church's enlargement, and the principle of the market. However, in the crisis of Corona, it became the trigger for the possibility of the church to form a community centered on the Word of God and the will of the clergy to reform and innovate, and a church where the laity can be the owners was requested. It was a sudden crisis for the church without preparation, but it can be a new opportunity for the church which has no choice but to create a new pastoral paradigm.

Even if various regulations and restrictions on the COVID-19 pandemic are lifted, we have no choice but to accept With Corona. Many Christians expect that when the Corona 19 pandemic is lifted, they will return to their daily lives before Corona, but that is not the case. In the meantime, the corona pandemic for three years has changed people's consciousness and culture. You can have a comfortable mind without going to church, and it has become convenient and familiar to watch the service through video. COVID-19 strengthened the family community but weakened the church community.

Some churches are shrinking and retreating from the crisis, while others are trying to change and innovate in the crisis. Although it is a minority, there are churches that restore the essence of the church through new ideas and coping in crisis situations and grow more among God's will. This requires excellent leadership from church leaders. Leaders should be able to accurately analyze the current situation and make predictions about the future.

The purpose of this paper is to study what crises are caused by COVID-19 and how to overcome them. For this study, first, I would like to suggest a way for the church to go after SWOT analysis, focusing on current Christianity.

Analysis of Church SWOT in With Corona 19 Era			
External Environment		Opportunity	Threat
Internal Environment		Educational Training, Will to Reform, Online Communication	Lack of IT Skill Decrease Church members and Donation, Individualism
Strength	Will to Reform, New Normal, Online Communication	Vitalizing Online Communication, Strengthening Capacity of the Pastor, Church on Weekdays	Growth of the Village Church Vitalization Home Church Activating Role of the Lay People
Weakness	Distancing, Closing Church, Decrease Church Members	Keeping Tradition, Weakening of face-to-face activity, Weakening of Religious Education	Face to face Communication Difficulties, Community Slackness, Lack of IT Skill of Leaders

1. Strength

Since communication in many fields of the church is conducted online, there are more opportunities for communication, and communication can be activated. Worship and prayer meetings are also non-face-to-face (Untact), so they can be more active away from the limitations of place and time. Therefore, if leaders have the will and effort to change, they have an environment where communication can be more active than before COVID-19. Communication can be activated through the use of the Internet and various information devices.

Various face-to-face small groups that were restricted due to COVID-19 social distancing can be activated. Various small groups can be carried out at home, in cafes outside the church, or outdoors. The home church, which was originally planned in the will of God, can be revitalized, and an opportunity has come to form a community of love, fellowship, and service with close neighbors.

In the meantime, the high wall between denominations could also be lowered. The religious consciousness of the church members will also weaken a lot. In order to respond to COVID-19, organic meetings between denominations can also be activated. The church members were able to participate in the worship services of other religious groups online, and if there were good sermons and content posted in the video, they could watch it from choice.

2. Weakness

Distancing caused by the COVID-19 pandemic and non-face-to-face communication caused by distancing brought a new culture to the church. Due to non-face-to-face contact, a decrease in the number of members and a decrease in offerings led to a crisis in the church. The biggest problem is that the religious attitude and consciousness of the church members have changed. There is a question of whether, even if regulations due to COVID-19 are lifted, they will be able to restore their faith, attitude, and consciousness before the COVID-19 pandemic.

Due to the pandemic, many new neologisms have been created, among which the term 'Canaan church members' (Annaca members- "I don't go to church members" in Korean) has become a normal word. It means that the

number of believers who do not go to church has increased. Due to COVID-19, the word "new normal" is also being used as a new word. The norms and traditions of the past have changed. In the past, it was rude to wear a mask when meeting people, but now it is polite to wear a mask, and in the past, worship at a church was held in a chapel, but now it is natural that worship is held online.

Until now, large-scale temples have been built, and professional clergy has been mass-produced with the idea that worship, religious ceremonies, and education take place in the temple. In the future, the role of the temple and the role of the clergy will change. The concept of church space should be changed. In the concept of sacred space so far, it should now be a center that makes the world a sacred place. It will also have to cover the cost of managing the temple and prepare for changes in the scene of the clergy's activities.

3. Opportunity

There are companies that have grown and succeeded due to the COVID-19 pandemic. Demand for IT devices exploded due to non-face-to-face video lectures, and the distribution industry enjoyed a boom through home delivery. Some countries have developed the coronavirus vaccine, resulting in a lot of income. On the other hand, schools, churches, and travel businesses were hit hard and were in crisis.

Of course, these opportunities were not created by themselves, but they were met by changes in the external environment. The problem is that if restrictions due to the COVID-19 pandemic have been lifted and we settle for our pre-COVID-19 routines, we will be in crisis and trouble. Many experts predict that the lifting of the COVID-19 pandemic regulations is not the end of COVID-19, but now the second epidemic will occur, saying we must thoroughly prepare for this.³ It is predicted that it will be the era of With Corona.

This will be the same for the church. Until now, it should not be mistaken that non-face-to-face pastoral activities will return completely to the previous face-to-face activities. If pastoral activities before the pandemic are followed, the growth of the church will stop or decline. There is a need for great transformation and innovation in pastoral activities. It is necessary to find and prepare lessons and countermeasures learned through the COVID-19 pandemic.

The church space should be converted into a meeting hall rather than a temple. It should become a local church and become a place of education and friendship that helps local publicity. It should also be a healing place to help health and well-being. Priests will now have to focus on "spreading ministry" rather than "gathering ministry." The church should become a ministry where priests visit members rather than members visiting the church.

4. Threat

Even if the COVID-19 pandemic is lifted, it would be an illusion to be able to return to full daily life.⁴ It is necessary to evaluate whether church activities can be activated as before COVID-19 as non-face-to-face worship, education, and friendship become convenient and familiar. Even if you return to your daily life like before COVID-19, reality and fantasy will intersect for the time being. Through each church's SWOT analysis presented above, it is necessary to see the clergy themselves, see the church, and prepare for the world from a balanced perspective.

First, the consciousness of the church members should be changed. Some of the traditions and norms that have been normal so far have become Abnormal. There should be a theological understanding of this. In addition, the understanding and attitude toward face-to-face activities by generation will be different. Among middle-aged believers who lack IT skills, they will prefer face-to-face activities. On the other hand, teenagers and young adult believers will prefer non-face-to-face worship.

In a situation of chaos and crisis, as above, church leaders will have to reorganize the direction and purpose of pastoral activities. Just because the era and people's consciousness has changed due to corona, we should take it as an opportunity for renewal and growth of the church, not a precursor to the decline and collapse of the church. We will have to use the COVID-19 pandemic as an opportunity that God has given us to renew and reform the church

3. Prediction of Future Religion

Theologians, pastors, sociologists, and futurists predict and prophesy about future religions. Since these prophecies and predictions are difficult to verify, there are limitations and a lack of logic to deal with academically. However, using this prediction as a hypothesis, predicting future churches and accepting them in a positive direction will help future church growth and development. In this study, we analyze the predictions of the future church of the three prophets, Sylvia Browne, Unification Church founder Sun-Myung Moon, and Christian theologian and pastor Lee Sung-hee, and find future church images in common.

I would like to use the famous American prophet Sylvia Browne's⁵ prophecy of future religion as a hypothesis

and discuss how to prepare to accept the hypothesis. Of course, because she is not a futurist, she came up with prophecies without any scientific evidence. However, it can be said that her prediction was verified by the fact that she hit the mark in many of her past prophecies.

In the words of Sun-Myung Moon, the founder of the Unification Church, I would like to analyze the contents of the future church to reveal the church image of the future church. When Sun-Myung Moon founded the Unification Church in 1954, he made many comments on the future church. I think those predictions are church figures that are requested in this era. Meanwhile, Pastor Lee Seong-Hee, a Christian theologian and pastor, published a book called *Future Pastoral Grand Prophecy* in 1988, in which many prophecies are consistent with the church phenomenon after the COVID-19 pandemic.

1. Silvia Browne's Future Church Prediction

Sylvia Browne (1936–2013) was a psychic and prophet. She is a Catholic, majoring in psychology and comparative religion, and is also a hypnotist. She made many predictions in the fields of politics, economy, society, culture, and religion of the future on Earth from 2008 to 2080. She has been a hot topic in American society for more than 50 years, saying that many predictions have hit the mark. In particular, she is emerging as a hot topic again because she accurately predicted the COVID-19 epidemic in her 2008 prophecy. Her prediction of future religion is as follows.⁶

- 1) You will have an advanced sense of community beyond the distinction between religions.
- 2) Religions will join forces for the benefit of the human community and themselves, and a cooperative process will materialize.
- 3) The church space will function as a healing center.
- 4) The Healing Center will be a religious collaboration beyond religion.
- 5) The Healing Center has four buildings consisting of four pyramid-shaped buildings, and these buildings are operated in cooperation with each religion. The function of each building is as follows.
 - (1) The first pyramid provides services such as sanitation, medical care, and emergency counseling with accommodation.
 - (2) The second pyramid educates and trains religious practices such as yoga, meditation, and chakra practice to improve physical and mental health.
 - (3) The third pyramid functions as a library with paper books, not e-books
 - (4) The fourth pyramid is a place for spiritual communication, such as prayer and meditation, and priests reside across sects and provide education and counseling.
 - (6) The title of the Creator God is bisexual and is called Father God and Mother God.
 - (7) An antichrist or a terrorist similar to an antichrist appears.

2. The future church image of Sun-Myung Moon of the Unification Church

Sun-Myung Moon, the founder of the Unification Church, founded the Unification Church in 1954 and made many predictions about the future church. These predictions have been the basis of the theory of the Unification Church and the direction of pastoral activities. There are things that have been realized as he predicted so far, but there are things that are still in progress. One of the most representative predictions of his future church is the prediction of the home church. He already said that in 1959, the future church should be a private church and a home church. (Selections, Volume 6, 320)

- 1) God will be a family church, a personal church era that transcends denominations. (Father's words, Volume 6, 320)
- 2) God is the parent, father, mother, and neutral subject. (Divine principle, the principle of creation)
- 3) Now is the time for the world's fugitives (the founders of religion) to gather. (Speaking May 22, 1963)
- 4) The future church should be the center of the region (build a center on a county unit in the 1980s)
- 5) In the future, a super-religious supranational coalition should be established. (Father's words, September 15, 2001)

3. Pastor Lee Sung-Hee's future ministry prophecy⁷

Pastor Lee Sung-Hee, a theologian and a pastor predicts the future church as follows in his 1998 book, *Future Pastors' Great Prophecy*, as if he predicted the 2020 COVID-19 Pandemic. In his book, he makes predictions about 25 future pastoral directions, and ten key contents are listed as follows.

- 1) From a centralized ministry structure to a decentralized ministry structure
- 2) Transition of ministry from generation-centered to intergenerational-centered
- 3) Transition from public ministry to small group ministry
- 4) Switch from Sunday church to everyday church
- 5) Transition from coming church to visiting church
- 6) Transition from a clergy-centered ministry to a lay-centered ministry
- 7) Switch from program ministry to spiritual ministry
- 8) Transition from church growth to community service
- 9) A shift from church-centered to home-centered
- 10) Transition from solo ministry to network ministry

4. Consensus on predictions of future churches

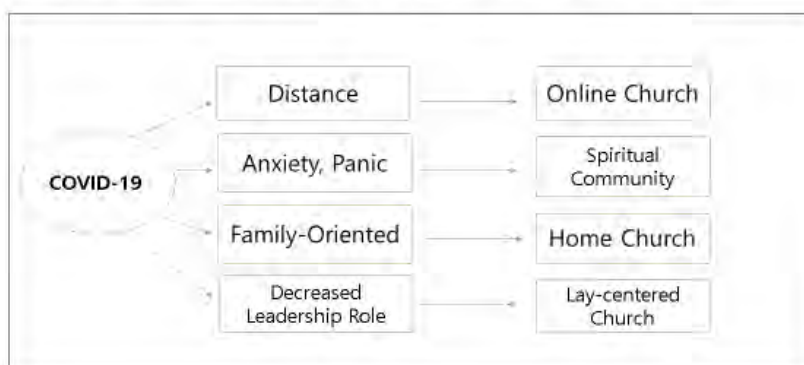
The church prophecy of the three experts is expected to be the image of a church in the post-Corona era. The situation in the post-COVID-19 era has forced the church to change on its own or by others. Today's situation calls for change and reform. Hans King said that the nature of the church does not change, but the form of the church must change at the request of the times and environment.⁸

The essence of the church is the realization of the kingdom of God. This essence is the purpose of the church's existence and the direction of its ministry. There are various obstacles in the process of realizing the kingdom of God. These obstacles may include obstacles that cannot be controlled by human power, physical obstacles, and artificial obstacles. In order to realize the kingdom of God, whether these are physical obstacles or artificial obstacles, these obstacles must be overcome in order for the kingdom of God to be realized.

The COVID-19 pandemic is not an obstacle that humans can artificially control. It is necessary to find a way to realize the kingdom of God in the situation of this obstacle. If the church does not change and reform, it is impossible to realize the kingdom of God. The COVID-19 pandemic is an independent variable that changes the situation of the church. The COVID-19 pandemic has created factors of change such as distancing, anxiety and fear, individualism, family-centeredness, and leadership roles. The COVID-19 pandemic has become a parameter that changes the church. With these parameters, the church must renew. If the renewal is not made, the church will inevitably decline or disappear.

If a road is destroyed by a natural disaster, the road must be repaired or newly constructed to reach its destination. Likewise, churches should develop other means of communication if there is an obstacle to face-to-face communication. It is difficult to reach the kingdom of God with the existing method of communication. A new tool for communication is non-face-to-face online communication. Now, through online communication, it is necessary to realize the kingdom of God, the essence of the church such as missionary work, education, counseling, and friendship. For the realization of the kingdom of God, the direction of the future church is presented as follows.

Church in the Age of With Corona



First, online churches will grow. With the development of computer communication networks, signs of cyber churches began to appear even before the COVID-19 pandemic. In the United States, many attempts have occurred to replace worship by watching TV sermons, and various missionary activities have been carried out in cyberspace.

Due to the COVID-19 pandemic, communication in cyberspace has become a necessity, not an option. The characteristics of the Internet through a computer communication network are 'distributed' and 'bidirectional'.⁹ This is what has come to be combined with the request for distancing. In order to practice distancing, there is no other choice as a communication tool than cyberspace.

Second, it will become a spiritual liberalism community.¹⁰ Due to the corona pandemic, open worship and festival worship as in the past will decline, and small-scale spiritual communities will be activated. With the emergence of postmodernism in the 1980s, interest in spirituality increased. In this situation, the newly emerged church form is the Emerging Church. The Emerging Churches are seeking to restore the spiritual community of the first church. It is a church that aims for an individual's subjective experience by decorating the church space as a sacred place of worship to restore the spiritual community. Emerging churches accept oriental yoga meditation and engage in pastoral activities that mature individual spirituality in an emotionally static atmosphere. After COVID-19, Emerging Church-type churches are expected to emerge as alternative churches.

