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The Purchase Behavior of HMR for SAFETY Food Culture for the Elderly People

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Abstract

Purpose; Currently, the silver industry is developing very much, and research on elderly aging food is needed for the elderly who are having a hard time digesting and chewing food.

In order to develop HMR for the elderly, the results were derived through FGI(Focus Group Interview) to identify the purchase status of HMR for the elderly, to identify satisfaction and importance through IPA analysis, and to present the needs and development directions for the elderly food development.

Method: A total of six consumers aged 60 or older were interviewed(December 28-30, 2019), and the content of the interview was that for elderly consumers with experience in purchasing HMR each interview took two to a half hours to record a maximum of two and a half hours.

Results: There were six women in gender, and four under 65 age to 70 age. HMR was frequently purchased(once or three times a week) and purchased by four people, due to the convenience of purchase(simple), four large discount stores were purchased by HMR. Preferred food ingredients were found to prefer beef, spinach, cucumber, brown rice, fermented milk, apples and strawberries. The IPA results showed that the importance and satisfaction were high in taste, nutritional value, various menus, and convenience of food acquisition.

Conclusion: It is necessary to develop various menus that suit the tastes of the elderly so that they can safely protect the elderly from health and lead their lives. In the next study, it is thought that the size of food that the elderly can chew with their teeth should also be studied to help them eat more comfortably. It is also thought that a detailed study on the level of chewing and swallowing food should be conducted depending on the condition of the teeth of the elderly.

[Keywords] Crisis, Safety, HMR, Elderly, IPA

1. Introduction

In human life, diet is an act of eating food, and it is developing into a culture beyond maintaining life, growing right and leading a healthy life[1]. Dietary life is affected by a variety of factors, including socioeconomic factors and technological advances, differences in personal characteristics and the environment[2]. The domestic consumption environment has been changed by social and economic conditions, affecting the dietary life of modern people, and HMR(Home Meal Replacement), which enables simplicity and time saving of meals, is gaining huge popularity in modern people's pursuit of a comfortable life[3]. HMR is described as 'instant food', 'simple food', 'delivery food', 'packaging food' and 'Take-out'[4]. Because of progress by the rising standard of living increased life expectancy of the people in 2000 and, therefore, the aged population is rapidly increased to our country with an ageing population. Food is very important for maintaining the health of the elderly[5]. Elderly develop problems such as poor digestion and absorption, loss of teeth, decreased muscle strength and reflective ability associated with age[6]. The diet is very simple for the elderly, who are not able to eat easy-to-chew foods, and the lack of intake of hard or tough fruits and vegetables is pointed out as the most serious problem in low nutrition, such as vitamins and minerals[7][8]. In addition, intakes of meat and seafood, which are protein-based foods, are very necessary[9]. Therefore, it is necessary to develop geriatric foods that can maintain health and prevent disease, taking into account the physical and physiological characteristics of the elderly[10].

The study on elderly foods, food intake status due to chronic diseases[9]. Flounder in studies relating to food, dine off roast beef[11], add you6ng fruit[12], etc. have been reported. As a result, the elderly and older people, including eating habits over the preferred diet to conveniently there is little research on a study available with the case.

According to a study by Shin KJ et al(2016), the elderly's preferred recipe is steamed wet cooking method, prefer vegetable ingredients, and develop HMR, which can be easily consumed in a fully cooked state, in consideration of taste, hygiene and nutrition [9].

Therefore, in order to develop HMR for the elderly, the satisfaction level and importance of HMR are identified through IPA analysis, and the requirements and development direction for the development of food for the elderly are presented in this study.

2. Methods

2.1. FGI composition of questionnaire

Questions about elderly' HMR purchasing behavior, preferred food materials, the degree to which they consider important when purchasing and the degree to which they are satisfied after purchasing were revised and used in accordance with this study based on studies by prior study[13][14].

2.2. FGI test

FGI the six or seven(focus group interview, focus group discussion) box panel moderator inviting study in one place to present any questions or issues freely about to suggest. of the research says.

A total of six consumers aged 60 or older were interviewed(December 28-30, 2019), and the content of the interview was that for elderly consumers with experience in purchasing HMRs, consumption patterns, purchasing methods, preferred ingredients, and importance-satisfaction(on the scale of 5 points in a rack(1 point), and favorite(5 points) each interview took two to a half hours to record a maximum of two and a half hours.

2.3. Data analysis

Statistical processing of this study was done using SPSS Statistics(ver. 22.0, IBM Corp., Armonk, NY and Mplus 8.0). Frequency analysis was performed for general information, and IPA(Importance-Performance Analysis) analysis was performed for the importance and desirability of optional.

3. Results & Discussion

3.1. Demographic characteristics of the elderly

A demographic analysis was conducted to identify elderly HMR purchasing behavior, which was the same as <Table 1>. There were six female, two under 60age to 65age and four under 70age. There were three married and three divorced/separated, and the number of your family members currently living together was five for two and one for three. There were four people in charge of the meal myself, one child and one et al.

Gender	6 female(100%)
Age	Under 60 age to 65 age : 2 persons Under 65 age to 70 age : 4 persons
Marital status	Married: 3 persons Divorced/separated : 3 persons
Number of your family members currently living together	A family of two : 5 persons A family of three : 1 person
A person in charge of meals	Myself : 4 persons Sons and daughters : 1 person Et al. : 1 person

Table 1. Demographic characteristics of the elderly.

3.2. Purchasing behavior of HMR for the elderly

Purchase analysis to investigate the frequency the elderly HMR table a result of <Table 2>. How often do you buy a simple ceremony that regular to the question(1-3 times a week). In the case that there are two(1-3 times a month), often purchasing. HMR the convenience of purchasing has is taste and convenience to because(simplicity) the purchase of three, two, diverse menu is one. The place where HMR is purchased was four large discount stores, two local small discount stores, one TV/radio/newspaper advertisement, two mart/department store salesmen, and three family/friendship/ acquaintance recommendations.

Item	Frequency(%)
How often do you buy	Normal purchases(1-3 times a month): 2 persons Frequently purchased(1-3 times a week): 4 persons
Reason for Purchase	Because it's delicious: 2 persons Convenience of purchase(simple): 3 persons Various menus: 1 person
Place of purchase	Large discount store: 4 persons Local small mart: 2 persons
Information path	TV/radio/newspaper/advertising: 1 person Mart/department store salesperson: 2 persons Family/friendship/acquaintance recommendation: 3 persons

Table 2. Purchasing behavior of HMR for the elderly.

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3.3. Elderly HMR preferred food ingredient

Looking at the HMR ingredients favored by the elderly, they were like <Table 3>. The most preferred food ingredient among proteins turned out to be beef. Next came pork, egg, fish, tofu and soybeans> shellfish in order and chicken was the least preferred. Older people are at risk of various diseases and fractures due to reduced musculoskeletal bone, so they have various proteins every day. Older people are at risk of various diseases and fractures due to a decrease in musculoskeletal bone, requiring daily intake of various proteins. In this study, we examined the preferences of protein products that we usually encounter, and as in the study of Kim HA(2019), it is thought that it would be good to develop various HMR products and supply protein by utilizing unfamiliar but protein-rich dental seeds for the elderly[15].

Elderly preferred spinach and cucumbers as their favorite types of vegetables were spinach and cucumber. Next, onion > Green bean sprouts & bean sprouts, potato, sweet potato, broccoli> corn> mushroom, sweet pumpkin, and the least favorite vegetable was carrot. Carrots are commonly used as ingredients and are rarely consumed as main ingredients, so it is thought that they are not preferred.