Third, a family-oriented family church will grow. As social distancing becomes commonplace after COVID-19, religious activities will become more personalized through non-face-to-face worship, telecommuting, and refraining from going out, and the number of believers living comfortably at home will increase. The number of so-called 'Canaan' believers (Annaca believers – "I don't go to church believers" in Korean) is increasing. These cannot be seen as just a deterioration of faith or a weakening of faith. It should be seen as a change in the form of faith. Originally, the first Christian church was a home church. Even if the COVID-19 pandemic ends, institutional churches in the region will exist, churches in the form of home churches will be mainstream, and the role of existing local churches and priests will be reduced and limited by becoming a family-centered church. Of course, current local churches must exist. Even if a home church appears, the current local church must continue to exist. The local church should be a center that supports information and knowledge to the home church and will be a platform that connects the local churches.¹¹

Fourth, it will be laymen-centered churches. Due to distancing, small group face-to-face and non-face-to-face worship services will be activated. In the future, the base of worship, education, and missionary activities will be cyberspace and homes. This situation will automatically turn churches into laymen-centered churches. Local churches will exist, but their functions and roles will be different.¹²

Local churches will play a role in supporting home churches or cyber gatherings. On the other hand, the type of church members will also be different. In general, when it comes to church members, those who attend Sunday services and participate in offerings are called church members. After the COVID-19 pandemic, non-face-to-face worship was activated, and the number of so-called "Canaan members" (Annaca members- "I don't go to church believers" in Korean) increased. They are church members, but the number of church members who do not attend church and practice faith personally has increased. When the COVID-19 pandemic is lifted, most of the church members will return to the church, but the number of church members who do not come to church and practice faith personally at home will increase. The church needs to accommodate the Canaanite church members and create a network of church members. In the future, it will be necessary to classify the types of church members into face-to-face church members, non-face-to-face church members and Face-to-face-non-face-to-face intersection members will be classified, and a pastoral approach tailored to each will be needed. A church where face-to-face and non-face-to-face church members coexist can be called a "hybrid church."¹³

Fifth, the church space will be converted into an environment-centered space. With network communication, the gathering space is no longer so important. Therefore, the meaning of the church space should also change. From now on, the sacred space for missions and education must become a center for making the world a sacred space. It should be a space for rest and meeting as a community. It should not be a church open only on Sundays but open on weekdays to be a place for people to rest and have fellowship. It is necessary to create a cozy and friendly cafe-like church environment so that residents can meet and use the church as a venue for festivals and conversations. The church should be opened as a village church and a neighborhood church.

Sixth, there will be a tendency toward religious pluralism that transcends denominations. In the future church, predicted by Silver Browne and Sun-Myung Moon, the denominations would not be so important. Until now, sects or denominations have been important as a factor for people to choose churches. However, accessibility, content superiority, and globality are the main factors in church selection today, when network communication is common. Religion will be transformed into a cooperative system according to the demands of the times. Religious scholar William James said, "The doctrinal argument between religions cannot be consistent with dialogue. It can be consistent with conversation when sharing experiences and activities between religions."¹⁴ The religions of the future will unite in healing and service activities.

4. CONCLUSION

The church faced a crisis due to the pandemic of COVID-19. If churches deal with the crisis well, it becomes an opportunity for change and reform. However, failing to cope with this crisis, the church will have no choice but to go on the path of extinction. The COVID-19 pandemic has brought crises to the church, such as changes in

religious consciousness, weakening of spirituality, communication difficulties due to distancing, non-face-to-face worship, and reduced leadership roles.

If churches cope well with the crisis of the COVID-19 pandemic, they will have new opportunities for the development and growth of the church. Distancing can further increase the possibility of realizing the kingdom of God, the essence of the church. It will serve as an opportunity to advance the spiritual community, the small group home church, and the laymen-centered church, which were originally pursued by the church for the kingdom of God.

The COVID-19 pandemic will be a crisis for the church and a new opportunity. In this study, we will diagnose the church through a SWOT analysis of the current church situation during the COVID-19 pandemic and present a church image to be built in the future based on this analysis. As a new church, an online church, a spiritual community, a home church, and a laymen-centered church were presented.

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A Study on the Development and Validity of the scale of Church Member Morale

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Abstract

The purpose of this study is to develop a scale that measures the morale of church members and to verify the reliability and validity of the developed scale. The factors constituting the morale of the church members were divided into 5 areas, and 5 sub-questions were selected in each area. Following this, reliability and exploratory factor analysis were conducted with a total of 25 questions. The four-factor model was selected as a factor analysis model, and finally, factor analysis was conducted with 21 questions. As a result of the analysis of the Kaiser-Meyer-Olkin (KMO) measure, the KMO index in this sample was .919, which was suitable as a question for factor analysis, as it was found to exceed .700, the general criterion for judging appropriateness. Also, Bartlett's sphericity verification data with results $p < .001$ were found to be suitable for factor analysis. As a result of principal component analysis and exploratory factor analysis through the Varimax right angle rotation method, a total of four factors were extracted: 1) leadership 2) vision and values 3) human relationships 4) environment. As a result of the reliability analysis using the internal consistency map, the Cronbach's α value was .945, was seen to show a high reliability level. Next, a confirmatory factor analysis was conducted by referring to goodness-of-fit indices such as TLI, CFI, and RMSEA. The TLI was .891, approaching .90, and the CFI was .90 or higher. The RMSEA is .098, showing a normal fit. In addition, the lowest standardization factor load was .637, and most of them were .70 or higher. Further, it was found that each item had a statistically significant value. These results showed that the Church member morale scale consisting of the four-factor model of these 21 items was proven to be a reliable and valid measure, suggesting that it could be used in related research in the future

KEYWORDS: church member morale, measurement development, validity, reliability, factor structure

1. Introduction

1) Research necessity and objective

“Morale refers to the desire, spirit, and attitude of individuals and groups to voluntarily and actively cooperate and strive to achieve the goals of the organization.”¹ The morale of members of any organization is linked to the harmony of the organization, smooth communication, ease of work, and effectiveness, and has a profound impact on the organization's goals. The satisfaction and sense of achievement of the needs of the members of the organization are a key factor in morale and also a factor in balanced development of the purpose of the individual and the purpose of the whole.

Morale factors vary depending on the nature of the organization. Compulsory organizations, such as military organizations, are given strong leadership and strong weapons to boost morale. Interest groups such as company organizations have salary, expertise, and democratic leadership as factors contributing to morale. However, in normative organizations such as churches, the morale of church members can be improved by the church's vision and guidance expertise.

During the recent situation of the COVID-19 pandemic, we can see that the morale of not only church leaders but also church members is falling. In the Covid era, the church is experiencing changes and confusion that it has never experienced before, and traditional values and beliefs are shaking. The concept that worship should be held in the church building itself was torn down, and because of distance, online video worship was provided. Further, the meal community after church service collapsed. Church ministry such as worship, evangelism, and education had to be carried out online.

The decline in morale of church leaders and church members is affecting the entire church ministry, including the decrease in the number of church members attending worship, the decrease in donations, and the loosening of community awareness. According to a survey by the Mokmok Data Research Institute, the decrease in the number

of church members rose from 17% to 37% on average depending on the church after the COVID-19 pandemic.² Meanwhile, the decline in donations has also hit the church's finances hard. According to the COVID-19 awareness survey of pastors of the integration of the Korean Presbyterian Church, donations have decreased by at least 20% to as much as 60%.³

The cause of the decline in the morale of the church members may be internal psychological factors, but it is also largely due to factors such as the church's vision and policy, relations between the church members, the pastoral leadership, and the church's environment. In particular, various environmental changes after the COVID-19 pandemic can be seen as having a great influence on the morale of church members.

Although the factors that constitute morale differ depending on the organization, the common factors that constitute morale in any organization can be classified into personal and collective factors. Personal factors include psychological factors, job satisfaction, and achievement, and collective factors include human relations, financial compensation, and environment. It can be seen that the morale factors of church organization also fit within the above category.

Of course, personal factors and collective needs to interact. Personal satisfaction can increase the satisfaction of group activities and group activities can satisfy personal needs. The higher the sense of stability, belonging, and happiness in church organizations, the more responsibility and achievement can be felt by participating in group activities.

Deok-seop Shin classified morale into psychological factors, task factors, organizational factors, and environmental factors.⁴ According to these four categories, the sub-factors of church organization's morale can be classified into psychological factors such as belonging, stability, and happiness, task factors such as job placement and satisfaction with religious activities, and environmental factors which include church atmosphere, mission, and educational activities.

The morale of the congregation is directly linked to the growth of the church. Administrative scholar Kyu-jung Kim emphasized that morale is deeply related to human reform ability and said that morale depends on reform factors such as self-completion, achievement motivation, and creativity.⁵ Any organization needs these reform factors to boost morale. Even in church organizations, the morale of the church members must be raised to grow into a healthy church.

Kyu-jung Kim suggested that the components of morale are (1) material factors (2) sense of belonging and unity (3) sense of security (4) sense of success (5) sense of participation (6) adequacy and recognition (7) clear perception of organizational goals (8) physical and mental health and working conditions.⁶ Most of the above mentioned component factors of morale also correspond to the church's morale factors. Nevertheless, there will be a difference in the proportion that affects the morale component factors in general organizations and the morale component factors in church organizations.

Scholars of church growth have suggested various factors for church growth. These growth factors are generally consistent with the morale factors of church members. Donald A. McGavran, who presented 10 steps of church growth, cited solid biblical principles, solid goal awareness, effective evangelism, correct awareness of the body, community activities and student training, care through parents' minds, growth structure, organization, and risk management.⁷ According to McGavran, the church's goals and visions, evangelism and education, community cohesion, service and care, organization and environment were derived from the church's growth factors as morale factors. Man-oh Han presents 10 principles of healthy church growth (prayer, Holy Spirit, Word of God, worship, gospel, leadership, human relations, student training, strategic planning, and organization).⁸

Through the principle of church growth claimed by various scholars, the external factors constituting church morale were divided into five areas: 1) church vision and values 2) worship and preaching 3) human relationships 4) leadership 5) church environment, and five sub-factors were selected from the above areas. The purpose of this study is to develop a scale that measures the morale of church members and to verify the reliability and validity of the developed scale.

2) Research question

The research problems of this study are as follows.

Research Question 1. Develop a preliminary question for the development of the church member morale scale issue.

Research Question 2. The factor structure of the preliminary question on the developed church member morale scale is explored, and the reliability and validity are verified accordingly.

2. Theoretical background

Even up until the year 1900, the morale and desires of members of an organization were not considered so importantly. The evaluation standard for their members were based upon how much expertise they possessed to

ramp up organizational productivity or their obedience to the organization authorities. In the 1900s, it began to be understood that satisfying the morale and desires of organizational members led to increased productivity. They started to become aware that human relationships, environment of the organization, and compensation of its members were key factors that influenced productivity.⁹

The same is true of church organizations. Catholic or traditional and evangelical churches emphasized individual obedience and duty and educated based on this that rewards would be reaped in heaven. In addition, emphasis was put on duty and obedience to the leader, while stressing the leader's central role. With the emergence of liberal theology in the early 19th century and liberation theology and popular theology in the 1960s, the status and role of laymen were emphasized, and the morale and satisfaction of a church's followers became an important task for church ministry.

Since the 1960s, the morale and satisfaction of members have influenced the growth of the church as well as the establishment of its policy directions, and thus research papers on this topic have begun to pour out. As the need for tools to scale religious attitudes or acts of faith was required, many means for measuring were developed, including religious beliefs and practices, religious attitudes, religious tendencies, religious devotion and participation, religious values or personal characteristics, spirituality and mystery, and the concept of God.¹⁰ Ellison, C.W., *Spiritual maturity Index*. Nyack: Alliance Theological Seminary. 1983.

In 1967, Allport, G.W., & Ross J.M. investigated through the Religious Orientation Scale, ROS) whether religious behavior was based on internal motives or external motives.¹¹ ROS consisted of a total of 21 questions with 12 external factors and 9 intrinsic questions.

In 1982 through the religious status interview of Malony, N.H. and Nelson D.O. has been developed.¹² This measure is intended to measure the religious maturity of Christians, with the first part being an interview and the second part answering to a questionnaire. In the same year, Paloutzian, R. F. & Ellison, a Spiritual Well-Being Scale (SWBS) developed on this scale.¹³ R. F. Paloutzian, *Assessing Spirituality in a Divers in a World*, Springer, 2021.

It was viewed as two factors constituting religious well-being and existential well-being. Religious well-being refers to the vertical relationship between God and man, and an existential scale is to measure satisfaction in the relationship with oneself and the community. The SWBS survey measured religious happiness in 10 questions and existential happiness in the remaining 10 questions. In 1983, Ellison measured the spiritual maturity of a human individual, with the Spiritual Maturity Index (SMI).¹⁴ Developed based on evangelical Christian theory, he developed a measurement tool to measure spiritual maturity under the assumption that mentally mature people have a high degree of spiritual health. This measurement tool measures his spiritual maturity by examining religious practices and attitudes of faith.

In 1993, Morrow, Washington, and McCullough developed the Religious Values Scale (RVS). The test tool is a measurement tool that measures individuals' religious attitudes and beliefs and compares the differences in religious values held by others.¹⁵ As a measurement tool for religious behavior in Korea, Nan-ye Kim's 1999 "Measurement of Conceptualization of Belief Behavior"¹⁶, Nan-ye Kim, In 2002, Nan-ye Kim, "Development of a Measurement Tool for the Representation of God",¹⁷ "

The development was made by Hye-geun Yoon and Kim Geun-hyang, Hye-young Yoon/Geun-hyang Kim, "Validation of the Korean Version with Shortened Multidimensional Religion/Spiritual Scale."¹⁸ This study was such to evaluate the reliability and validity of the Brief-Multidimensional Measure of Religiosity/Spirituality Scale (BMMRS) developed by Fetzer/NIA.

In addition, evaluation indicators with high satisfaction with religion, religious form, religious growth, and pastoral activities were developed, but survey and evaluation indicators on the impact of church pastoral activities on church morale were difficult to find on academic paper search sites.¹⁹ The Korea Research Foundation and the Korea Academic Information (KISS) searched for the main words of the "Churchgoer Morale Test" and "Churchgoer Faith Development Test," but could not find related papers, and five papers were found through the search words of "spirituality".

A survey on the morale of church members is essential for the growth and development of the church, but in reality there is no written thesis on this topic. That is why this research first tries to create a morale survey scale for church members.

3. Research method

This study is such that develops a scale of the morale of church members. The research procedure is as follows. First of all, is the stage of developing preliminary questions. The preliminary question development stage is a process of coming up with preliminary questions that constitute a measure of the morale of church members. The detailed procedure first reviewed the previously developed measurement of faith development, faith satisfaction, spirituality, and religious attitude to understand the main factors and questions that make up the morale of believers

through literary review. Based on this, questions were written based on theoretical, logical, and rational grounds. Second, in order to more accurately understand the factors that make up the morale of church members at the church site, in-depth interviews were conducted with church members who lived a religious life for a certain period of time to collect cases related to the morale of church members. Third, through an open-ended survey, cases related to morale of church members were additionally collected by requesting a description of cases related to church member morale. A total of 25 questions were created by selecting the 5 constituent elements of morale and 5 sub-questions in each area constituting church member morale by verifying the content validity of the preliminary questions derived from the previous 3 processes.

The second step in scale development is to fill out a questionnaire based on the questions developed in this way. Then a questionnaire survey of 200-300 participants will be conducted, followed by carrying out question analysis, reliability, and exploratory factor analysis, with the final step being to ultimately select the questions that will measure the church member's morale. Through question, reliability, and exploratory factor analysis, we will be able to validate whether the constituent factors which lead to the morale of the church members are appropriately derived. Further, whether each question is appropriate, and whether the reliability of the test is plausible. Through this procedure, we will review whether a scale consisting of five measurement factors is appropriate, and construct a measurement item that finally constitutes a morale scale by removing the items evaluated as inappropriate.

The next step in scale development is to go through a confirmatory factor analysis step that finalizes whether the measurement tool analyzed through the previous step is valid. In this stage, a survey is conducted on 200-300 new research participants. This step is required to check whether the measurement tool is valid by conducting a confirmatory factor analysis using AMOS 20.0. If the measurement tool developed through this step is confirmed to be valid, then this measurement tool will be considered to be objectively proven to be suitable as a tool to measure the morale of church members. In addition, in this final step, the validity related to the criterion of the scale is analyzed. In other words, it will show that the developed test is actually measuring the morale that must be measured. If there is a previously developed morale scale, it will thus analyze the correlation between this existing scale and the developed scale. If there are no previously developed scales, then it must analyze the correlation with other scales or measurement methods that may be the basis for morale. In order to show whether the developed test actually measures morale, that is, if the degree of religious immersion is high when morale is high, the relationship between the religious immersion scale and the newly developed scale will be analyzed. If the correlation between morale and religious commitment is high, it can be shown that the developed scale can indeed be applied as a valid measure of morale.

4. Research results

1) Development of the Church Member Morale Scale Question

(1) In-depth interview

For this next step, in-depth interviews were conducted through face-to-face meetings to more accurately grasp the concept of morale perceived from church followers. The criteria for selecting subjects for this in-depth interview were set as 1) Church members currently attending church and 2) Those who have been practicing a religious life for more than 3 years. In order to recruit in-depth interview participants, 10 people were recruited with the cooperation of an anonymous City Church. The church manager received an explanation of the purpose and meaning of the church member scale development study and we received recommendations of those who were judged to have a relatively successful religious life regardless of their current living circumstances or any other conditions. After this, the interviews were carried out in a comfortable space where they could converse freely. There were a total of 10 people, 6 female church members and 4 male church members, and the age of the study subjects was 2 in their 30s, 5 in their 40s, and 3 in their 50s. The interviews were conducted from May 1st to 28th, 2022, and each interview took roughly an hour with the contents recorded and used for further data analysis.

As a result of analyzing the contents of the in-depth interview data for 10 participants, a total of 25 sub-categories were derived as shown in <Table 1>, and as a result of classifying them in consideration of the theoretical categories, they could be classified into core categories of morale in five areas.

<Table 1> In-depth interview results on the scale of church member morale

Core categories	Subcategories
1. Vision and values	Expectations for the future of the church Vision for the future of the church Expectations of an increase in members The Practicality of Missionary Strategy

	The social reputation of the church
2. Worship service and Sermon	The dynamism of worship Voluntary participation of worship Positive assessment of the sermon Hopes and visions of the sermon Salvationistic composition of the sermon
3. Human relationships	Care and love for each other Care and love for new members Positive faith motivation Voluntary participation in church meetings Voluntary participation in volunteer work
4. Pastoral leadership	Leadership skills and faith Leader's mission and responsibility Amiable and humble leadership Attention and affection for the congregation Pastoral Professionalism
5. Environmental	Strong sense of community Financial stability Bright and warm atmosphere of the worship place Environment for children and adolescents A church where members want to attend and remain

(2) Focus Group

A morale focus group was conducted to verify the validity of the core concept and sub-concept of the morale scale derived through in-depth interviews. For the five core categories and 25 subcategories obtained through in-depth interviews, their validity and omission were reviewed through a focus group of five experts. In this study, a total of five experts, consisting of one pastor, two professors majoring in theology, one professor of psychology, and one doctor of theology were carrying out the analysis.

As a result, most of the focus group subjects agreed without objection to most of the concepts of the core and subcategories of morale presented in <Table 1>. However, there was a difference in the importance of categories amongst the clergymen and of seminarians. Pastors practicing ministry in the field placed some emphasis on leadership and the human relations categories, while professors teaching theology tended to place more emphasis on the importance of church vision and worship. For this study, it was decided to develop an equivalent number of items for each category without distinguishing the differences in core categories.

(3) Production of Preliminary Questions on the Church Member Morale Scale

This researcher, one Ph.D. and two Ph.D. students gathered to produce the church member morale scale questions based on the core and subconcepts of church member morale in the in-depth interview and the focus group's validation process. First, questions were produced based on the concept of church member morale presented in 25 subcategories. In summary, in order to produce items with the same importance for each category, it was decided to write one item for each subcategory. As a result, a total of 25 preliminary questions were prepared by composing 5 questions for each category. In order to review the level of understanding of the 25 preliminary questions written in this way and the choice of language, 10 church members were then asked to check each question, and the results were shown that there was no problem in comprehension of the questions. The final 25 items developed are shown in Table 2 below.

<Table 2> Preliminary questions for measurement of Church Member morale

Morale categories	Question
Vision and Values	1. I am positive about the future of our church 2. Our church has a vision 3. Our church membership will continue to grow

- 4. Our church's missionary strategy is reasonable and realistic
- 5. Our church has a good social reputation
- 6. Our church service is vital and moving
- 7. Our church members participate in the service voluntarily and joyfully
- 8. Our church pastor's sermon has love and grace
- 9. Our church pastor's sermon is hopeful and has a vision
- 10. Our church pastor's sermon is based on God's word and is salvationistic
- 11. Our church members have interest and love for one another
- 12. Our church members greet new believers with kindness and love
- 13. The motives of our church members' faith are pure relationships and reliable
- 14. Our church members trust and support each other
- 15. Our church members voluntarily participate in church meetings with joy
- 16. Our church pastor has both skills and faith
- 17. Our church pastor has a strong sense of calling and responsibility
- 18. Our church pastor is humble and amiable
- 19. Our church pastor has interest and affection for his congregation
- 20. Our pastor has expertise in ministry
- 21. Our church has a strong community
- 22. Our church is financially stable Church environment
- 23. Our church has a bright and warm atmosphere
- 24. Our church has a well-equipped environment for children
- 25. Our church is a place that I want to go and stay

2) Verification of the reliability and validity of the measurement questions regarding congregation's morale

(1) Exploratory Factor Analysis

① Investigation procedures

This study conducted a survey of a total of 550 people by conducting a face-to-face and a mail survey on church members currently practicing a life of faith. Out of 545 copies, excluding questionnaires that could not be analyzed, As a result of the survey, 323 copies, or 60% of the total, were randomly chosen and selected as analysis targets for exploratory factor analysis. The survey was conducted from August 1st to August 27th, 2022. The demographic characteristics of the data used for exploratory factor analysis are shown in <Table 3>.

<Table 3> Demographic Characteristics of Exploratory Factor Analysis Survey Subjects

Classification		Frequency	Percentage (%)
Gender	Male	132	40.9
	Female	191	59.1
Marital status	Married	291	90.1
	Single	32	9.9
Academic Background	High Sch.	96	29.7
	Graduate	135	41.8
	Postgraduate	92	28.5
Age	20s	38	11.8
	30s	14	4.3
	40s	37	11.5
	50s	109	33.7

	60s	78	24.1
	70s	47	14.6
Faith Activities	Everyday	132	40.9
	2-3 times a week	81	25.1
	Once a week	65	20.1
	2-3 times a month	17	5.3
	Once a month	17	5.3
	5-6 times a year	11	3.4
Total		323	

② Analysis method

This researcher conducted exploratory factor analysis using SPSS 27.0 on 323 randomly selected people to analyze factors and verify reliability of the church member morale scale.

In the exploratory factor analysis method, principal component analysis was used, and varimax, a right angle rotation technique, was used. The total sum of the questions and the correlation coefficient of each question are $r \geq .30$ or above. In the process of conducting factor analysis, where the factor load was either high across several factors, or questions were grouped with completely different concepts in meaning, results were removed. In the process of developing preliminary questions, the researcher classified five factors into subcategories. In this study, 4,5,6 factors were designated, compared, and selected based on the number of key categories, leaving the possibility of change in the number of factors open. Based on the final calculated factor structure through this process, the correlation coefficient and Cronbach's α of each factor were calculated.

③ Analysis Results

After conducting exploratory factor analysis by designating 4, 5, and 6 factor numbers using the data from the sample, the interpretability of the three factor models was examined. As a result, four factors were detected in each of the four, five, and six-factor models, and most of the questions were found to have a significant factor load on these four factors, so the four-factor model was selected as a factor analysis model. As a result of analyzing with a four-factor model, Question 6 'Our Church Worship is Vital and Touching' showed almost the same factor load, Question 7 'Our church members attend worship spontaneously and joyfully', Question 10 'Our church pastor's sermon is based on God's word and is of salvationistic nature' and Question 21 'We have strong community' were deleted. Overall, most of the questions, which were considered as worship and sermon factors in the preliminary questions, show a high factor load with other factors, suggesting that the meaning of the questions overlaps with other factors. In particular, questions 8 and 9 were found to be related to pastoral leadership as a result of factor analysis, and the contents of the questions could be evaluated as corresponding to pastoral professional competence, so they were classified as pastoral leadership factors.

Finally, before conducting factor analysis, the Kaiser-Meyer-Olkin (KMO) measure was analyzed to confirm the appropriateness of the factor analysis sample of 21 items. As a result of the analysis, the KMO index of this sample came out as .919 and was thus suitable as a question for factor analysis, and it was found to exceed the general appropriateness criterion of .700. Bartlett's sphericity test results data were found to be suitable for factor analysis at $p < .001$. As a result of conducting exploratory factor analysis through principal component analysis and Varimax right angle rotation method, a total of four factors were extracted as shown in <Table 4>.

Factor 1 is a factor that reveals 23.40% of the total variance, and includes questions related to the pastor's leadership. Factor 2 is a factor that reveals 18.59% of the total variance and consists of questions related to the church's vision and values. Factor 3 is a factor that reveals 17.54% of the total variation and consists of questions related to church member relationships. Finally, factor 4 is a factor that explains 13.74% of the total variation, and includes questions related to the church environment. As a result of reliability analysis using internal consistency, the Cronbach's α value was .945, showing a high level of reliability. And the correlation between factors is as shown in <Table 4> where the results were found to be between $r = .464$ and $r = .603$, so there was no correlation at all or too low a factor.

<Table 4> Four-factor model Factorial Pattern Matrix and Factor Name

Factor name

Factor

		1	2	3	4
	17. Our church pastor has a strong sense of calling and responsibility	.833			
	16. Our church pastor has both ability and faith	.817			
	18. Our church pastor is humble and friendly	.816			
Pastor Leadership	20. Our pastor has expertise in pastoral affairs	.813			
	8. Our church pastor's sermon has love and grace	.724			
	19. Our church pastor has an interest and affection for his family	.723			
	9. Our church pastor's sermon is hopeful and visionary	.697			
	2. Our church has a clear vision		.839		
	1. Our church has a positive outlook for the future		.834		
		1	2	3	4
Vision and Values	3. Our church membership will continue to grow		.832		
	4. Our church has a good social reputation		.768		
	5. Our church missionary strategy is rational and realistic		.752		
Relationships	14. Our members are feel value and joy in church volunteer work			.781	
	15. Our members voluntarily participate in church meetings with joy			.768	
	11. Our members have care and love for each other			.759	
	13. The motives of our members' faith are pure and reliable			.730	
	12. Our members welcome new members with kindness and love			.677	
Church Environment	24. Our church has a good environment for children and teenagers				.806
	22. Our church is financially stable				.764
	25. Our church is a church where our family wants to go and stay				.680
	23. The atmosphere of our place of worship is bright and warm				.671

	Eigenvalue	9.31	2.39	2.04	1.20
	Explanatory Variant (%)	44.32	11.39	9.69	5.70
	Cumulative Variation (%)	44.32	55.71	65.40	71.11

<Table 7> Correlation matrix between factors

Factor	1	2	3	4
1	-			
2	.507	-		
3	.602	.464	-	
4	.601	.502	.603	-

(2) Confirmatory factor analysis

① Subject of investigation

For confirmatory factor analysis, 222 copies, or 40% of the total 545 questionnaires, were selected by random division. Demographic and sociological characteristics are shown in <Table 5>.

<Table 5> Demographic characteristics of the subjects of confirmatory factor analysis

Classification	Frequency	Percentage (%)
Age		
Male	84	37.8
Female	138	62.2
Marital		
Married	193	86.9

Status	Single	29	13.1	
Academic Background	High School Grad.	75	33.8	
	Undergraduate	90	40.5	
	Post-graduate	57	25.7	
Age	20s	25	11.3	
	30s	8	3.6	
	40s	28	12.6	50s
	87	39.2		
	60s	64	28.8	
	70s	10	4.5	
Faith Activities	Every Day	79	35.6	
	2-3times a week	62	27.9	
	Once a week	48	21.6	
	2-3times a month	12	5.4	
	Once a month	13	5.9	
	5-6times a year	8	3.6	

Total		222		

② Analysis Method

The purpose of this step is to verify whether the factor structure of the four-factor model consisting of 21 items extracted from exploratory factor analysis can be checked once more or be generalized. To this end, a confirmatory factor analysis (CFA) was conducted on 222 samples. Chi-Square (X²), TLI, CFI, and RMSEA were verified to confirm the fit of the model. The most basic measure of overall fitness to evaluate the model is the X² statistic, which is sensitive to the size of the data, so this study referred to suitability indices such as TLI, CFI, and RMSEA. TLI and CFI, which are incremental suitability indices, show a good fit when the value is .90 or higher, and RMSEA shows a good fit when the value is smaller and in general is a close fit when the value is less than .05. A reasonable fit follows if less than .08, mediocre fit if smaller than .10 and bad fit if larger than .10. The suitability index as a result of confirmatory factor analysis in this study is shown in <Table 6>.