Elderly favorite grains were brown rice and barley. It was followed by white rice, glutinous rice, white flour, black rice, and oats. It is thought that the fiber rich was preferred over the white rice due to the increased interest in health of the elderly. Kim HA(2018) studied muffins using enamel, and it is thought that enamel is softer than grain and is suitable for the elderly to consume[16]. It is also good to develop various products using enamel to help elderly people who are uncomfortable with the work. It is also thought that developing products that can be used to manufacture noodles using rice flour to provide various staple foods to the elderly, as was done in the study by Kim HA(2018), rather than flour that increases blood sugar, will also help the elderly eat grains[17].

The dairy products preferred by the elderly are fermented milk>milk>cheese, which is considered to be preferred because it is convenient to choose between drinking and eating. Currently, many of the fermented oils on the market are being released with enhanced protein, which is thought to be good for the health of the elderly.

Apples, strawberries and watermelons were the most favored fruit among the elderly. Next, bananas were preferred because they are easy to eat and soft to eat. Orange, melon and peach were also preferred, while grapes, pears and kiwis were found to be less preferred than other fruits.

Pro	ein Vegetable		Protein		table	Fruit	
Beef	4.67±0.51	Cucumber	4.83±0.41	Apple	4.33 ± 0.81		
Pork	4.33±0.52	Carrot	3.50±0.54	pear	3.17 ± 0.75		

 Table 3. Elderly HMR preferred food ingredient.

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Chicken	2.50±0.55	Sweet pumpkin	3.67±0.51	Banana	4.17 ± 0.75
Fish	3.50±0.54	Onion	4.67±0.52	Orange	4.00 ± 0.89
Shellfish	2.83±1.32	Spinach	4.83±0.40	Strawberry	4.33 ± 0.51
Tofu and soybeans	3.50±0.55	Potato & sweet potato	4.17±0.75	Watermelon	4.33 ± 0.81
Egg	4.17±0.40	Mushroom	3.67±0.82	Korean melon	4.00 ± 0.63
		Green bean sprouts & bean sprouts	4.50±0.54	Grape	3.67 ± 0.51
		Broccoli	4.17±0.75	Peach	4.00 ± 0.89
		Corn	3.83±0.75	Kiwi	3.17 ± 0.41
Gra	ains	White rice	4.17±0.75	Dairy products	
Brown rice	4.67±0.52	Glutinous rice	4.17±0.75	Milk	3.67 ± 0.81
Black rice	4.00±0.89	Barley	4.50±0.83	Cheese	3.17 ± 0.40
Oat	3.67±0.52	White flour	4.17±0.75	Fermented milk	4.33 ± 0.51

3.4. Importance and satisfaction of HMR purchase(IPA)

Items of high importance and satisfaction were 1.Taste, 3.Nutritional value, 5.Various menus, 8.Convenience of food intake. The most important and satisfying taste is the taste of food, regardless of life cycle, and it is thought that we should develop an elderly HMR product that is tasty, nutritious, and can conveniently consume various menus. Items of high importance but somewhat less satisfaction were 16.Ease of time reduction, 13.Clean and easy packaging. The items with high satisfaction but somewhat less important were 2.Hygiene, 4. The amount for one person, 9. Trusted brand, 11. Marking the expiration date. The items with both low importance and satisfaction were found to be of a value of 7. Price Appropriate, 12. Notation of Nutrient, 17. Ease of Access to Purchase. The importance and satisfaction survey found that elderly consider taste the most important when purchasing HMR, and that it is easy to access or not very important about price. In the study of Jung SA & Jang SH(2017), HMR products reported that convenience and simplicity were the most important, so they were different from this study[18]. In a study by Jeon HY(2018), simplicity was also reported to be important[19].

When developing products for the elderly, it is thought that results should be derived and developed through more detailed research on taste, various menus, and convenience of food

intake. Since the elderly feel a lot of depression due to loneliness [20], to help the health of the elderly by managing their diet, As reported in Kyeong BM et al(2019), it would be good to develop food related programs to provide healthy education for the elderly [21]. Therefore, the most important factor for the elderly to purchase and consume HMR safely and healthily is the taste, so it is necessary to develop various menus that suit the tastes of the elderly so that they can safely protect them from health and lead their lives. A study by Lee JS et al(2020) reported that fresh convenience food HMR products should be increased in consideration of consumers' health, and efforts should also be made to develop fresh convenience foods such as fruits and salads suitable for eating once for the elderly[22].



Figure 1. Importance and satisfaction of HMR purchase(IPA).

1.Taste 2. Hygiene 3. Nutritional Value 4. The amount for one person 5. Various menus
 6. Use organic ingredients 7. Price Appropriate 8. Convenience of food intake 9. Trusted Brands
 10. Marking of Origin 11. Marking the expiration date 12. Notation of Nutrient
 13. Clean and easy packaging 14. Recommendations from family, friends and acquaintances
 15. Advertisement, Promote 16. Ease of time reduction 17. Ease of Access to Purchase

Note: Supplementary explanation.

4. Conclusion

In order to develop HMR for the elderly, the results were derived through FGI(Focus Group Interview) to identify the purchase status of HMR for the elderly, to identify satisfaction and importance through IPA analysis, and to present the needs and development directions for the elderly food development.

There were six women in gender, and four under 65 age to 70 age. Three married and three divorced/separated, and the number of your family members currently living together was five, and the person in charge of the meal was found to be yourself. HMR was frequently purchased(once or three times a week) and purchased by four people, due to the convenience of purchase(simple), four large discount stores were purchased by HMR, and three family/friend-ship were recommended by their acquaintances. Preferred food ingredients were found to prefer beef, spinach, cucumbers, brown rice and barley, fermented milk, apples, strawberries and watermelons. The IPA results showed that the importance and satisfaction were high in taste,

nutritional value, various menus, and convenience of food acquisition. Therefore, since the most important factor for the elderly to purchase and consume HMR safely and healthily is the taste, it is necessary to develop various menus that suit the tastes of the elderly so that they can safely protect the elderly from health and lead their lives.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution	
		-Set of concepts 🔽	
Lead	ICV	-Design 🔽	
Author	121	-Getting results 🔽	
		-Analysis 🔽	
		-Make a significant contribution to collection 🔽	
Corresponding	BHC	-Final approval of the paper 🛛	
Author*	brie	-Corresponding 🔽	
		-Play a decisive role in modification $\ igsqcare{}$	
		-Significant contributions to concepts, designs,	
Co-Author	НАК	practices, analysis and interpretation of data $\ oxtimes$	
	HAK	-Participants in Drafting and Revising Papers 🛛	
		-Someone who can explain all aspects of the paper $\overline{\!$	

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The Effect of Barefoot Rhythm Training on the Body Composition and Abdominal Circumference of Elementary School Students in Health CRISIS

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Abstract

Purpose: The study was conducted on 30 6th grade(13 years old) students from S elementary school in D metropolitan city in Korea to verify the effects of 'barefoot rhythm training', which combines barefoot and rhythmic exercises, on the body composition and abdominal circumference of obese male elementary school students who have a body mass index of 26kg/m² or higher by performing rhythm training after equally dividing them into barefoot and shoe-wearing groups.

Method: Exercise treatment composed of 5 minutes of warm-up and cool-down exercises and 20 minutes of main exercise was given 4 times a week with targeted RPE of 9-10 for 1-4 weeks, 11-12 for 5-8 weeks, and 13-14 for 9-12 weeks. A corresponding sample t-test was performed to compare the changes before and after 12 weeks of exercise treatment.

Results: As a result of the study, it was found that the body mass index, body fat mass, and body fat percentage of the variables of body composition were found to be decreased more in the barefoot group compared to the shoe-wearing group, while the skeletal muscle mass and lean mass were increased more in the barefoot group compared to the shoe-wearing group. Similarly, the abdominal circumference of barefoot group showed a greater reduction compared to the shoe-wearing group.