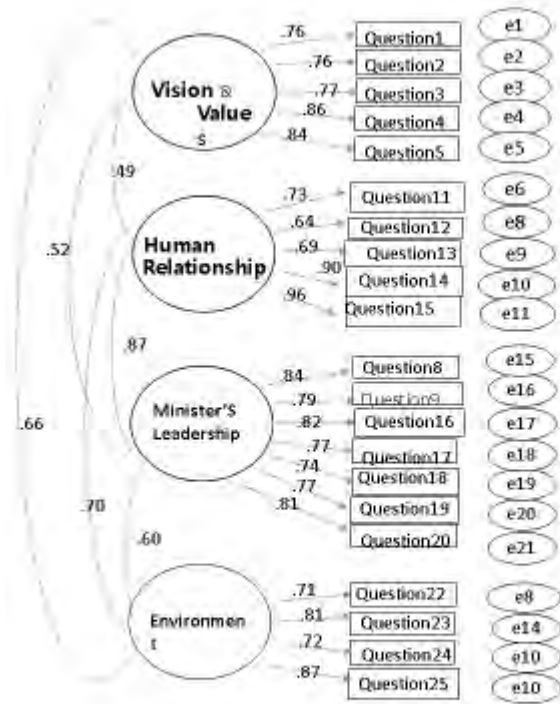
<Table6> Model suitability Index

Model	X ²	df	TLI	CFI	RMSEA
4 Factor Model	683	183	.891	.902	.098(.089-.108)

RMSEA=Root mean square error of approximation ; GFI=goodness of fit index; CFI=comparative fit index.
CFI=Comparative Fit Index; TLI=Tucker-Lewis Index

The RMSEA is .098, which is lower than .10, and TLI is .891, which is close to .90, and CFI is .90 or higher. Judging this comprehensively, it can be said that the four-factor model seen is at a good level of suitability.

<그림 1> 사기 척도의 CFA 모델



<Figure 1> CFA Model of Morale Scale

<Table 7> CFA results on the Morale scale

Order	Observed	Non-standardized coefficient	Standard error	Standardization coefficient (β)	p
Vision and Values	→ Question1	1.000	0.000	0.762	< .001
	→ Question2	0.959	0.083	0.760	< .001

	→ Question3	1.010	0.085	0.774	< .001
	→ Question4	0.974	0.074	0.856	< .001
	→ Question5	0.830	0.064	0.840	< .001
Human Relationships	→Question11	1.000	0.000	0.733	< .001
	→Question12	0.900	0.097	0.637	< .001
	→Question13	0.922	0.091	0.693	< .001
	→Question14	1.285	0.097	0.904	< .001
	→Question15	1.247	0.098	0.860	< .001
Pastoral Leadership	→ Question8	1.000	0.000	0.837	< .001
	→ Question9	0.938	0.067	0.794	< .001
	→Question16	0.933	0.063	0.822	< .001
	→Question17	0.847	0.063	0.770	< .001
	→Question18	0.820	0.064	0.742	< .001
	→Question19	0.809	0.060	0.771	< .001
	→Question20	0.882	0.061	0.812	< .001
Environmental	→Question22	1.000	0.000	0.709	< .001
	→Question23	1.019	0.090	0.814	< .001
	→Question24	1.138	0.113	0.724	< .001
	→Question25	1.148	0.096	0.871	< .001

In order to evaluate the validity of the four factor models of the scale developed in this study, the factor load of each factor and the standardized factor load were examined in detail. Looking at the standardized factor load in <Table 7>, it can be seen that the lowest value is .637, whereas others are mostly .70 or higher. Additionally, it was found that each item had statistically significant values. Taking these results together, it can be said that the church member morale scale consisting of the 21 question four-factor model has proven to be a reliable and valid measure.

5. Discussion and Conclusion

This study was conducted to develop a scale that measures the morale of church members, and to verify the reliability and validity of the developed scale. Based on the literary review, we wrote the main factors and questions that make up the morale of the church members, conducted in-depth interviews to more accurately understand the factors that make up the morale. Based on the core and subconcepts of the church members and the focus group, a total of 25 questions were prepared by selecting 5 sub-question items in each of 5 areas. 1) The vision and values of the church 2) Worship and sermon 3) Human relations 4) Pastoral leadership 5) Church environment

A survey was conducted with the questions developed in this way, and item analysis, reliability, and exploratory factor analysis were conducted. After conducting exploratory factor analysis by specifying 4, 5, and 6 factor numbers using sample data, the interpretability of the three factor models was analyzed, and as a result, the four factor model was found to be suitable. The four-factor model was selected as the factor analysis model, and the items showing almost the same factor load for all four factors and the items showing high factor across two or

more factors were removed, leaving the factor analysis to ultimately be conducted with 21 items. As a result of the Kaiser-Meyer-Olkin (KMO) measurement analysis to confirm the appropriateness of the factor analysis sample of 21 items, the KMO index of this sample emerged to be .919 and was suitable as a question for factor analysis, as it was found to exceed the general appropriateness criterion of .700. For Bartlett's sphericity test results the data were found to be suitable for factor analysis as $p < .001$. As a result of conducting exploratory factor analysis through principal component analysis and Varimax orthogonal rotation method, a total of four factors were extracted 1) pastoral leadership 2) vision and values 3) human relationships 4) environment. As a result of reliability analysis using internal consistency, the Cronbach's α value was .945, showing a high level of reliability.

As a result of the exploratory factor analysis, the five factors that appeared in the preliminary question stage based on literary review and in-depth interviews were reduced to four factors. In the preliminary question stage, the questions that were regarded as the categories of worship and sermon were found to have a high load with other factors. This suggests that the significance of the questions of worship and sermon overlap with those of other factors. In particular, since questions 8 and 9 show high loads with the pastoral leadership factor, it can be said that significance of worship and sermon factors appear to overlap with the significance of pastoral leadership factors.

Next, a confirmatory factor analysis was conducted to finally confirm whether the measurement tool analyzed through exploratory factor analysis was valid. In this study, fitness indices such as TLI, CFI, and RMSEA were referred to. For TLI, an incremental fitness index, results were .891, approaching .90, and CFI was .90 or higher. RMSEA was .098, which is lower than .10, showing a normal fit. Comprehensively judging this, it can be said that the four-factor model seen is at a good level of suitability. In addition, in order to evaluate the validity of the four factor models of the scale developed in this study, the factor load of each factor and the standardized factor load were examined in detail. The lowest standardized factor load was .637, and most were .70 or higher. Lastly it was found that each item had statistical values with particular significance.

Taking these results together, it can be said that the church member morale scale consisting of the 21 question four-factor model has proven to be a reliable and valid measure. Therefore, this study is meaningful in that it provided a measure to objectively measure the morale of worshippers. Accordingly, it suggests that the scale developed in this study can be used for future related studies. In particular, the development of a measure to objectively measure the morale of church members is expected to trigger follow-up studies related to this. It is expected that studies will objectively analyze how demographic variables such as gender, age, and faith activities are specifically related to church members' morale, and how they affect other religious variables such as religious immersion and faith.

As a limitation of this study, this study was a survey of church members nationwide, but it has a limitation that the number of samples cannot be considered sufficient. Also, in the process of verifying the validity of this scale, no official validity analysis was conducted. In subsequent studies, the analysis of the certified validity of this scale is expected to contribute to strengthening the validity of this scale.

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¹⁹ The Korea Research Foundation and the Korea Academic Information (KISS) searched for the main words of the "Churchgoer Morale Test" and "Churchgoer Faith Development Test," but could not find related papers, and five papers were found through the search words of "spirituality".

Improvement of roller contact fatigue behavior and restoration mechanism of steels for industrial knife applications by ultrasonic nanocrystal surface modification

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Abstract

This study systematically investigated the effect of ultrasonic nanocrystal surface modification (UNSM) technology on the roller contact fatigue (RCF) behavior and fatigue restoration mechanism of various steel for industrial knife applications. This study aims to compare the effect of UNSM technology on the RCF behavior of M4 and a mixture of M4, D2 and H13 tool steels manufactured by direct energy deposition (DED) process and their fatigue restoration mechanisms with H13 tool steel, which is currently used to manufacture industrial knives. The fatigue life of the specimens was evaluated by carrying out RCF tests at a rotating speed of 1000 rpm and contact stress of 2.4 GPa. The S-N data were collected for each specimen to compare the fatigue lifetime under the same loading. The fatigue specimens were treated by UNSM technology to restore the fatigue mechanisms which were investigated by RCF tests and microstructural analysis. It is expected that the application of UNSM technology can enhance the fatigue limit of M4 and a mixture of M4, D2 and H13 tool steel to a similar or higher level of existing knives made of H13 and D2 tool steel leading to a reduction in the labor and manufacturing cost required for knife replacement.

KEYWORDS: Steels for Knife Application; Roller Contact Fatigue; Restoration Mechanism, Surface Modification

1. Introduction

Increasing the strength of industrial knives enables a reduction in weight and an increase in service life. Tool steels that are used for producing industrial knives need tend to have high strength. Recently, the cutting and shearing mechanism has been getting complicated and requires a high precision level according to the development of more valiantly peripheral equipment. In order to solve this tough and severe requirement for knives, we have dedicated keeping quality control to satisfy the precise dimensions, also have proprietary developed one of the solutions, which are surface hardening technology called UNSM (Ultrasonic nanocrystal surface modification), that increases the mechanical performance including surface hardness, roughness, compressible residual stress resulting in achieving great durability and sharp cutting face of industrial knives [1]. Over the past few years, Additive Manufacturing (AM) is gaining momentum in diverse industrial applications. Industrial knives made of tool steel such as H13 and D4 manufactured by the traditional method have been replaced by industrial knives that are fabricated by AM, whose demand is highly increasing by potential applications [2]. As one of the significantly developed methods of direct energy deposition (DED), laser powder-based direct energy deposition (LP-DED) demonstrated many promising achievements [3]. Meanwhile, these LP-DED fabricated materials still cannot be replaced entirely due to inevitable microstructural defects that reduce mechanical properties [4]. Post-DED surface finishing processes such as polishing and grinding are highly required to smooth the surface of the DED fabricated components. Earlier, it was found that LP-DED fabricated components are restricted from being used in various applications because of the drawbacks above, which can be resolved by the application of mechanical surface finish technologies that improve the mechanical performance of components. The main objective of this study is to evaluate the influence of the UNSM technique on the rolling contact fatigue (RCF) behavior of M4 and a mixture of M4, D2 and H13 tool steels manufactured by direct energy deposition (DED) process to a similar or higher level of existing knives made of H13 and D2 tool steel leading to a reduction in the labor and manufacturing cost required for knife replacement and also to investigate the fatigue restoration mechanisms.

2. Materials and Methods

In this study, the AISI D2 material was used in the experiments as the substrate and the hard-faced surface was created with the AISI M4 powder by laser melting. D2 has a very high carbon and chrome content. After it is hardened through the appropriate heat treatment (quenching and tempering), it is suitable for a wide range of practical applications. M4 steel powder, which consists of spherical particles with an average particle size of approximately 110 μm (supplied by Carpenter Co., Philadelphia, PA, USA), was used as the powder for the DED process. M4 is a molybdenum-based high-speed tool steel; the hardness of the substrate is used for general cutting

tools that must have a high degree of toughness, such as cold-forged tools, molds, and parts for high-speed presses. Table 1 lists the chemical compositions of M4 powder [5].

Table 1. Chemical composition of M4 powder in wt.%

C	Si	Mn	P	S	Ni	Cr	Mo	Cu	V	W
1.33	0.33	0.26	0.03	0.03	0.3	4.25	4.88	0.25	4.12	5.88

2.1 Rolling Contact Fatigue

In this study, the fatigue performance of tool steels was evaluated using an RCF tester at a contact pressure of 2.4 GPa and a rotating speed of 1000 rpm. The upper specimens with a diameter of 40 mm and a thickness of 8 mm made of SAE 52100 bearing steel were extracted from the standard bearings manufactured by Wonil bearings (No. 51204). The fatigue specimens with a diameter of 50 mm and a thickness of 8 mm were prepared by DED method.

2.2 UNSM technology

UNSM technology is one of the surface modification technologies which utilizes ultrasonic energy. In UNSM technology, a tungsten carbide ball is attached to an ultrasonic horn that strikes the surface with a frequency of 20 kHz as shown in Figure 1a. A detailed description of this technology was described in our previous study [6]. Strikes, which can also be described as micro cold forging, cause severe plastic and elastic deformations on the surface layers, thus inducing a nanocrystalline structure and deep compressive residual stress. These strikes also produce controllable micro-dimples on the top surface of the specimen, which improves the tribological characteristics of the interacting surfaces in relative motion. The produced nanostructure of the surface layer after UNSM treatment can simultaneously improve the strength (hardness) and ductility (toughness) of the specimen, according to the well-known Hall-Petch relationship [7]. Fig. 1 shows the UNSM treatment processing under the parameters listed in Table 2.

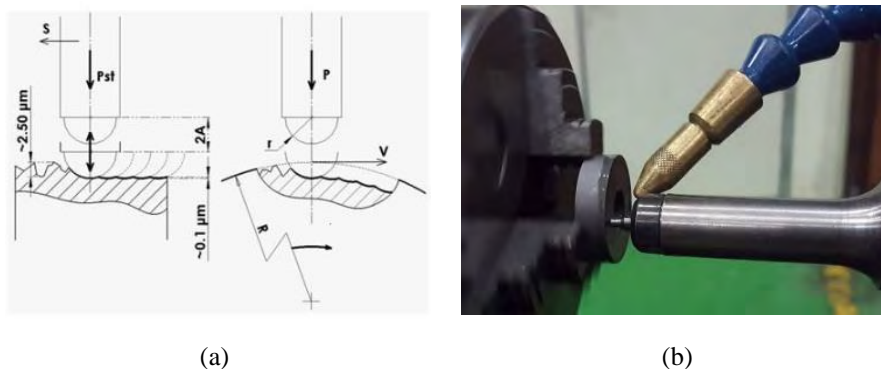


Fig. 1. (a) Ultrasonic nanocrystal surface modification (UNSM) treatment principles and (b) the processing of the specimen

Table 2. UNSM treatment process.