Conclusion: In conclusion, since barefoot rhythm training has a higher exercise efficiency compared to the shoe-wearing rhythm training done in the same intensity and pattern, it has a greater positive effect on the body composition and abdominal circumference, which affect the obesity and metabolic diseases of elementary school students in health crisis.

[Keywords] Obesity, Middle School Students, Barefoot Rrhythm Training, Body Composition, Abdominal Circumference

1. Introduction

Elementary school-aged children often show exuberant desire for physical activity, building exercise habits and harmonious developments of mind and body while experiencing the active interaction with other students through physical activities. In particular, the upper elementary years, as one of the most active phases of physical and mental development, is an important period to maintain and improve the physical strength[1]. In recent years, obesity among elementary school students has emerged as a major social problem. In fact, obesity is not a mere increase in weight, but overweight or disease accompanied with metabolic disorders caused by excessive accumulation of body fat. In other words, obesity refers to an abnormal increase in body weight caused by energy intake exceeding energy expenditure which, in severe cases, can be identified as a disease. The causes of metabolic syndrome in pre-pubertal elementary school years are known to be associated with poor cardiopulmonary fitness due to overweight, obesity,

sedentary lifestyle and lack of physical activity. In addition, the risk from metabolic syndrome has been reported to be higher among children and adolescents^[2].

Recently, there have been increasing trends in barefoot exercises and activities that can prevent and promote health by stimulating the foot through a side effect of wearing shoes. Barefoot exercises and activities can strengthen the muscles of feet and ankles as well as improving blood circulation and boosting metabolism through delicate and harmonious movements of 1/4 of the body – 52 bones, 38 muscles and 214 ligaments. Stimulating the neural reflexes distributed in the foot activates the function of various organs, taking effects when it reaches the corresponding nervous or circulatory system[3][4][5].

Previous studies have shown that foot reflexology massage increases the blood flow rate and decreases systolic and diastolic blood pressure. In fact, such relaxation affects the endocrine system, immune system and neurotransmitter system, helps excretion process in the body and prevents diseases or pain by stimulating the peripheral nerves distributed throughout the sole and facilitating the function of organs in the body[6].

Previous studies on barefoot walking and exercise have reported that barefoot exercise has a partial positive effect on reducing weight, body fat percentage and LDL-C in obese female middle school students and demonstrated that the barefoot group showed greater exercise effects than the sneaker group when barefoot rhythm training was provided to adolescents[7][8]. In addition, 108 elderly people between the ages of 60 and 92 in the United States were divided into a group walking on a gravel road with barefoot and another group walking on the gravel road with shoes. After walking 60 minutes for three times a week for 16 weeks, participants who walked in barefoot scored significantly higher than those in the shoe-wearing group on the balance test and blood pressure[9]. Similarly, in the study on the differences between the characteristics of running with barefoot and running with shoes among children and the relationship between the characteristics and ability to jump conducted at the University of Tsukuba, Japan showed that among the 94 children aged between 6 and 12 who were tested for sprint races, recoil jumps and five consecutive jumps those with barefoot significantly improved their running and jumping skills compared to their counterpart. Also, the study found that jumping ability is higher when jumping with barefoot compared to jumping with shoes [10].

Likewise, in the study analyzing the effects on the dynamics of foot muscles when running barefoot and running with shoes, the barefoot group showed a higher maximum and average values of force applied to the three plantar muscles - the flexor digitorum longus muscle, flexor hallucis longus muscle and peroneus longus muscle, compared to the sneaker group. The findings were reported to be supporting the hypothesis that running barefoot uses more foot muscles and results in a greater exercise effect compared to running with shoes, proving running barefoot helps strengthen the foot muscular system[11].

Barefoot rhythm training is an exercise program developed in Japan to improve physical strength and athletic ability by maximizing exercise effect through the implementation of barefoot into rhythm training. The form and style of barefoot rhythm training movements are similar to music rope-skipping, letting the body freely move to the rhythm based on the basic movement in 8 beats(the rate at which eighth notes are lined up in one measure) and any derived movements from it. In addition, one of the characteristics of barefoot rhythm training, which is similar to that of the plyometric training, is that it shortens the time during which the foot touches the ground when landing a foot after a step or jump, increasing the strength of lower body and endurance and enhancing agility and explosive quickness during the process of freeing the movement of feet and knees and turns in the air between each beat[8]. Numerous previous studies have been conducted on the plyometric exercise for its effects on the motor skill, obesity, health and physical strength, body composition, bone density, exercise prescription and rehabilitation of a wide range of test subjects including elite athletes from various sports, elementary,

middle and high school students, college students and middle-aged groups and showed positive results[11][12].

The trainees of barefoot rhythm training can adjust the intensity of steps and jumps to one's own physique and fitness level when running forward to the rhythm and freely clapping or moving body parts on the way back to the start point. Walking barefoot when returning to the start point shows a higher rate of fatigue recovery, compared to a normal walking which has a less exercise effect than barefoot walking, as the feet get stimulation and acupressure and recover the mobility. With height and intensity of jumps and width and speed of steps adjusted to one's own ability and style, it also has the advantages of strengthening the muscles or ligaments surrounding joints and preventing injuries through the arches of feet and ankles absorbing shocks as the forefeet land on the ground before the rest of the feet. Arms and hands, which are axially moving with respect to joints to match the steps and jumps of the lower body, help the muscles and joints of the upper body to increase flexibility and strengths. In addition, without the need of rope skipping which requires exact timing and tightens the muscles, it is an exercise program that even students without a good athletic sense can follow if they have the ability to walk and jump can easily follow[8].

Barefoot activities on soil or sand can have sufficient health effects, but barefoot rhythm training stimulates the neural reflexes with a higher level of intensity along with the acupressure and massage effects on the feet. Meover, without tightening the top of foot, arteries and other blood vessels by an elastic sock or tightly strapped sneaker, it promotes blood circulation and improves the blood flow and the flows of cytosol and lymph in the lymph vessels by more strongly bending and twisting the feet, compared to wearing shoes [13]. Increasing the movement of the feet, which have one-fourth of the total body bones, 38 muscles and 214 ligaments, produces an exercise effect greater than that of aerobic exercise by helping the removal of toxic tissues and dead cells and promoting blood circulation. In addition, harmonious physical development of reflex, muscular strength, muscular endurance and cardiopulmonary endurance can be achieved through muscles and ligaments of the ankle and lower body which are strengthened through mid / low intensity squat effect resulted from intrinsic motor sensation with joints absorbing shocks during the process of jumping and stepping [8]. As such, exercises stimulating the feet, e.g. barefoot rhythmic training, do not only improve health but also stabilize the body. However, exercising with shoes will not induce natural foot reflex [14] nor generate the effects mentioned above. To date, there have been no studies investigating reduction of the indicators of obesity and metabolic syndrome through barefoot rhythm training or health promotion effects of barefoot rhythm training among obese upper elementary students.

Therefore, this study examines the effects of barefoot rhythm training, which has characteristics and benefits of a variety of exercises, such as foot reflexology, music rope-skipping and plyometrics, on the body composition and abdominal circumference of male obese elementary school students by comparing against the shoe-wearing group in order to provide fundamental data necessary in activating bare-foot rhythm training and bare-foot exercises for the physical education of elementary school students.

To verify the purpose of this study, the following hypotheses were set; first, the body composition of the barefoot rhythm training group will more positively change compared to the shoewearing rhythm training group. Second, the abdominal circumference of the barefoot rhythm training group will be more effectively reduced than that of the shoe-wearing rhythm training group.

2. Method

2.1. Subjects

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The study was carried out for 12 weeks from mid-April 2019 to mid-July 2019. 34 6th grade(13 years old) obese male students from S elementary school in D metropolitan city in Korea who have a body mass index of 26kg/m² or higher, without any restriction for physical activities, history of diet for the past five months and regular exercise habit were selected as the study subjects. A full explanation of the contents and purpose of the study was given to all subjects and conducted with the consent of the parents and the subjects received after a multiple notification through the parent's general meeting and letters to the parents. Excluding those who were not able to continue the experiment due to personal circumstances and other 4 subjects whose data lacked reliability, an exercise prescription was given to a total of 30 subjects composed of 15 subjects from barefoot group and other 15 from the shoe-wearing group to comparatively analyze the measurements and results.