Amplitude (μm)	Load (N)	Rotational Speed (rpm)	Feed (mm/rev)
30	60	60	0.07

3. Results, Discussions, and Conclusions

Fig. 2 shows the S-N data of the untreated and UNSM-treated M4, D2, and H13 specimens. It can be seen that the UNSM treatment significantly prolonged the service life of the untreated specimens, whereas the specimens made by the DED method demonstrated a deteriorated fatigue life in comparison with the specimens manufactured by the traditional method. It means that the DED processing parameters need to be optimized based on the microstructural defects and also the mechanical properties to achieve a better fatigue life performance. Nevertheless, the UNSM treatment effect on the fatigue life performance of the mixed powder specimen manufactured by DED method was at the same level as the untreated H13 and D2 tool steels.

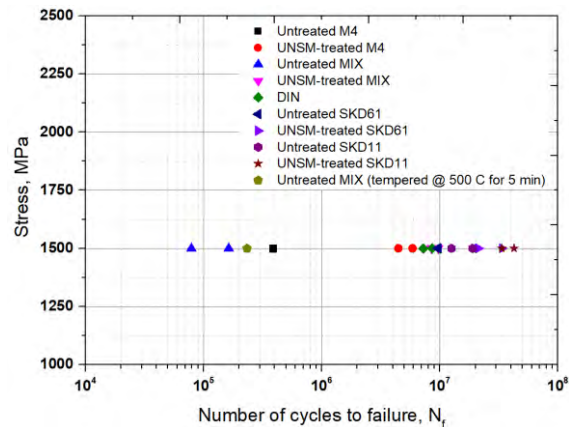
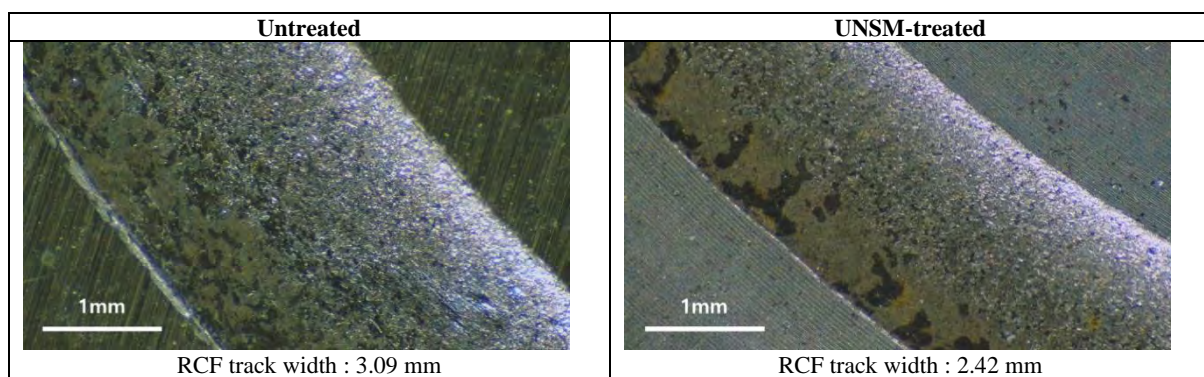


Fig. 2. S-N data of the specimens

Fig. 3. Fractography of the untreated and UNSM-treated mixed specimens subjected to RCF testing



4. Conclusions

In this study, the effect of UNSM technology on the RCF behavior and fatigue restoration mechanism of various steel for industrial knife applications was investigated. It was found that the DED processing parameters need to be optimized based on the microstructural defects and also mechanical properties to achieve a better fatigue life performance. In addition, product quality control will be accessible through continuous production according to the improvement of the fatigue lifetime, which increases sales by supplying industrial knives to demanding companies such as Hankook tire, Hyundai steel, etc. Hence, it is possible to expand the sales market by grafting various types of knives required by demanding companies and to expand the domestic sales market by applying knives and tools similar to the developed process and product.

Acknowledgment

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The Home Dharma Meeting(HDM) as a Way to Revitalize the Buddhist Activities in the era of Post COVID-19.

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Abstract

The purpose of this study is to propose the 'Home Dharma Meeting' as a way to revitalize the Buddhist gatherings in the With COVID-19 era. Religious activities are shrinking a lot due to the COVID-19 pandemic. Religious gatherings have become difficult due to social distancing, a decrease in believers and a decrease in donations. Not only has it become difficult to operate temples and churches, but also the faith communities have weakened. Although non-face-to-face meetings are held, there are limitations in education, service, and friendship activities, which are the essence of religion. Untact meetings have limitations in smooth communication and social harmony. In order to overcome this situation, this study aims to examine how the Home Dharma Meeting is based upon Buddhist Scriptures. Home Dharma Meeting refers to all Buddhist gatherings held by groups of families outside temples. Its characteristic is that it is always based on the Dharma. The Home Dharma Meeting is a home-based gathering where groups of people pray for a community, praise the Buddha, and recite scriptures.

The conclusions of this study are as follows. First, the Home Dharma Meeting is based on Buddhist Scriptures, Second, it is an alternative form of gathering in the untact age. Third, the Home Dharma Meeting is centered on Buddhist families at home. Fourth, in order to revitalize the Home Dharma Meeting, it is necessary to establish a strong solidarity between the local temple and the Buddhists at homes.

KEYWORDS: With COVID-19, Home Dharma Meeting(HDM), untact meeting, Dharma meeting, Dharma teacher

I. Introduction

The COVID-19 pandemic has brought about changes not only in people's consciousness but also in their lifestyles. It strengthened the individualism, My Home Egoism (family centered), and the culture of You-Only-Live- Once(YOLO). Due to social distancing caused by COVID-19, the number of social meetings have decreased, and even such meetings have become optional. As family members spend more time together, family functions and family cultures are changing, and as many people work at home, the culture of the workplace community is also changing.

Religious organizations have been directly damaged by the COVID-19 pandemic. The number of believers and donations of temples and churches are rapidly decreasing, and religious activities are also shrinking. Activities such as missionary work, religious rituals, education, and volunteer services, which are the essential functions of religious organizations have shrunk. Even after the COVID-19 era, these aftereffects are expected to last a long time. Therefore, the form of religious organizations such as temples or churches should change and the role and leadership of the clergy should also change.

According to a survey by the Pastoral Data Research Institute, the number of church members decreased from about 10% to about 30% depending on the churches after the COVID-19 pandemic. Protestants have fallen by 10%, Buddhists by 8%, and Catholics by 4%. According to the current National Statistical Office survey, there are about 10 million Protestants, 8 million Buddhists and 4 million Catholics in 2020, and the Buddhist population is expected to be overtaken by Catholics in 2030.¹

Christian theologian Hans Küng said, "The church must always participate in new days, always adapt to changes in history and changes in human life, and always reconsider for reform and renewal."² In other words, even if the times change, the nature of the church does not change, but the form of the church must change depending on the times and the culture of the time. Therefore, the nature of the church for "human salvation" does not change, but religious activities to realize its essence must change.

Due to COVID-19, religious forms such as the religious rituals, missionary work, education, and volunteer services have also changed. With the prolonged social distancing, the past traditions and common concepts no longer work, and, throughout the society, new value standards and cultures have arisen. The new-normal phenomenon is taking place everywhere.³ The religious world cannot be exempted from this phenomenon. Existing religious traditions and values can no longer be maintained. Missionary activities are now more on-line than face-to-face. The claim that a Dharma meeting or a Christian service must be held in a Buddhist temple or in a chapel is no longer convincing.

This phenomenon cannot be solely influenced by the COVID-19 pandemic. However, it is certain that the COVID-19 pandemic has accelerated this change. Prior to COVID-19, online society and online communication were already common. However, religious sectors were not properly prepared for them, and religious

communications using online were delayed.

In this study, I propose the HDM as an alternative for the mission and education of Buddhism in the post-COVID-19 Pandemic era. HDM plays a central role in promoting Buddhist activities such as worship, missionary work, education, and friendship. In Buddhism, HDM may be a somewhat unfamiliar term. In Protestantism, however, Home Church has already become common. Through the home church, the believers form a large family with their neighbors and engage in worship, education, and friendship activities.

The HDM refers to a family-centered gathering, which does not necessarily take place at home. HDM refers to the formation of religious ceremonies, education, and friendship activities by a large family-like Buddhist community.

II. The Buddha's view of family

1. Concepts of filial piety and Buddha's view of family

It is often misunderstood that Buddhism emphasizes individual enlightenment and does not emphasize the importance of family. But Buddha never neglected his family and taught his disciples the importance of family. *Dgha Nikya Singalakadasutta* told the son of his eldest son to keep six things. ① Serve your parents. ② Carry on your duties for your parents. ③ Keep the family traditions well. ④ Maintain the family inheritance ⑤ Pay tributes to your parents after they died.⁴

Buddha also taught the parents that they should ① protect their children from evils ② lead them to good things, ③ teach them skills, ④ match them suitable spouses ⑤ give the inheritance at the proper time. As such, Buddha taught people not to leave the world and go on the path of asceticism, but to be faithful to their families. In addition, he said that we should serve the teachers well, get along well with the friends, and not only serve the monks, but also serve the servants and workers well.⁵

Buddha told his disciples that serving their mothers and fathers was like the earth, and that not serving them was like dirt. He said that the reason why a man does not serve his parents was because he does not understand the truth of the Four Noble Truth.⁶

As such, parents should be served at home, but the reason why the monks have to leave home is that they have to break the cycle of reincarnation through greater enlightenment. This is because a home causes many obstacles to the path of practice for enlightenment. Breaking the cycle of reincarnation and the enlightenment eventually save parents.

The Parental Benevolence Sutra, which can be said to be a *The Hsiao Ching*, explains well why we should serve our parents. Buddha was walking along the street with the public, and when he saw a pile of bones of dead bodies, he bowed to them politely. When Ananda asked how Buddha bowed to the dry bones, he replied, "I bowed because this pile of bones may be the bones of my old ancestors or parents in my previous life."⁷ This means that both the living and the dead must be respected and served because they may have been themselves or their family members in their previous lives.

Why did Sakyamuni Buddha decide to renunciate his family? Sakyamuni's departure from home is not an act of filial impiety. He fulfilled his duty to his family, set his family right, and became a monk at the age of 29. These were Hindu traditions and practices at the time. The path to nirvana was divided into student period, travel period, term period, and wandering period.⁸ Until youth, cultivate personality and knowledge; as an adult, set up a family right, as you grow older, seek the truth and enlightenment, and finally go out to the world to save the people. In accordance with the four cycles of the life, Sakyamuni Buddha also learned as a prince, married, established a family and entered the forest, gained enlightenment through practice, and went to the world to save the people.

Buddha renunciated his family and became a monk in order to gain enlightenment because the family had various obstacles in practice. In *Ssanyutta Nayae*, Katsaba said to Ananda, "Family life is the path of dust, but renunciation is like a free space. It is difficult for a person living at home to practice a clean life that shines like a polished conch shell."⁹

The ultimate goal of Buddhism is liberation. Practice is the only path to get to this nirvana. However, if you practice at home, you have various obstacles. So you renunciate the family. This path of renunciation can lead not only yourself but also your family to the nirvana.

It seems that overcoming various obstacles in the world of desire, living in accordance with the Buddha's teaching may be a slow and difficult way, but it can certainly be a sure way to gain enlightenment through practice. The HDM is a way to fulfill the life of benefiting oneself and others, while practicing at home. The HDM is a Dharma community to give worship to the Buddha and develop Bodhicitta, the thought of enlightenment.

Buddhism seeks great filial piety. It extends not only to the filial piety of the present generation, but also to

the three generations of the past, the present, and the future. The space and time of filial piety extends along the weft from hell to the realm of Buddha, and extends along the warp over the three generations, the past, the present, and the future.¹⁰ Raising the example of Sambo in Buddhism can also be said to express the spirit and attitude of basic filial piety. Therefore, it can be said that renunciation has nothing to do with the filial piety.

As can be seen from Buddha's family view, the family can be a place to realize self-discipline and Buddhism. When you live in a peaceful and happy world of paradise at home, you can resolve the karma of your past and present life and break the cycle of reincarnation. When you become a Buddha at home and serve your family and neighbors as a Buddha, you can relieve your karma and enjoy eternal life.

The home is a place to learn and practice Buddha's teachings and also a place to cultivate and practice benevolence, which is the first virtue of Buddhism. It is a place to cultivate morality, Buddhist personality and spirituality(Buddhism). This Buddhist personality and spirituality are the basis of Buddhist filial piety. The HDM is a large family community, which forms the basis for Buddhism to systematically cultivate the real human traits of Buddhist filial piety.

2. Family Shanga Community and HDM

Shanga is a phonetic translation of Samgha in Sanskrit. At the time of Buddha, it was also called 'gana', which had the meaning of group and gathering. In general, it refers to a community of monks who left their families, but originally, it referred to people who practice religious asceticism regardless of whether they renounced their families or not; bhikkhu, bhikkhuni, Ubai(female laity), and Ubasae(male laity).¹¹

Originally, the meaning of 'Shanga' was simply a community, such as "gathering" or "group". But when Buddha taught his ideas of 'Buddha', 'Dharma', and 'monks', it came to refer only to the monks. With the letter "ga" deleted from "Seungga", only "Seung" began to be used. Today, "Seung" simply means "a monk" while "Seungga" means "a monk community."¹²

While proposing the HDM, I would like to reconstruct the concept of "Seungga" as a community of Buddhists composed of both monks and laity who study Buddhist scriptures, and practice Buddhist virtues and charity. Its meaning is extended to include Buddhist communities whether at temples or at homes. In this extended sense, HDM refers to a home community in which a group of family members and neighbors gather together to share meditation, reading, and preaching.

III. The Basis and Necessity of the HDM

1. The basis of the HDM as seen in the scriptures

Knowing that Buddha's nirvana was near, his student Ananda asked, "Who will teach and lead us now if the teacher is no longer in this world?" Buddha responded, "light your own and dharma candles." It meant that you should become a beacon for yourself, and Buddha's teachings should also be a beacon for you, and that you do not follow any others."¹³

It means that Buddhists after Buddha's death should live their lives based on the words of Buddha. He left messages about how people should live. There is a Dharma or a path to enlightenment in his words. Therefore, families and neighbors can form a community and live according to the Dharma. Such a Dharma community is the HDM. HDM refers to a community in which families of laities cherish Buddha's teachings and live according to his words.

Buddha said that to be filial to parents and to love their children is to inherit the Dharma. And it is said that the diligent study of scriptures by children makes parents born in heaven, receive all the joys and lose the sufferings of the hell forever.¹⁴ Parents pass on the Dharma to their children and the children diligently study this Dharma to return the parents' grace. In this sense, To hold a HDM is both a way for parents to love their children, and a way for the children to be filial to their parents.

The Buddha did not tell his disciples that the only way to attain enlightenment was to leave home and practice Dharma. However, as it was difficult to concentrate on Dharma practice within a family, the Buddhist communities were mainly composed of the monks and nuns who left their families, i.e., the Bhikku and the Bhikkuni. As noted above, the original sense of 'Seungga' referred to any Buddhists, whether at temples or at homes, who study Buddhist scriptures, and practice Buddhist virtues and charity.