2.2. Measurement items and methods

In this study, at-rest measurement of body composition and abdominal circumference of the two groups was made 3 days before the start of the exercise and 3 days after the exercise.

1)Body composition

Body fat mass, lean body mass, skeletal muscle mass, body fat percentage and body mass index were measured automatically using Inbody 720(Biospace, KOR). For a more accurate body composition test, the subjects were asked to wear light summer gym clothes and remove metals and jewelry from their body. The tes was carried out after 10 hours of fast and 30 minutes of rest.

2)Abdominal circumference

Using a measuring tape(hoech mass, Germany), abdominal circumference(at belly) was measured before and after the exercise treatment. The subjects were asked to comfortably breathe while standing upright for the measurement. The measurement was repeated three times by one person and read up to first decimal place(0.1 cm) for accuracy.

2.3. Exercise program

1)Exercise site preparation and preliminary adaptive exercise During the two weeks before starting the experiment, the area for planned rhythm training was prepared to remove risk factors, such as stones or sharp objects, of barefoot activities. In addition, the subjects carried out preliminary adaptive exercises, such as low-intensity walking, jumping and running with barefoot on the playground, in order to remove physical and psychological anxiety factors educating them of barefoot walking and activities[8].

2) Main Exercise

<Table 1> lists the rhythm training programs set for barefoot and shoe-wearing groups[8].

Table 1. Exercise program.

Туре	Exercise program	1~4 Wk	5~8 Wk	9~ Wk
Warm-up	Stretching and Joint twisting	RPE	RPE	RPE
(5min)	walking-lightly or jumping in-place	9~10	11~12	13~14

	Level1	 Put feet apart and jump forward Put feet apart and jump backward Put feet together and jump forward Put feet together and jump backward Parallel jump to the left Parallel jump to the right Cross left and right feet and jump backward Cross left and right feet and jump backward Cross jump forward and backward to the left Cross jump forward and backward to the right Put feet together jump forward and squat Put feet together jump backward and squat Forward jumping twice Forward jumping twice Put feet apart jump to the left, right and forward Put feet apart jump to the left, right and backward Jump forward twice and barefoot clapping Jump backward twice and backward Jump to the left, forward and backward 	2 sets (20min)	1 set 1 s (10min) (10	set min)
Main exercise (20min)	Level 2	 Put feet apart, jump forward and change rhythm Put feet apart, jump backward and change rhythm Put feet together jump to side and diagonal and rhythm change Put feet together jump backward and diagonal and rhythm change Put feet together jump backward and diagonal and rhythm change Parallel jump to the left and rhythm change Parallel jump to the right and rhythm change Cross left and right feet, jump forward and rhythm change Cross left and right feet, jump backward and rhythm change Jump forward and backward to the left and rhythm change Jump forward and backward to the right and rhythm change 		1 set 1 s (10min) (5n	set nin)
	Level3	 Put feet apart, quick jump forward Put feet apart, quick jump backward Put feet together quick jump to side and diagonal Put feet together jump backward and diagonal Quick parallel jump to the left Quick parallel jump to the right Cross left and right feet, quick jump forward Cross left and right feet, quick jump backward Quick cross forward and backward jump to the left Quick cross forward and backward jump to the right Quick jump forward and to the left and backward and to the left 		. 1 : . (5n	set nin)
Cool-dov (5min)	vn	Stretchcing			

2.4. Data analysis

The data collected from this study was analyzed by SPSS ver 23.0. First, t-test was performed to verify homogeneity of prior scores of the barefoot and shoe-wearing groups. Second, the before and after measurements of barefoot and shoe-wearing groups were measured through paired-sample t-test after 12 weeks of exercise treatment in order to compare the changes. The statistical significance level for each item was 0.05.

3. Results

3.1. Verification of homogeneity and measurement of prior items among the test subjects

<Table 2> shows the results of t-test on the body composition and abdominal circumference of the students to determine the homogeneity of the samples conduced on the barefoot and shoe-wearing groups before the exercise treatment. As no significant difference in respect to the studied items between the two groups was found, the homogeneity between the two groups were deemed to have no problems.

Measurement	Group	Average	Std. deviation	t	р	
Body mass index	Barefoot group	27.243 2.1825		0.545	0.102	
(kg/m²)	Shoe-wearing group	27.642	2.3411	8.515	0.102	
Body fat	Barefoot group	22.546	3.2215			
(kg)	Shoe-wearing group	24.837	6.7758	6.598	0.221	
Lean body index _ (kg)	Barefoot group	44.225	5.3877		0.274	
	Shoe-wearing group	44.785	6.5012	0.088		
Skeletal muscle	Barefoot group	23.987	3.5574			
mass (kg)	Shoe-wearing group	25.879	3.6852	1.775	0.255	
Body fat percent	Barefoot group	35.257	4.1322			
(%)	Shoe-wearing group	35.685	6.5567	0.285	0.588	
Abdominal circumference – (cm)	Barefoot group	88.157	6.1851	2 404	0.470	
	Shoe-wearing group	90.221	8.3895	3.401	0.173	

 Table 2. Verification of homogeneity and measurement of prior item.

3.2. Pre and post analysis of measurement items of the barefoot group after exercise treatment

<Table 3> summarizes the results of paired sample t-test to verify the difference in the measured items after 12 weeks of exercise treatment among the members of the barefoot group.

Measurement	Туре	Average	Std. deviation	t	р
Body mass index	Before	27.243	2.1825	2 1 6 2	0.001**
(kg/m²)	After	24.075	2.5512	2.103	0.001

 Table 3. Comparison of before and after measurements among the members of the barefoot group.

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Body fat	Before	22.546	3.2215	E 220	0 002**
(kg)	After	18.478	3.4525	5.556	0.002
Lean body mass	Before	43.932	5.3877	0.750	0.028*
(kg)	After	44.893	5.1879	5.758	0.038
skeletal muscle	Before	23.987	3.5574	F 410	0.002**
(kg)	After	24.988	3.5567	5.412	0.002
Body fat percent	Before	35.257	4.1322	6 125	0.002**
(%)	After	28.985	5.5661	0.125	0.003
Abdominal	Before	88.157	6.1851	2 421	0.002**
circumference – (cm)	After	84.601	4.8855	2.421	0.002**

Note: *p<.05, **p<.01.

3.3. Comparison of before and after measurements among the members of the shoewearing group

<Table 4> summarizes the results of paired sample t-test to verify the difference in the measured items after 12 weeks of exercise treatment among the members of the shoe-wearing group.

Measurement	Туре	Average	Std. Deviation	t	р
Body mass index	Before	27.642	2.3411	4 705	0.420
(kg/m²)	After	27.449	3.1022	1.785	0.128
Body fat	Before	24.837	6.7758	C 441	0.081
(kg)	After	24.005	5.6859	6.441	0.081
Lean body index	Before	44.785	6.5012	2 4 5 0	0.007**
(kg)	After	45.631	3.5599	3.158	0.007
Skeletal muscle in-	Before	25.879	3.6852	0.217	0.000**
(kg)	After	26.702	5.3968	0.317	0.008
Body fat	Before	35.685	6.5567	0 200	0.022*
percent(%)	After	33.992	6.8775	8.288	0.033
Abdominal	Before	90.221	8.3895	4 106	0.255
(cm)	After	90.018	6.8931	4.100	0.255

Table 4. Comparison of before and after measurements among the members of the shoe-wearing group.

Note:*p<.05, **p<.01.

3.4. Comparison of the difference in 'before and after test' changes th verify the exercise effects

Measurement	Barefoot group avg.	Shoe-wearing group avg.	Difference in change
Body mass index	3.168	0.193	Barefoot group > Shoe-wearing group
Body fact	4.068	0.832	Barefoot group > Shoe-wearing group
Lean body index	-0.961	-0.846	Barefoot group > Shoe-wearing group
Skeletal muscle index	-1.001	-0.823	Barefoot group > Shoe-wearing group
Body fat percent	6.272	1.693	Barefoot group > Shoe-wearing group
Abdominal circumference	3.556	0.203	Barefoot group > Shoe-wearing group

Table 5. Comparison of changes in before-after.

4. Conclusion

The ideal change in body composition is increasing the lean body mass including skeletal muscle, while reducing the weight and body fat percentage. In this study, the differences between before and after the exercise treatment demonstrate a statistically significant positive change in all items, including body mass index, body fat mass, lean body mass, skeletal muscle mass, body fat percentage and abdominal circumference among the members of barefoot rhythm training group. On the other hand, statistically significant positive improvement was found in all items except body mass index and abdominal circumference among the members of shoe-wearing group. The difference between before and after the exercise treatment, indicative of the effectiveness of the exercise, showed a more positive result in every item among the members of barefoot group compared to the shoe-wearing group. Foot reflexology known to stimulate the sole has been reported to activate the corresponding organs while promoting the supply of blood[15]. In addition, stimulating the foot has been found to promote the blood and lymph circulation in the circulatory system and reduce the body fat percentage by decreasing blood triglycerides and LDL-C, which inhibit blood circulation[16][17][18].

Barefoot rhythm training, which has the characteristics and benefits of jump-roping and plyometric, seems to activate the organs by stimulating and massaging the nerve reflectors, lymphatic system and nerve endings distributed throughout the foot via jumps and steps loaded with the body weight. Likewise, blood circulation in organs responsible for the reflex sphere seems to be increased more among the members of barefoot group compare to the members of the shoe-wearing group, resulting in increased blood flow and flow rate. Therefore, it can be argued that the important indicators of obesity, such as body mass index, body fat percentage, body fat mass and abdominal circumference, were more significantly reduced among the members of barefoot group, compared to the shoe-wearing group through the improvement of lipid and discharge of accumulated or stagnated bodily waste. It is especially noteworthy that the difference in body fat mass, body fat percentage, and abdominal circumference between the barefoot and shoe-wearing rhythm training groups is significantly different. Therefore, barefoot rhythm training is considered to be an effective exercise program that can prevent metabolic syndrome and lifestyle disease derived form obesity among adolescents[19][20].

The before and after change in skeletal muscle mass and lean body mass among the members of barefoot group show higher improvement compared to the members of shoe-wearing group,

indicating strengthened lower extremity muscular system through continuous contraction and relaxation of the muscles surrounding the joints and arches to absorb[10][19] the shocks from the jumps and steps of barefoot rhythm training. It can be understood that the previous studies demonstrating that barefoot rhythm training, which has repetitive exercise patterns of jump-roping and plyometrics, uses more foot muscles and ligaments and creates a greater exercise effect in terms of reflexes and muscular endurance compared to shoe-wearing rhythm training support the findings of this study[8][20].

Consequently, barefoot rhythm training, which stimulates the reflexes distributed on the feet connected to all areas of the human body, including the nervous system and circulatory system and has various advantages of jump-roping and plyometric exercise and a higher exercise efficiency compared to the shoe-wearing rhythm training done in the same intensity and pattern, with a more positive effect on the body composition and the abdominal circumference of elementary school students with health crisis, e.g. obesity and metabolic syndrome.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution		
Author	ТНК	 -Set of concepts Ø -Design Ø -Getting results Ø -Analysis Ø -Make a significant contribution to collection Ø -Final approval of the paper Ø -Corresponding Ø -Play a decisive role in modification Ø -Significant contributions to concepts, designs, practices, analysis and interpretation of data Ø -Participants in Drafting and Revising Papers Ø -Someone who can explain all aspects of the paper Ø 		

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A Study on the Investigation of the Presence of Potential Infected Tree in the PREVENTION of Pine Wilt Disease

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Abstract

Purpose: The methods of preventing and controlling pine wilt disease(PWD), currently used in Korea, include fumigation, incineration, and fragmentation of the infected tree, which shows exterior discoloration. However, there are potential infected trees that have a healthy appearance but is already running out of resin, which serves as a breeding ground for Monochamus alternatus, aka Japanese pine sawyer.

Method: Therefore, in order to confirm the presence of potential infected trees in the affected area, the damage was divided into five grades, and potential infected trees were investigated through the process. Accordingly, the time sequential examination of the reduced pine resin and the coniferous discoloration in a total of 1,057 pine trees of kinds(Pines, Japanese black pines, Korean pines, Pinus rigida) was conducted to investigate the existence of the potential infected trees in the 2 district of extreme damage in this study and among them 176 trees(16.7%) were selected as the potential infected trees.

Results: The results of this study showed that there were usually 4 to 5 percent of potential infected trees right after the removal of infected trees and that the percentage gradually increased over time. In addition, 26 diagnostic kits and 29 microscopic examination of 32 samples confirmed Bursaphelenchus xylophilusas in the target trees.

Conclusion: Therefore, it is considered necessary to concentrate on checking the expansion of the pine wilt by preventing the attracted egg laying of the vectors by searching the potential infected trees through the relatively easy-to-perform extraction of pine resin from the healthy trees in external appearance around the damaged withered trees. The cross-checking of the results of the diagnosis kit and microscopic examination confirmed the presence of Monochamus alternatus in the potential infected trees with the 25 samples.

[Keywords] Pine Wilt Disease, Bursaphelenchus Xylophilus, Bursaphelenchus Mucronatus, Potential Infected Tree, Coniferous Discoloration

1. Introduction

The natural ecological distribution of pine trees is divided into two main areas. One is formed as a continuous colony of pseudoclimax at the location of the mountain's rocky outcropping[1], and the other is observed as a constituent of pioneer vegetation due to the physical disturbance of the location due to flooding of mountainous sand streams or decay slopes. Pine trees(Pinus) on the Korean Peninsula have most successfully adapted to the environment since its emergence in the Cretaceous period of the Mesozoic Era and have so far spread from the warm regions to the high reaches of the cold regions, and the ecological coverage is so wide that they can grow from close to the sea level to 1,300 meters above sea level. Pine trees are a major local species representing coniferous trees and are an important economic tree species, accounting for about 1.47 million hectares, or 23 percent of the total forest area of 6.37 million hectares[2].

Pine trees are the most Korean-like and Korean-style trees in material usefulness and mental symbolism[3]. The Korean people have created an unusual pine tree culture in the world and made progress in it[4]. Pinewood has long been used as structural members of large-scale wooden buildings such as palaces, temples, and mansions, and as civil engineering materials, it is still well-received for high-quality wooden houses and old buildings. However, pine trees, which occupy such a major position as a living resource in the Korean culture, are suffering from pine wilt disease(PWD), so-called "pine trees' AIDS," and the damage has now spread nationwide and reached a serious state[5]. The outbreak of PWD was first discovered in Nagasaki, Kyushu, Japan in 1905, but the initial damage spread rapidly due to the lack of awareness of it as an infectious disease and the prevention effort. It is reported that it was first discovered in Korea in Geumjeongsan Mountain in Busan in 1988[6].