Sangha is a phonetic translation of Sanskrit 'samgha', which is translated into monk union, monk union requires at least four ascetics. Therefore, Sangha means harmony, community, union, etc.¹⁵ Sangha can be extended to mean a family community where the monks live together.

Theravada-Buddhism emphasized individual practice, but Mahayana Buddhism pursued public salvation, so there are many Buddhist scriptural verses that can be realized by the Buddhists at home. Since Mahayana Buddhism aims for altruism, salvation of the people, universalization of enlightenment, and practice of Paramita, the daily life itself is the basis of truth, and apart from the daily life, it is impossible to realize true

enlightenment. Therefore, it can be said that HDM serves as a venue to explore the truth and practice an unspoiled life in everyday life.

Vimalakirtinirdesha Sutra in the Mahayana scripture, male devotee Yuma was more knowledgeable in Buddhism than Buddha's disciples and was more enlightened, so Buddha's disciples avoided discussing the Buddhist teachings with him.¹⁶ Yuma criticized the existing monk-centered Buddhism and emphasized the practice of Buddhism at home. In the *Vimalakirtinirdesha Sutra*, Yuma gives four important teachings. First, Buddha's Land exists in this present life, not in another life. Second, practice mercy. Third, practice equality. Fourth, there every people can attain enlightenment.¹⁷ These teachings of Yuma Sutra will be the essential values and functions of the HDM.

In addition, Lady Seungman, a female lay-person, was so proficient in orthodox Dharma that her preaching to Buddha and his disciples was even praised by Buddha himself.¹⁸ Considering Buddhist lay-people like Yuma Hill and Lady Seungman, it can be seen that enlightenment is not necessarily achieved by becoming a monk. We can also achieve enlightenment from HDM by practicing 受持讀誦 (i.e., receiving, maintaining, reading and studying) and by practicing the Six Perfections (Generosity, Morality, Patience, Energy, Meditation, Wisdom).

2. Why is the HDM?

1) The home is a field of enlightenment.

Buddha said that there are four foundations of *sati*(mindfulness) (heart, feeling, thoughts, and phenomena). It is said that if these fourfold stages are cultivated, they will achieve the ultimate knowledge in this world, reach 不來果(never-to-be-reborn), with no reincarnation only longer, or reach the wisdom of 道(Tao) and 果(Fruit).¹⁹ However, as long as obsession remains, the foundation of this mindfulness cannot be formed and the world of ultimate liberation cannot be reached.

Human obsession derives mostly from the desire for possession, sexual desire, and desire for pleasure. And these obsessions are mostly connected with the family. The reason why the monks leave their families is that the family is a source of desire and obsession. But, is the enlightenment acquired by renunciation the real enlightenment? Can a man be said to have achieved the real enlightenment just because he is happy and satisfied. If anyone suffers from his renunciation, it cannot be said to be a real enlightenment.

The purpose of Buddhist practice is to gain wisdom and achieve liberation. True wisdom is not acquired only from one's inner insight. Insight is developed and wisdom is enhanced when you encounter conflicts and problems in the real life. Therefore, in order to acquire wisdom from real life experiences, it is necessary to pursue enlightenment at home and in society.

Of course, practice alone in the mountains may be a quick and easy way to reach the samadhi. However, the life of the true enlightened person must transcend himself and put the enlightenment into practice through altruism and compassion. Therefore, the Buddhist monk's practice is in conflict with Enlightenment in view of the Buddhism's virtues of altruism and benevolence.

In orthodox Buddhism, the practice of asceticism was to be supported and encouraged. However, now that the social situation and the family structure have changed since the 20th century, religious practice should move into daily life.²⁰ Staying away from social relationships can cause pain to someone. And when he comes to the world after training, it will be difficult to overcome materialistic culture and worldly pleasures.

John Welwood, author of "*The Psychology of Enlightenment*," said, "In human relations, exchanging love is a tremendous opportunity in terms of the path of Enlightenment to become an intact human being." In particular, he said that love between men and women will be a valuable opportunity to realize human nature.²¹ In general human relationships as well as relationships between men and women, love becomes a great way of enlightenment to become an intact human being. It is said that the relationship between men and women is not based on a particular form, function or emotion, but based on the true essence of a whole person.

Therefore, the home can become a proper place for Enlightenment. The home becomes a place to learn love, trust, respect, and moral values. A scripture is a textbook that teaches these norms and happy lives. In particular, religious scriptures are textbooks that guide Enlightenment and wisdom. The HDM can be a place to learn and practice love and compassion, and thereby a place to practice, demonstrate and spread Buddhism.

2) The world today is calling for a HDM

Today, many social problems are caused by the increase of divorce rates, nuclear families, and single-person households. According to 2020 statistics, the proportion of single-person households in their 20s and 30s in the total population reaches one-third and the proportion of senior citizens living alone reaches 20%.²² The problem with nuclear families is that their children do not learn the love, ethics, and altruism that should be experienced at home. Children are likely to become unfit for social life because they do not properly cultivate their

characters through care and education at home.

Today, the elderly living alone are also becoming a serious social problem. Due to the increase in the unmarried rate and the decrease in the birth rate, the young population is decreasing and the elderly population is rapidly increasing. The number of elderly people suffering from economic poverty, disease, and loneliness is increasing day by day. As the elderly population increases, it becomes a heavy burden on society, and it is necessary to expand the social system to take care of their illness and loneliness.

Due to COVID-19, the village nursing home, church, and other institutions that played a role in communication and comfort in the community are closed, adding to the loneliness and pain of the elderly. Even if religious organizations cannot be responsible for all their economic needs and illness, they should play a role in making up for their sense of alienation and loneliness. One of the alternatives in charge of this role is the HDM. If men and women of all ages in the neighborhood come together and run the HDM, it will be possible to revitalize the social role of Buddhism, which has been shrinking due to COVID-19, as well as the growth of Buddhism.

3) COVID-19 Pandemic is demanding a HDM

The COVID-19 pandemic, which began in early 2020, has changed all fields, including economy, society, culture, and education. What was normal until now can no longer be the standard for evaluation, and new systems and standards that match the new environment and values are emerging. Nothing will survive if it does not adapt to these changes.

The same is true of religion. The COVID-19 pandemic is urging religious people to change their consciousness and faith form. Religious organizations such as churches and temples have faced situations that they have never experienced, such as a decrease in the number of believers and offerings due to social distancing. The number of believers who say, 'you can live without churches or temples' has increased, and the stereotype that you should go to a chapel or a temple to worship for salvation has also been broken.

As the saying goes, "A crisis is an opportunity." In this crisis, believers can increase their dependence on their savior and strengthen the love among their families. Also, by using online communication tools, believers can have more active fellowship and strengthen religious education. HDM can also be an effective way to revitalize the Buddhist community and activate friendships that have shrunk since the COVID-19 pandemic.

4) Family religious education is falling apart.

Religious education takes place at home, in society, and at school. It is a well-known fact that the home is the most important place for education. In particular, the role of the family in religious education is absolute. Even without a formal curriculum, the home is clearly an important place for education and learning. The home atmosphere serves as a greenhouse that nurtures faith.

Horace Buschnell, a religious educator, argues that the fundamental position of parents in a family is to mediate the faith between the subject of faith such as Jesus Christ and the family. If non-religious parents try to preach the truth, the truth has no power to change their children. Such religious education eventually becomes an obstacle in raising children religiously. In the end, the success or failure of religious education depends on whether or not parents fulfill their educational responsibilities in the place of education called the family.²³

Parents are responsible for conveying their knowledge and experiences to their children in a religious atmosphere. They should read the scriptures with their children and guide them to engrave and practice the teachings of the scriptures. Parents' faith education does not simply end in the role of conveying knowledge. Children must be cared for with love and sincerity to achieve their desirable religious growth and maturity. The religious atmosphere of the family is more important than specific educational methods and curriculum. Only in such an atmosphere can the home be a place of learning for spiritual growth.

But in modern families, the religious and educational mission of the home has been lost. Due to the nuclear family, avoidance of marriage, declining birth rate, childless culture, and increasing divorce, the unique functions of the traditional family have collapsed. In particular, the increase in nuclear families is shaking the foundation of the family. Among the unique functions of the family, only the functions of consumption and rest remain, and the educational function of the family has almost disappeared.²⁴ Parents in Korea are devoted to raising skilled workers or professionals by relying on private education rather than education as a person of character or a whole person.

The loss of religious education in the home eventually took its toll on moral and ethical education in schools. Currently, school violence and juvenile delinquency are raising discussions about the futility of schools. Faced with the absence of character and moral education in the family, the HDM can be an effective alternative to religious education.

IV. Measures for the Operation and Revitalization of the HDM

1. Significance of the HDM

It is difficult to define the Dharma meeting in one sentence because there are various types. In general, a Dharma meeting is defined "a gathering for monks and believers to listen to Buddhist texts."²⁵ However, this definition is hard to incorporate all types of Buddhist gatherings. In a broad sense, it refers to all sorts of gatherings related to Buddha's teachings. For example, 'Buddhist activities', which refer to various tasks of spreading and carrying out Buddha's teachings, 'Buddhist rites' where food is offered to the public or all the spirits, and 'Buddhist lecture' to teach the essence and the gist of Buddhism. A common element of these Dharma meetings is that they all use the Buddhist scriptures as texts. Dharma meetings does not have a single purpose or exist in a single form, but its ultimate purpose is to convey and teach Buddha's tradition and teachings.

In this research, meetings at home with such a purpose and significance are named 'Home Dharma Meeting(HDM).' After the COVID-19 pandemic, it became difficult to hold public gatherings at temples, and instead, online Buddhist services were activated. In such a situation, family-led meetings are desperately needed. The outstanding characteristic of the HDM is that it consists of small group meetings at home, whether face-to-face or non-face-to-face.

The HDM refers to a meeting where a group of several neighboring families gather to form a community and hold Buddhist services. It can be thought of as the Christian district meeting or home church.

Buddhism has the form of self-belief. The HDM has also a form of self-belief. It is not a traditional meeting led by the clergy and followed by the laity, but a meeting run by the laity voluntarily and autonomously. The HDM is a venue for developing enlightenment and wisdom through self-study and practice of the scriptures. It will be future-oriented Buddhism to switch from the temple-centered Dharma meeting to the home-centered Dharma meeting.

2. Functions of the HDM

In Buddhism, all the Buddhist activities of various purposes can be called Dharma meetings. Various types of Buddhist activities, such as the Buddhist worshipping rituals, scripture readings, Buddhist educational meetings, anniversary Dharma meetings, and Buddhist ordination services, are all considered different types of Dharma meeting.²⁶

The ultimate purpose of such Buddhist activities, formal or informal, is to pass on the teachings of the Buddha and gain enlightenment. Therefore, it can be said that any form of Buddhist activity has educational purposes, and thus becomes part of a religious curriculum.

In this sense, HDM can also serve as a venue for Dharma education to learn and teach Buddhist traditions, cultures, and truths. By doing so, HDM becomes the base of the Buddhist Land. The Buddhist Land must be realized at home.

The function of the family becomes the purpose and function of the HDM. Families traditionally have functions of childbirth, education, economic sharing, and entertainment and relaxation.²⁷

The traditional functions of the family are the same as those of the HDM. The missionary function of the HDM can be likened to the fertility function of the family. The religious educational function coincides with the educational function of the family. The generosity function corresponds to the family's economic function, and HDM's social and cultural activities correspond to the family's entertainment and relaxation function.

3. Problems of the Dharma meeting and plan to revitalize the HDM

Most temples hold various types of Buddhist ceremonies, but there is no classic example of such ceremonies. What is clear, however, is that sticking to the traditional Dharma ceremony format in an era of change will discourage believers from participating and lead to indifference to such Dharma events. Even if the nature of the Dharma meeting is maintained, the form of the meeting has to change according to the times. In order to overcome these problems, we will look into the problems and attempt to ways to improve the traditional Dharma meeting.

1) A society in accordance with the times

The current era is referred to as the era of postmodernism, the era of the 4th industrial society, and the era of the COVID-19 pandemic. People in this era have different consciousness and cultures. A new era comes with new people. In a new era, for new people, the service of the Dharma meeting should also change. Of course, the nature of the Dharma meeting can be maintained, but its form should change. It is difficult to attract believers simply by emphasizing that it is the Buddha's entrust and the Buddhists' duty.

Of course, it is true that the Dharma meeting is the request of the Buddha. However, it should be a privilege rather than a Buddhist's duty. It should not be a meeting which is led by the monks and simply followed by the lay-people. Rather it should be a meeting that is willingly participated by the lay-people as the owner of the meeting. In order to be such a meeting, it should have "the contents that can be beneficial, fresh, fun, and helpful to lay-believers' daily lives."²⁸

I have once attended a Dharma meeting held in a Zen center. To my disappointment, however, much of the scripture reading was hard to understand: Sutras such as *BanyaSim-gyeong(the Heart Sutra)* and *Cheonsu-gyeong(The Thousand Eyes and Hands Sutra)* were read in Chinese characters. It was strange to read it aloud without the understanding of the laity. In order to popularize Buddhist conferences, HDM that promotes understanding and participation is needed.

2) Development of generation-specific programs along with integrated programs

In general, Dharma meetings are classified into Children's Dharma meeting, Youth Dharma meeting, and Adult Dharma meeting, according to the participants. However, in the HDM, it is difficult to set up a separate session for each generation due to limitations in venue, teacher, and curriculum. Integrated education for all the generations is needed. This is called 'inter-generational education'. For the inter-generational Dharma meeting, it is necessary to prepare rituals and Dharma discourse that can encompass all generations.

In particular, we'll have to prepare a Dharma meeting that meets children's eye level. Of course, even without understanding all the aspects of the meeting, children will remember the feeling of Dharma meeting, and learn its tradition, community style, and purpose.²⁹ Even if the HDM has no formal curriculum, there is a hidden curriculum within the process of the Dharma meeting that promotes participants' socialization, culturalization, and religious growth. However, in order to effectively operate the HDM, the Buddhist headquarters should provide public lessons so that an integrated consciousness and culture can be spread.

3) The cultivation of a Dharma teacher for HDM

Lotus Sutra explains the position and value of the Dharma teacher: the Dharma teacher refers to a person who reads the Buddhist Sutra and distributes its teaching widely to the world.³⁰ *The Ten Biggest Wisdoms of Avatamaka Sutra* also explains in detail the responsibilities of Bodhisattva and Buddhist monks.³¹ The Dharma teacher originally meant a monk who led a Dharma meeting, but recently it has been generalized and means a propagator who is well-versed in Buddhism. Therefore, it is necessary to prepare a certain curriculum to develop the expertise of lay leaders who lead the Dharma meeting.