Bursaphelenchus xylophilus is a native species of North American continent of Canada, the U.S., and Mexico[7][8][9], and most native tree species in North America are known to be resistant, but when it enters other countries such as South Korea, Japan, and China, it causes fatal damage to the forest ecosystem[10]. PWD occurred in Japan for the first time in 1905[11], but they mistook it as pine Thysanura, and it was not until 1972 that it turned out to be PWD. As of 2011, Japanese black pine and pine trees in Japan are almost wiped out by PWD spread across the country except for Hokkaido and Aomori[12][13][14]. In 1982, China first discovered the damage by PWD on P. thunbergii in Namkyung City, and they created a 4-kilometerwide, 100-kilometer-long no-pine belt on Yellow Mountain as a control and prevention effort[15]. Taiwan first discovered it in 1985 in the afforestation zone of P. luchuensis in Taipei prefecture, and since then, it has been known that native pine tree species including Pinus taiwannensis and black pine are in a state of annihilation[16]. In Canada, it occurred in Ontario in 1985. It also first occurred in Portugal in 1999 in the Pinus pinaster near the Setubal Peninsula near Lisbon[17].

The number of damaged pine trees in Korea reaches 2 million every year, with the cumulative damage reaching 10,662,481 as of the end of April 2016. A total of 731,263 million won was invested in the budget, including 517,161 million won in state funds and 214,102 million won in local expenses, to eliminate 10,632,487 damaged trees, and 85,183ha in crop dusting, 18,915ha in ground control, and 3,080ha in tree injections[2]. But PWD continues to spread and increase.

Most of the causes of the spread of PWD are spread by medium insects, especially Monochamus alternatus, which has an activity range of about 100 meters, but travel more than 2 kilometers in strong winds. It is reported that PWD is closely related to location environmental factors, and among many factors, temperature and soil moisture conditions are known to be significantly related to the outbreak of PWD[18]. Areas with summer air temperatures below 20°C have reported moderate damage to PWD, while areas with low water retentivity soil are reported to be severely affected by PWD[19]. And the damage is increasing as the resistance of pine trees is weakened due to the neglect and eutrophication of pine forest. After the removal of the damaged dead trees in the spring season at the end of April, there were many potential infected trees around the logging site that looked healthy but slowly dying due to the decrease in the resin in the trunk, which became very suitable for the breeding ground of Monochamus alternatus, inducing the spawn of medium insects, leading to the recurrence of the spread of the damage. In addition, PWD first discovered in Korea is believed to be caused by a monkey carrier from Japan, which has been assumed by the discovery of an escape hole on it. As such, the biggest reason for the spread of PWD is the long-distance migration of damaged timber containing Bursaphelenchus xylophilus and medium insects. Currently, Korea

applies forestry control, chemical control, biological control, and physical control, but the main control method is forestry control and chemical control. To prevent the spread of PWD, complete control of the movement of pine trees and the research and introduction of new control methods are needed. Therefore, this study provides a clear basis for the detection of potential infected trees that may be omitted from the current methods of preventing PWD, validates the effectiveness of diagnostic kits that are expected to be effective, and suggests an efficient method for preventing PWD in the future.

2. Research Method

2.1. Selection of experimental zones

Pohang and Andong, where PWD is extremely severe, were selected as experimental zones, the areas to be studied. 201 pine trees, 107 Japan black pine trees, 22 pitch pine trees in Pohang and 311 pine trees and 416 nut pine trees in Andong were selected as subjects to be tested, and pine resin extraction and coniferous discoloration tests were conducted. According to the criteria, suitable damaged trees for each grade were selected as the subjects to confirm the presence of Bursaphelenchus xylophilus.

2.2. Research tools and materials

As tools for this study, GPS(Trimble, juno T41/5), 1/5,000-level map, drill(BOSCH–GSR18-2), and 8mm diameter specimen collector and, as research materials, remaining pine trees in the experimental zones, samples taken from potential infected trees, experimental/medium insects, and diagnostic kits(detect kit - GENE0041 from NIPPON GENE Co., Ltd.) were used.

For each type of insects used in microscopic examination and diagnosis kits, they were used separately from samples collected from the laboratory at Kyungpook National University's Insect Physiology Laboratory and Pusan National University's Insect Research Institute, while for Bursaphelenchus xylophilus, larvae were bought from Gyeongbuk Forest Environment Research Institute and used. And other materials and samples were bought from Kyungpook National University's Insect Physiology Laboratory Laboratory and Samples were bought from Kyungpook National University's Insect Physiology Laboratory and used.

2.3. Time series investigation of the reduction of resin and the coniferous discoloration

This was divided into five grades according to the criteria for time series analysis of resin reduction and coniferous discoloration and was divided into normal(grade 3 and 4) and infected(grade 0, 1, and 2) and normal(grade 4) and discolored(grade 0, 1, 2, and 3).

2.4. Setting for the stop and start point of resin extraction

The setting of the stop and start point and the time of confirmation of the extraction after perforation are as shown in <Table 1> and <Table 2>.

Grada		Start point								
Grade	10.30	11.6	11.13	11.20	11.27	3.13	3.20	3.27	4.3	4.10
4	24	-	-	-	-	-	-	-	-	16
3	6	18	-	-	-	-	-	-	16	14
2	-	12	12	-	-	-	-	10	14	-
1	-	-	18	12	-	-	22	20	-	-
0	-	-	-	18	30	30	8	-	-	-

Table 1. Setting for the stop and start point of resin extraction.

Tree					1	Time pass	ed after p	erforatior)			
species	5 min	10 min	20 min	30 min	40 min	50 min	1 hr	2 hr	3 hr	4 hr	5 hr	
	5.14	1.0	2.5	3.1	3.2	3.8	4.0	-	-	-	-	-
Discotore	7.9	1.3	2.9	3.4	3.5	3.9	4.0	-	-	-	-	-
Pine tree	9. 3	1.2	2.4	3.0	3.3	3.8	3.9	-	-	-	-	-
	Avg.	1.2	2.6	3.2	3.3	3.8	4.0	-	-	-	-	-
	5.14	0.1	0.2	-	0.3	-	-	0.7	1.4	2.0	2.8	3.6
Nut pine	7.9	0.4	0.9	-	1.2	-	-	1.8	2.4	2.8	3.4	3.9
tree	9. 3	0.2	0.9	-	1.2	-	-	1.9	2.6	2.8	3.3	3.9
	Avg.	0.2	0.7	-	0.9	-	-	1.5	2.1	2.5	3.2	3.8

Table 2. Setting for the time of confirmation of the resin extraction after perforation.

2.5. Checking the presence of Bursaphelenchus xylophilus in potential infected trees

Among the 176 trees of the subjects identified as potential infected trees, 2 Japanese black pine trees, 13 pine trees, and 17 nut pine trees were selected as the target samples and microscopic examination and diagnostic kit response tests were conducted. Samples were collected from the subject trees and microscopic examination was conducted after the separation of Bursaphelenchus xylophilus by the Baermann funnel method.

2.6. Diagnostic kit test

For the diagnostic kit test, the two sample pieces collected were placed in a container containing extracts and kept warm at 55°C for 20 minutes, then kept warm at 94 to 100°C for 10 minutes, then melted the target for DNA extraction. In order to amplify DNA extracted from the sample pieces with the kit, $2.0\,\mu\ell$ of DNA extraction solution was added to $18.0\,\mu\ell$ of the test solution to keep it warm at 63°C for 60 minutes, and then the test reaction was stopped after holding it at 80°C for 2 minutes. In ultraviolet light, the samples were judged positive for vivid yellowish green color and negative for light brown color.

3. Research Results

3.1. Results of analysis of the timing of coniferous discoloration according to the grade of resin extraction

After conducting the resin extraction test, the research team analyzed when the coniferous discoloration began to occur according to the resin extraction grades. The results show that pitch pine trees were not infected with PWD as shown in <Table 3>. In addition, coniferous discoloration did not occur in grades 3 and 4, it was most common when it was grade 1, and the occurrence frequency was high in the order of grade 0 and grade 2. In other words, although there were some differences between the potential infected trees, it was confirmed that the reduction of pine resin was significantly preceded by the coniferous discoloration.

		Coniferous discoloration grade										
De sins surs de		Pine	trees		Japanes t	e black pine rees	Nut p	ine trees	Pitch	Pitch pine trees		
Resin grade	Р	ohang	Aı	Andong		Andong		0/	No	0/	No	0/
	No.	%	No.	%	NO.	70	INO.	70	INO.	70		
4	-	-	-	-	-	-	-	-	-	-		
3	-	-	-	-	-	-	-	-	-	-		
2	5	9.4	2	9.5	2	9.1	5	6.3	-	-		
1	32	60.4	11	52.4	9	40.9	50	62.5	-	-		
0	16	30.2	8	38.1	11	50.0	25	31.3	-	-		
Total	53	100.0	21	100.0	22	100.0	80	100.0	-	-		

 Table 3.
 Analysis of the timing of coniferous discoloration according to the grade of resin extraction.

3.2. Analysis of the starting point of resin reduction and coniferous discoloration

The results of the experiment on the starting point of coniferous discoloration in regards to the resin reduction are shown in <Table 4>. Pine trees have changed since an average of 46 days since the start of the resin reduction, while 39 days for nut pine trees.

Tree species Description		Per	The start	A			
	4 weeks	8 weeks	12 weeks	16 weeks	Time took	Average	
Dina	No. of trees	7	5	2	-	14	-
Pine	Time took	196	280	168	-	644	46
Nut also	No. of trees	41	14	3	1	59	-
Nut pine	Time took	1,148	784	252	112	2,296	39

Table 4. Analysis of the starting point of resin reduction and coniferous discoloration.

3.3. Microscopic examination results

Microscopic and diagnostic kit results for primary 40 trees and secondary 32 trees to determine the presence of potential infected trees are shown in <Tables 5> and <Table 6>. As shown in <Table 5>, the microscopic examination of the primary 40 trees confirmed the presence of Bursaphelenchus xylophilus in 55% of potential infected trees on average.

	S	ubject trees by	/ sample grou	р	No. of	Infection	No. of insects/g	
I ree species	Total	0	1,000 2,000 trees		trees	rate (%)	Total	Avg.
Pine	17	7	9	1	10	41.2	2,686	158
Japanese black pine	3	1	1	1	2	66.7	1,321	440
Nut pine	20	10	8	2	10	50.0	5,434	272
Total	40	18	18	4	22	55.0	9,441	236

Table 5. The result of primary microscopic examination.

As shown in <Table 6>, microscopic examination showed that 9 out of 13 pine trees from Pusan National University and 7 from Kyungpook National University showed a 69.2% infection rate, and both universities confirmed 82.4% infection from 14 pine trees and 2 Japanese black pine trees.

T	Cubic et trace	PNU		К	NU	No. of	Infection rate	
Tree species Subject tre	Subject trees	Positive	Negative	Positive	Negative	infected trees	(%)	
Pine	13	9	4	7	6	9	69.2	
Japanese black pine	2	2	0	2	0	2	100.0	
Nut pine	17	14	3	14	3	14	82.4	
Total	32	25	7	23	9	25	78.1	

Table 6. The result of secondary microscopic examination.

3.4. Diagnostic kit test results

The results of the diagnostic kit test for the presence of Bursaphelenchus xylophilus in potential infected trees are shown in <Table 7>. According to the diagnostic kit test, 10 out of 13 pine trees were matched(76.9%), 2 out of 2 were matched for Japanese black pine trees, and 14 out of 17 were matched for nut pine trees, showing an 82.4% infection rate. This was consistent with the results of the microscopic and diagnostic kit tests for Japanese black pine and nut pine trees, excluding pine trees. And one more pine tree was confirmed by the diagnostic kit test, which is the advantage of the diagnostic kit test that responds only to parts of the body of Bursaphelenchus xylophilus, unlike only live Bursaphelenchus xylophilus is found in microscopy. Table 7. Diagnostic kit test results.

- .	Cubicathras	Diagnost	ic kit	No. of infected	Infection rate(%)	
Tree species	Subject trees	Positive	Negative	trees		
Pine	13	10	3	10	76.9	
Japanese black pine	2	2	0	2	100	
Nut pine	17	14	3	14	82.4	
Total	32	26	26	26	81.3	

3.5. Diagnostic kit reaction test

The results of the diagnostic kit reaction tests on Bursaphelenchus xylophilus, Bursaphelenchus mucronatus, and other larvae in order to more clearly identify the presence of separated Bursaphelenchus xylophilus are shown in <Table 8>. In order to confirm the presence of Bursaphelenchus xylophilus, 10 units of each of the three species of prenatal larvae(Bursaphelenchus xylophilus, Bursaphelenchus mucronatus, and other larvae) were tested with LAM-PCR. It showed positive only for Bursaphelenchus xylophilus and negative for Bursaphelenchus mucronatus and other larvae, confirming the diagnosis kit showed positive only for Bursaphelenchus xylophilus.

Table 8. Reaction test of Bursaphelenchus xylophilus diagnosis kit by group.

Time	No. o	f unit	
туре	1	10	
Bursaphelenchus xylophilus	Positive	Positive	
Bursaphelenchus mucronatus	Negative	Negative	
Other larvae	Negative	Negative	

3.6. Comparison of infection rates by pine species

In this study, in the final field survey on October 30, 2016, the research team considered pine trees with resin reduction and coniferous discoloration as infected trees and compared the infection rates for each of the four species. Symptoms were not found on pitch pine trees at all, and 8.4% for Japanese black pine, 11.4% for pine trees, 27.4% for nut pine trees were found to be infected, in that order.

In general, the resistance to PWD is known be strong in the order of pitch pine, pine, black pine, and nut pine trees[20]. However, the results of this study showed the order of pitch pine, black pine, pine, and nut pine, showing a different tendency from the previous research results. This is presumed to be the result of the decrease in access to the medium insects, as pine trees are dominant in Pohang and the black pine trees are scattered.

4. Consideration

To control PWD, there are methods to control Bursaphelenchus xylophilus itself, and to control Monochamus alternatus, which is the medium insect[21], and to control Monochamus alternatus is the easier way[22]. According to the macroscopic observation of coniferous discolorations, the typical damage symptoms of dead trees caused by Bursaphelenchus xylophilus are distinctly different from those caused by other forest pests due to as in single trees rather than group distribution in one place. Currently, the most commonly used method for preventing PWD is fumigation[23][24][25], fragmentation, crop dropping, and injection,

which focuses on the post-treatment rather than prevention. The most effective way to control PWD is to control the movement of pine trees, which is the host plant. However, there is a limit to the control of Bursaphelenchus xylophilus. Even after removing dead trees from the spring season at the end of March, there were many potential infected trees in the same forest. It will continue to supply the breeding grounds for Monochamus alternatus, which is the medium insect. Therefore, it is necessary to prevent the domination of it by removing the potential infected trees while removing the damaged trees, and to do so, first, potential infected trees should be identified through resin extraction test. According to this experiment, the coniferous discoloration occurs 46 days after resin reduction for pine trees and 39 days for nut pine trees, so potential infected trees must be removed when removing damaged trees. In particular, when a damaged dead tree in the area of prevention of PWD is found, a full investigation of pine trees within a radius of 20 to 60 meters from the first dead tree must be conducted and all potential infected trees and weak trees must be removed to prevent the spread. Currently, it relies solely on microscopic examination to check for the infection, which is not enough to confirm the spread of PWD. Rapid and accurate diagnosis of infection is required through research and development of diagnostic kits in the future.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution
Lead Author	JYH	-Set of concepts ☑ -Design ☑ -Getting results ☑
Corresponding Author*	LWH	-Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑
Co-Author	LSJ	-Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs,
Co-Author	PJS	practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Reflective Research on the Impact of the Public Health CRISIS on Chinese Sport Industry by the COVID-19 Pandemic

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Abstract

Purpose: The outbreak of public health crisis of COVID-19 has caused the Chinese sports industry to suffer a "cold winter" and turned into stagnation from rapid development. Although China's sports industry has been gradually restored under the leadership of the government after the epidemic has been effectively controlled, the internal problems exposed by COVID-19 are still worth pondering. These problems will not only impede the further development of China's sports industry, but also make it difficult to cope with other public health emergency crisis.