Due to the nature of the HDM, there is a limit to leading all meetings by monks or professional Dharma teachers. It is difficult to send a monk to every small home meeting, and not every monk is trained to lead such home meetings. Therefore, in order to properly run the HDM, it is most ideal to educate qualified lay believers and appoint them HDM leaders to lead the home meetings.

Special educational institutions and curricula are needed to train Dharma leaders who can lead the HDM. Currently, in most Buddhist universities and graduate schools, there are educational institutions for training monks or scholars who study Buddhism academically. In college, students can learn general studies, and in graduate school, they can develop knowledge and expertise in Buddhist ceremonies, sermons for ascetic practices. But there is a lack of educational institutions that train lay people to become Dharma leaders. To establish a curriculum to train Buddhist leaders is beyond the capacity of any one temple. The headquarters of the religious order should be involved in establishing special institutes to train lay HDM leaders.

4) The development of the Cyber Dharma meeting

The Buddhist Dharma meeting or the Christian worship can be taken as essentially an act of trans-sectional communication. It is communication with Buddha or Jesus, communication between the clergy and the layman, and communication between church members and church members. Through communication, you grow into a mature believer who understands and practices truth. The HDM can also be taken as an effective mode of communication. It is because more active communication takes place in small Dharma meetings.

The COVID-19 pandemic has hampered face-to-face meetings. Due to the COVID-19 pandemic, the method of communication had to change from face-to-face to non-face-to-face communication unintentionally. Due to the COVID-19 pandemic, even Dharma meetings have switched to an online communication mode. The idea that true worship is possible only through face-to-face encounters had to be broken.

As the social distancing has been lifted and the fear of the COVID-19 pandemic has eased, there is a tendency to return from online religious events to face-to-face events. However, many people have become accustomed to untact worship services and the convenience of online participation has reduced the attendance in Christian services by more than 20 percent.³² In particular, the attendance rate of teenagers and young people who are

more familiar with untact online communication is expected to be much smaller.

Therefore, it is necessary to establish a cyber meeting as an alternative while maintaining face-to-face Buddhist meetings. With the advent of the COVID-19 era, Buddhist services are to be divided into three types: face-to-face services, blended services in which offline and online services alternate, and untact services. And there is a possibility that untact meetings will gradually become mainstream.

4. The operation of the HDM

The Dharma meeting has certain regulations, but its operation can be modified according to the tradition and characteristics of each temple. In general, the Dharma meeting hold in the temple consists of ① The threefold refuges ② Praise Buddha, ③ Recitation of the Heart Sutra, ④ Song for beseeching, ⑤ Entering into samadhi, ⑥ Dharma discourse, ⑦ Donation ⑧ A great vow ⑨ The Four Great Vows, and ⑩ Notice.³³ The HDM should also be held in the same context as above, but a simpler and more efficient program is needed.

In order to efficiently proceed with the HDM, the characteristics and class of the participants, environment, and progress time should be considered. It is necessary to prepare the place of the HDM, preaching, and tools necessary for worship. In particular, the Dharma discourse should prepare a Buddhist phrase to be read in advance and write a manuscript based on it. For an effective HDM, the following matters should be considered.

First, the order of the HDM must be simple. If the contents of the meeting go beyond the participants' daily thoughts and if its process is too formal, there is no meaning in running a Buddhist meeting at home. Participants should understand the meaning of each process and be able to apply it in their daily lives.³⁴

Second, it should be a layman-centered meeting. The family-based HDM should not be unilaterally conducted by the leaders while the congregation become nothing but dull spectators. Consideration should be given to the participation of believers in each process. In general, the preaching session tends to be a boring time with the preacher speaking and the believers listening passively. A excessive preaching needs to be avoided and it is desirable to have time for conversation after the Dharma discourse is over.

Third, the untact HDM should be activated. Since the COVID-19 pandemic, social distancing has become a new trend. Untact meetings due to distancing are becoming common even in religious services. In the past, the geographical locations such as temples and churches were meaningful. There was a belief that religious ceremonies and rituals should take place in a sacred place. However, the COVID-19 pandemic has shattered such a stereotype. Online Dharma meeting and services have become popular. It has been a long time since social environments and the consciousness of believers have changed. If the religion sticks to tradition and denies change, religious activities will inevitably be eliminated.

Fourth, religions must unite for the salvation of mankind. The ultimate purpose of all religions is to save humankind. Even if times change, this purpose remains the same. In the face of COVID-19 crisis, the central Buddhist headquarters, the local parishes, the missionary parties and the meditation halls must establish a close alliance. Propagation halls and Zen centers should be converted to places for the HDM. Until now, terminal temples and missionaries should be supervised by the parish headquarters. But many temples were only officially affiliated with the headquarters while actually run independently with no real supervision.

However, it is difficult for individual missionaries or Zen centers to survive the COVID-19 pandemic if they choose to maintain independent operations. The higher order should support the denomination or the neighboring HDMs must act in unity. The parish headquarters should take the lead in building a religious platform to support local HDMs. Due to the lack of financial and human resources, it is difficult for a single HDM to operate independently. Headquarters should provide support for education, missionary work, and ceremonies. Above all, it is necessary to provide education and public lectures to strengthen the professionalism of the HDM leaders. When the representative religious order of the region and the unit HDM become wings and fly in balance, the HDM will be activated, and when the HDM is activated, the propagation of Buddhism will be activated.

V. Conclusion

The basis for the HDM can be found in the Buddha's Nirvana Discourse, "Light your own and Dharma candles." It is a teaching that dictates the purpose and function of the HDM. "Use yourself as a lamp, use the Dharma as a lamp." In the face of the crisis of the COVID-19 pandemic, we must maintain strong faith on the basis of our own judgement and the Dharma.

The HDM is a way to overcome the religious problems caused by the COVID-19 Pandemic. The HDM is a union of a small number of families to hold a Dharma meeting at home. The functions of the HDM are the same as those of the traditional family. Such family functions as childbirth, education, economic distribution, and rest and entertainment amount to the HDM functions of mission, education, preservation, and stability.

This paper is an attempt to introduce the concept of HDM and to provide a few suggestions for its proper

operation. Even without traditional leaders such as monks or Dharma teachers, lay people can hold regular Dharma meetings at home with prayers, meditation, scriptures reading, and donations. Tasks for the development of HDM include establishing layman-centered meeting format, introducing an adequate training system for lay leaders, and developing a communication system suitable for HDM. In particular, the education and training of HDM lay leaders desperately needs the active support of the parish headquarters.

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A Study on the Spiritual Healing of the Family Federation for World Peace and Unification (FFWPU): Focusing on the Healing Cases of HJ Heaven and Earth CheonBo Training Center and HJ Magnolia International Medical Center

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Abstract

It has been 30 years since the spiritual healing history of the HJ Heaven and Earth ChengBo Training Center began, and numerous patients suffering from spiritual diseases have been healed with the love and grace of Heavenly Parents and True Parents. While working in the psychiatry department of HJ Magnolia International Medical Center attached to the Training Center 20 years ago, the researcher has experienced many cases of improvement by treating mental illness patients with spiritual history and medical treatment in our hospital, who are having difficulty in treatment at other hospitals. In this study, the researcher will first discuss the similarities and differences between Christian and FFWPU of the spiritual healing, and then introduce the case of improvement and analyze the healing mechanism. In addition, for the future healing of mental illness, we will propose an effective healing plan for the spiritual healing of FFWPU.

KEYWORDS: Spiritual Healing, Mental Illness, Christianity, Family Federation for World Peace and Unification(FFWPU), HJ Heaven and Earth CheonBo Training Center, HJ Magnolia International Medical Center

1. Introduction

The study started with the motive of whether mental illness, which has limitations only with medical treatment, can't it be better cured by combining the spiritual healing? I have high hopes for the spiritual healing at the HJ Heaven and Earth Cheonbo Training Center, and I have experienced many cases that have been good as a result of applying the spiritual healing to patients' treatment, so I would like to leave a record here and discuss that the spiritual healing of FFWPU will help the mental treatment in the future.

2. Method

This paper will review literatures and conduct case studies. First, the existing papers related to the spiritual healing are organized and reviewed by searching based on domestic degree papers with the keyword 'spiritual healing'. In addition, we study the similarities and differences between the spiritual healing of Christianity and FFWPU, and determine the definition of the spiritual healing of FFWPU. The case analysis focuses on the definition of the spiritual healing of FFWPU by posting several representative cases in which the researcher treated the spiritual healing in parallel at HJ Magnolia International Medical Center and HJ Heaven and Earth ChengBo Training Center. Finally, based on such analysis, we will discuss the developmental methods about the spiritual healing of FFWPU.

3. Results, Discussions, and Conclusions

The term "spirituality" began to be used in Christianity in the late 20th century, but it is widely used today in various religions as well as in various fields of improving metaphysical quality of life. Spirituality can be said to be a human attribute to grow to a higher level through contact with a creator who transcends humans, a superior will, and a supernatural transcendent being. Defining "spiritual healing" under such a definition of spirituality refers to the process of overall growth of life on the ground due to holistic healing, not only to the healing of disease, but also to the body, mind, and soul. Mental diseases are caused by biological, psychological, social, and spiritual factors, so they must be treated from various angles and methods. The cases mentioned in this paper are

successful cases that have improved a lot by attending a spiritual program conducted at HJ Heaven and Earth ChengBo Training Center. By analyzing these cases, especially focusing on spiritual treatment, the mechanism for fundamental healing of mental illness was explained. In order to treat mental diseases, I think fundamental healing can be achieved only when considering not only biological psychological and social perspectives, which are biological treatment methods, but also spiritual perspectives.

Acknowledgement

I would like to take this opportunity to thank all those who participated in the study and the professors who commented on the presentation on this paper.

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A study on discipline theory based on unification ideology

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Abstract

In this study, various principles of discipline are presented in the thought of unification, and based on this, it is believed that it is possible to make a practical contribution to the perfection of individuality and peace of mankind by establishing a discipline system through analysis of domestic and foreign discipline methods and practicing the method. To this end, we intend to establish a discipline model based on unified thought by presenting an integrated discipline system by comparing and integrating Samilsingo(三一神誥) and yoga, which are representative discipline systems at home and abroad. The discipline system of Samilsingo is based on the idea of Heaven, Earth, and Humanity, and the Three Elements. In order to restore the original, it suggests the discipline of stationariness of senses(止感), breathing(調息), and forbidding touches(禁觸). The discipline system of yoga presents an integrated human view based on Panca-kosa, and the discipline system of Ashtanga-yoga and Hatha-yoga scriptures for enlightenment is presented. Samilsingo and the discipline system of yoga can be said to be similar to the idea of unification in that the discipline system and method for 'recovery of divinity' were chosen. Modern discipline develops with a mixture of various disciplines such as yoga, Buddhism, Taoism, Confucianism, Christianity, and Islam. And recently, these methods of discipline are being developed by combining the strengths of each method from an integrated point of view and improving them in a modern way.

In this study, based on the discipline principles presented in the Unification Thought, the integrated discipline system was classified into 7 stages, and then the methods of discipline discovered in the Unification Thought were presented. The seven systems of discipline are the purification method, regimen method, exercise method, breathing method, recitation method, meditation method, and prayer method. Health and happiness are possible when all elements that make up human beings interact with each other through comprehensive and integrated consideration, not just a specific part.

KEYWORDS: Unification Thought, Samil Singo, Yoga, Methods of Discipline, System of Discipline

Religious people's community building activity from the perspective of social capital- Focused on FFWPU members participating in the village community activity in Seoul

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Abstract

Religious people strive not only for personal religious salvation, but also for the welfare of their neighbors and the construction of a good society. Religious people's efforts to create an ideal society for their neighbors also contribute to the maturity and expansion of individuals and religious communities. The purpose of this study is to explore how religious people's practice of peace in the local community can contribute to the expansion of social capital of religious people and religious communities, and to provide implications for the future community activities of the FFWPU. Previous studies on religion and social capital claim that the social capital of religious people can only contribute to social development when it is circulated to the outside society beyond staying within religion. If I look at this argument in detail according to the three types of social capital, FFWPU members' community activities can be categorized as three- 1) the personal relationship of religious people is closely connected with outsiders of religion (bonding social capital), 2) the group activities of religious people are connected with groups of non-religious people (bridging social capital), 3) the group activities of religious people are connected with higher level of institutions(linking social capital). I take the experiences of participating in the Seoul village community project of the FFWPU members as an example. In order to carry out the purpose of this study, social capital theory was used to classify the types of social capital into three categories. It is argued that it is desirable to foster bridge-type and link-type village community activities rather than bonding type village community activities.

KEYWORDS: Community activity, Family Federation for World Peace and Unity, Social Capital

1. Introduction

Religious people strive not only for personal religious salvation, but also for the welfare of their neighbors and the construction of a good society. Religious people's efforts to create an ideal society for their neighbors also contribute to the maturity and expansion of individuals and religious communities. The purpose of this study is to explore how religious people's practice of peace in the local community can contribute to the expansion of social capital of religious people and religious communities, and to provide implications for the future community activities of the FFWPU

1.1. Research questions

1) In a case of FFWPU member's community building activity, how their activity can be categorized according to their character? 2) In a case of FFWPU member's community building activity, how their boundary of social capital is extended from family and church members to neighbor and society?

2. Methods

Oral interview is conducted in order to answer research questions above. The interview period is during October 2021 and from August to November 2022. 10 FFWPU members leading village community building project ('*Maul Gongdongche*') in Seoul were interviewed.

3. Results

If I look at this argument in detail according to the three types of social capital, FFWPU members' community activities can be categorized as three- 1) the personal relationship of religious people is closely connected with outsiders of religion (bonding social capital), 2) the group activities of religious people are connected with groups of non-religious people (bridging social capital), 3) the group activities of religious people are connected with higher level of institutions(linking social capital). I take the experiences of participating in the Seoul village community project of the FFWPU members as an example. In order to carry out the purpose of this study, social capital theory was used to classify the types of social capital into three categories.

3.1 Process of village community building project in 'Maeul Gongdongche' project, Seoul

There are four stages of process in developing community building project in 'Maeul Gongdongche' project. They are issue raising, mobilizing resources, learning, organizing. Through out those stages, FFWPU members

who is leading community project could have chance to expand their focus of activity from family and church to neighbors and society.

Issue Raising	Mobilizing Resources	Learning	Organizing
- Find issues to be solved in the local community	- Find 3 neighbors - Find more participants	-Research for project items -Discussion for proposals	- Advertise Locally - Invite local educator -Mobilize local participants

3.2 Expansion of social capital: from family and church members to neighborhood and society

I could find interviewees' change of their viewpoints. They could expand the boundary of objects for them to give love. For example, one couple started a project creating a flower path in their village. They enjoyed the joy of admiring beautiful flowers in their home, but they could share that joy to their neighbors. Secondly, one lady could create dependable neighbors like real sisters. Thirdly, a lady could embody God's heart through community projects not only through religious practice in church.

3.3 Typology of village community building project run by FFWPU members

Table 1. Categories of village community activity by FFWPU members

	Bonding social capital	Linking social capital	Bridging social capital
Inside of religious group	H, I	D	A, B
Outside of religious group	F, J	E, G	C

4. Conclusion and Discussion

Active participation in community building project can lead FFWPU members to expand their social capital from family and church to wider neighborhood and society. According to typology, some members are utilizing community project to enhance social capital within church community. It is time to discuss 1) how to foster bridging and linking social capital from bonding social capital, 2) how to foster social capital with non-church members from social capital with church members through community activities.

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A study of the Religious Theology and the Practical Model of its Religious Theology of the Family Federation from the Perspective of the "Together-ism"

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Introduction

- This study aims to organize the religious theology of the Family Federation for World Peace and Unification from the perspective of Rev. Sun Myung Moon's "together-ism", and also proposes a practical model for the trans-religious movement centered on the "together-ism".
- Until now, the Family Federation for World Peace and Unification(abb. Family Federation) has explained the theological nature of the Family Federation using the traditional types of religious theology.
- However, there was no attempt to establish the theology of the Family Federation on its own.
- Accordingly, in this thesis, the religious theology of the Family Federation will be examined from the perspective of Rev. Sun Myung Moon's "together-ism". In addition, I would like to present a practical model of the Family Federation's religious unification movement based on the "together-ism".

4. The Religious Theology of the Family Federation for World Peace and Unification from the Perspective of the together-ism

Practicing 위타주의 [witajuu] 爲他主義	Proclamation of True Parents (1992)	Opening of the Age of the together-ism
<ul style="list-style-type: none"> Meeting with General Secretary Gorbachev during the Cold War Meeting with President Kim Il-sung 	<ul style="list-style-type: none"> Reconciliation between the democratic world (Abel) and the communist world (Cain) Completed restoration of parental rights in the spirit world and on earth Restoration of True Parents (public self) to make 他 (Others) and 我 (Self) one 	<ul style="list-style-type: none"> 1997.4.8 The era of individual salvation, the era of the Holy Spirit Association for the unification of world Christianity has come to an end. 2003.5.15 Announcement of the together-ism 2003.7.13 Proclamation of the end of the era of indemnity in the providence of restoration 2004.5.5 Proclamation of the era after the coming of heaven 2011.4.8 Declaration of the era of living in the era after the coming of heaven 2013.1.13 Cheon Il Guk Foundation Day Life of Cheon Il Guk people

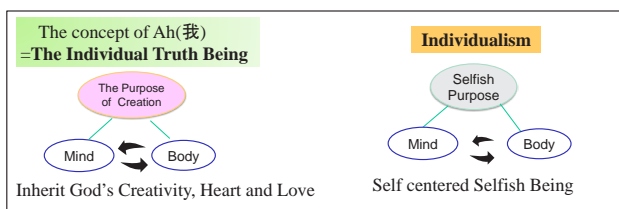
Statement of Experimental / Methods / Results

1. Together-ism seen as an individual truth being and a connected being of Unification Thought

❖ Unification Thought

The Individual Truth Being	an existing being considered as such, independently and without regard to any of its relationships with other beings	The concept of 'Ah'(我)
The Connected Being	refers to the same individual truth being, but in this case we are seeing it from the viewpoint of its relationships to other beings	The concept of 'Ta-Ah'(他我)

2. Individualism



3. The principle of living for the sake of others with true love : 위타주의 ([Witajuu] 爲他主義):

- Infinitely invested with true love that gives and gives and forgets

4. Together-ism (타아주의 [ta-a juui] 他我主義)

- the principle that you and I grow together, become one, and live together, centering on the heart of God.

The era of the Providence of Restoration:

- The principle of serving others with true love.
- Selfishness → 180 degree conversion of true love for the other person (Overcoming individualism)
- A prescription for distorted individualism



The era of the Together-ism

- Establishing a public concept of me
- Giving others to grow to the same level as me
- Living together as one through give-and-recvie action in a relationship of balance and level between me and the other person

5. Four-step practical model of an interreligious movement centered on 'the Together-ism'

1 st Step	realization of creativity	Commitment to realization of conception	<i>Sharpen your own religious spirituality and equip yourself with skills and achievements</i>
2 nd Step	expression of subjectivity	For the sake of others with true love	<i>While conveying the basis of one's religion to other religions, constantly conveying it with a heart of caring so that a heart of love can be created</i>
3 rd Step	expression of subjectivity	Growth and mutual give-and-recvie	<i>A give-and-recvie action where one's own religion and other religions are balanced and leveled on the common foundation of true love</i>
4 th Step	realization of unity	Growth and mutual give-and-recvie	<i>Raising each other's religions on the basis of true love, harmony, and unity</i>

Conclusions

- As a result of this study, it was possible to present the four-step practical model of reconciliation and unification among religions through the together-ism advocated and practiced by Rev. Sun Myung Moon.
- The first step is to become a religious person who has reached the true religious stage; the second is to love other religions wholeheartedly at your own sacrifice; the third is to bring the two religions into balance and level; the fourth is to raise each other's religions on the basis of true love, harmony, and unity.

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A Suggestion of Ecological Education Program to the Family Federation for World Peace (FFWP)

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Introduction

- The climate crisis and ecosystem destruction of the earth are more clearly revealed by COVID-19. Lynn White argued that "Human ecology is deeply conditioned by beliefs about our nature and destiny--that is, by religion" in ecological discourse on "The Historical Roots of Our Ecological Crisis". Accordingly, many studies and education on ecological and environmental theology, and movements to implement them have been conducted. Even though Family Federation for World Peace(FFWP) has been doing same way, there are still lacking. Therefore, in this study, suggestions for ecological education programs and ecological movements are derived

Environmentalism and Ecologicalism

Environmentalism	Ecologicalism
<ul style="list-style-type: none"> - Recognizing nature as a human-centered ethical perspective and maintaining the current values and social structure or solving problems with minimal reform - Nature is an object that humans dominate and use as a tool - Separation of humans and nature is premised 	<ul style="list-style-type: none"> - The view that existing values and political and economic lifestyles should be fundamentally changed. - Ecological definition: the interrelationship and interdependence of living organisms, living organisms and the environment. - Ideological reflection on technological civilization, capitalism, and humanism that caused the crisis, and philosophical search for the crisis problem of the ecological environment are premised.

The theory of education in Unification Thought

- Education**
Efforts to nurture and guide heavenly parents to resemble them
- Aims of Education**
Three Blessings`

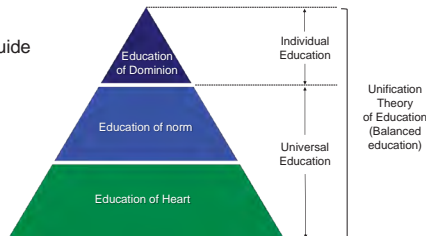


Fig. 1. universality and Individuality in Education

Ecological Education Program in Korea

- The Tbilisi Declaration(1977):** Representatives from 66 countries gathered to formally agree on the definition, purpose and objectives of environmental education.
- UN Decade of Education for Sustainable Development(2005-2014)**
- Environmental education began in Korea from the first curriculum(1953-1963)
- Training environmental education teachers from 2015.
- School Environment Education Information Center opened in 2022.
- Defining environmental education:** Education for a more sustainable future and a better life.
- Purpose of environmental education:** Cultivating Citizens with Environmental Literacy.
- Change from Environmentalism Paradigm to Ecologicalism Paradigm**

Typical Ecological Education Program in Christianity and Won Buddhism

Christianity	Won-Buddhism
<ul style="list-style-type: none"> - Group: Korea Christian Environmental Movement Solidarity(KCEMS) - There is a case of visiting a zero-waist shop and a recycling center during a training session for young people. - They share environmental prayers. - They are active in the study of textbook development and have published a total of seven books. 	<ul style="list-style-type: none"> - Group: Wonbulgyo Eco Network - Every 15th of every month, a 15-minute prayer meeting is held to repay the grace of heaven and earth. At this time, turn off the electricity and turn on the candle. - They educate children to adults on a wide range of topics about ecology. - They make and distribute ecological newsletters. Encourage action for the Earth through newsletters.

Key Considerations to Improve Ecological Education Program of FFWP

• First : Harmony and Balance

- harmony and balance between research society and movement society



- Need to harmonize environmentalism and ecologicalism.
- New theory in Unification Thought is needed to guide this issue

• Second : Balanced education program

- A new program should be added to Education of Dominion.
- In the form of balanced education, it should be conducted from low to high dimensions.

• Third : Lifelong education

- It should proceed throughout the past life, not just at a certain age.
- It's important to understand God's heart when managing Creature.
- The ultimate goal of human life is to complete the three blessings.

Suggestions of Ecological Education Program to FFWP

• First : Development and Implementation of Ecological-themed Worship and Activities

- Ecological theme in curriculum is lacking, so it should be added.

• Second : Development of ecological textbooks centered on Divine Principle, Unification Thought and True Parents' words is necessary.

- Ecological textbooks for infants, middle and high school students should be developed in consideration of the level of learners.

• Third : An ecological organization should be established.

- By establishing an organization, we should strive to establish and practice our ecological ideas.

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An Attempt to Resolve the Problems of Equality Issues in the Draft of the Anti-Discrimination Bill by Utilizing the Equality Concepts in the Unification Thought

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1. Introduction

- There are many serious problems of equality issues in the draft of anti-discrimination bill which have been introduced to Korean National assembly.
- This is an attempt to resolve these problems of equality issues by utilizing the equality concepts in the Unification Thought

2. Equality Concepts in the Unification Thought

- <Table 1> content summary

Theory of the Original Human Nature	Equality of order emphasizing object consciousness, Equality before God
Ethics	The First Equality and The Second Equality, Equality between men and women
Mutual Prosperity	Freedom and equality as two sides of the same coin

- 1) Equality of order emphasizing object consciousness

Modern society has caused problems due to the collapse of values as a result of recognizing equality as 'the equality of rights before the law'. It is important to establish an object consciousness first as a human being, a being with position, and many problems have arisen because it has been lost. Because God's love is revealed through order, he pursues equality in order. It means that we should pursue equality that keeps order in the family and society based on absolute values. On the other hand, the emphasis on subject consciousness was also considered necessary. In Unification Thought, the concept of the time sequence that starts from object consciousness and goes to subject consciousness is also explained. Subject is in a position to follow order, but does not follow it well. The subject takes on the role of creating and protecting order. Resembling God who creates and protects the cosmic order, we must stand in the position of loving the object as the subject who creates and protects the personal order, the family order, and the order of the subjectivity of all things.

- 2) equality before God

All human beings, as children of God, must realize the purpose of creation for which God, the Parent, created human beings, that is, the purpose of human existence, and strive to achieve that purpose. 'Equality before God' does not mean that everyone should be in an equal position and treated equally just because they are equal as children of God. To be equal as objects before God means to be equal after first knowing the purpose of creation of God, the subject, and conforming to the purpose of creation that operates as the fundamental norm and ethics of human society. In order to achieve equality before God, society-wide interpretation of what God, the absolute value, requires is needed, and based on that interpretation, policies for equality must be formulated.

- 3) The First Equality and The Second Equality

<Table 2> The First Equality and The Second Equality

The First equality	equality of love and personality, given equality, fair equality, absolute equality, objective equality, equality on the starting line
The Second equality	equality in the degree of fullness of love, equality to be achieved, unfair equality, relative equality, subjective equality, equality on the arrival line

God gave human beings free will and individuality, and each person's environment is different, so the achievements they will achieve are all different, but they can all be equal due to the concept of 'Second Equality'.

- 4) equality between men and women

Equality between men and women is not equal rights. Because men and women have different missions physiologically, their rights and roles are also different. This does not prevent 'first equality and second equality', and Unification Thought asserts that couples can enjoy full joy when they give and receive God's true love. Rights here are not human rights or basic rights, but this paper is limited to the rights to break the harmony of the family, such as the right to free sexual intercourse, the right to abortion, the right to engage in homosexuality, and the right to commit adultery.

- 5) Freedom and equality as two sides of the same coin

Freedom and equality are like two sides of a coin. In the condition of 'false freedom', the result of 'false equality' is derived, but in the condition of 'true freedom', the result of 'true equality' is derived. Freedom is not given because of equality. True freedom naturally results in true equality. Equality as a result is not 'true equality'. God endowed human beings with free will and individuality, and each human situation is different, so the results they will achieve are all different. In order to match performance as a result, freedom must be suppressed, and 'true equality' cannot be achieved under the condition of 'false freedom'. However, excessive deepening of economic inequality becomes an obstacle to achieving 'second equality', so wealth redistribution must be achieved through appropriate welfare policies.

Problems of Equality issues in the draft of anti-discrimination bill

- The discussion on the Anti-Discrimination Act was initiated by Article 11, Paragraph 1 of the Constitution of the Republic of Korea. "All citizens are equal before the law. No one shall be discriminated against in all areas of political, economic, social, and cultural life based on gender, religion, or social status."
- Organizations advocating anti-discrimination laws aim for equality of outcome. Their argument resembles the argument of extreme pluralism that 'You are right, I am right, and we are all right'. It is an extension of the ideological genealogy of postmodernism of the '68 Movement', which says, "Forbidden is prohibited." There is no absolute good or absolute evil, and in the situational awareness that everything is relative, it is only emphasized to see everything as equal and to have a tolerant attitude toward others. In other words, their equality is equality without absolutism.
- In particular, through the argument that sexual orientation and gender identity should not be discriminated against, they seek to justify homosexuality, defend the 'third gender', and destroy the traditional family system.

Concluding Remarks

- The serious problem in the draft of anti-discrimination bill is caused by the lack of "the concept of equality before God".
- Unification Thought recognizes absolute value as a prerequisite for equality, but the Anti-Discrimination Act does not recognize absolute value.
- Unification Thought had the purpose of fulfilling God's purpose of creation, the three great blessings, but the Anti-Discrimination Act did not require any purpose.
- There is no concept of 'fullness of love' in the concept of equality in the Anti-Discrimination Act.
- Compared to Unification Thought, which regards human sex as biological sex, the Anti-Discrimination Act considered it as gender. The Anti-Discrimination Act was different from the equality of Unification Thought in that it was equality that also claimed the right to break up the family.
- Unlike the Unification Thought position that true equality derives from true freedom, the anti-discrimination law holds that all people should be free because they are equal. It also pursues consequential equality that oppresses freedom.

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