Method: This study researched the impacts of COVID-19 on Chinese sports industry through literature review and data collation, so as to reflect the existing problems in Chinese sports industry and put forward corresponding suggestions.

Results: Through summarizing the current situation of impacts, it found COVID- 19 had negative impact on sports competition performance, sports fitness and leisure activities, sports tourism services and education and training industry of sports industry. It caused huge economic losses, even hinders the continue development of these industries. Through the specific analysis of the current situation, this paper believed that the huge losses on small and medium-sized sports enterprises was the reason caused such serious consequences. The reasons are as follows: (1)small and medium-sized sports enterprises lacked plans and capabilities to deal with public health emergency crisis due to their small sale and weak assets; (2)In order to control the spread of COVID-19, Chinese people have adopted a semi-closed life. The loss of physical consumers has a fatal shock to small and medium-sized sports enterprises model; (3)Small and medium-sized sports enterprises are unable to quickly and effectively resume normal operation after the epidemic situation is under control due to their insufficient recovery capacity.

Conclusion: In order to solve the existing problems, the development suggestions about government dominantion, enterprises assist for small and medium-sized sports companies are proposed. The suggestions are as follows. (1)public health emergency crisis plan for small and medium-sized sports enterprises is established in China to ensure that small and medium-sized sports enterprises can make timely and effective response when public health emergency crisis happens. (2)diversified online business is conducted based on big data and the Internet by small and medium-sized sports enterprises under the premise of effective supervision, so as to solve the problem of single operation mode and poor pressure-resistant ability of small and medium-sized sports enterprises. (3)epidemic sports industry insurance is carried out to create GDP and enhance the ability of small and medium-sized sports enterprises to resume normal operation.

[Keywords] Public Health Crisis, Chinese Sports Industry, Sports Industry Development, Crisis Countermeasures, COVID-19

1. Introduction

The successful hosting of the 2018 Beijing Olympics has brought the Chinese sports industry into a golden development period. By 2018, its total scale has reached RMB 2,657.9 billion(US \$372.1 billion), accounting for 1.1% of GDP[1]. It has officially become one of China's pillar industries. In order to ensure the continuous and stable development of the sports industry, the Chinese government again promulgated relevant policies in 2019 such as "Opinions on Promoting National Fitness and Sports Consumption to Facilitate High-quality Development of the Sports Industry". The document established the important position of the sports industry in China's economic construction in the future and clearly pointed out that the sports industry has achieved further development on the existing basis [2]. However, with the outbreak of COVID-19 in early 2020, the emergency brake button was forced to be pushed for the sports industry train that is supposed to continue to move forward rapidly. In order to control the spread of COVID-19, offline sales of sports goods were urgently shut down, import and export trades were put on hold, sports lotteries were suspended, sports training activities were prohibited, stadiums and fitness clubs were closed, and many sports events and performances faced cancellations and delays. Winter sports tourism, which is supposed to be in full swing, also missed the once-a-year development opportunity. Although the epidemic in China has been properly controlled and the government has issued numerous policies to restore the operation of the sports industry, it will take a long time to recover to the previous level. Moreover, the global spread of COVID-19 has not ended and the development of the sports industry is still greatly restricted. How to resume development is still an important issue facing the Chinese sports industry.

In order to find solutions, the Chinese academia has conducted numerous studies on this topic and achieved corresponding results. For example, Cheng(2020) of Chengdu Sports University believes that the damage to the sports industry in this epidemic is comparable to that to the cultural industry, which makes them both seriously damaged industries, especially the sports performance business, which is the most intense industrial pain point [3]. Zheng(2020) conducted a study on the development trend of the sports goods business and proposed corresponding strategies [4]; Zhang and Jiao (2020) studies the development space shift of sports industry and space shift and value reconstruction based on the Internet[5]; Hou, Zhang and Xiao(2020) adopted the SWOT analysis method to summarize the SWOT analysis matrix of the sports event industry under COVID-19 and proposed specific countermeasures [6]; Liu(2020) used the literature review method, questionnaire survey method, investment and financing theories to analyze the impact of COVID-19 on the Chinese sports venture capital fundraising, investment, management, and other links according to the development status of sports venture capital^[7]. In addition, other scholars have conducted research on this issue but in general, most of them focused on the development trend of the sports industry and how to solve the dilemma faced. COVID-19 is just one type of various public health emergencies. If internal reflections could be done on the impact of COVID-19 to manage possible crises from the roots, it could contribute to the faster and more effective solution for future public health emergencies. Therefore, this paper took COVID-19 as an example and summarized the impact of COVID-19 on the Chinese sports industry through literature review and data sorting and then reflected on the problems existing in the Chinese sports industry and put forward corresponding suggestions. It was hoped that this paper could provide theoretical guidance for the development of the Chinese sports industry after public health emergencies and references for the continued research in this field.

2. How Did Covid-19 Outbreak Affect Sports Industry in China

Sports industry is a market in which production activities are conducted to provide society with various sport related products including goods, programs, services etc. It includes 11 major

industries(such as sport management activities, sport competitions and exhibitions, fitness and leisure sports, management of sport venues and facilities, sport education and training, sport-related media and information services, construction of sport venues and facilities, etc.) which can be further divided into 37 subcategories of activities[8]. In order to have a more intuitive understanding of the impacts of COVID-19 on sports industry in China, it chose four sports industries; 1)sport competitions and exhibitions, 2)fitness and leisure sports, 3)sport travel, 4)sport education and training which were all had great shock.

2.1. The impacts of COVID-19 outbreak on sport competitions and exhibitions in China

For the industry of sports competitions and exhibitions, 2020 should have been a good year with a schedule packed with international and domestic events, but the COVID-19 outbreak changed everything. For the fierce epidemic, the General Administration of Sports of China announced the suspension of all sports events scheduled for April 2020. According to statistics, a total 120 sports events have been cancelled or postponed since January 2020 [9]. Taking marathon, a very representative sports event, as an example: According to the "2018 Big Data Analysis Report on Marathon Events in China" released by the China Athletics Association, 1581 marathon competitions and related events were held in China in 2018, giving rise to a total annual industrial output of RMB 74.6 billion(US \$10.43 billion) and another RMB 28.8 billion(US \$4.03 billion) in the consumption of related goods and services [10]. But in the year 2020, nearly 30% of the marathon events originally scheduled to be held in China this year have already been cancelled, which shocks not only to the economic performance of the Chinese marathon industry but also to the contributions it can make in terms of cultural promotion, nationwide fitness programs and urban construction. Other than marathon, China's professional sports leagues(basketball, football, volleyball) have also been suspended for some time due to the outbreak. Although competitions have successively resumed, it will take a long time for them to recover from the blow of the outbreak on their ticket revenue, sphere of influence and broadcast intensity etc., which is causing serious losses to not only the organizers, teams and other organizations of these leagues but also subsidiary industries that rely on them. What's more is that the 2022 Beijing Winter Olympics may also be affected by COVID-19 outbreak. Tokyo Olympics is postponed to 2021 but still faces the threat of cancellation, and according to estimation given by the Japan Tourism Bureau, just the postponement of the Tokyo Olympics alone will have a huge impact on Japan's tourism industry in the next few years [11]. If in the future Japan is forced to cancel the Tokyo Olympics because it can't control the epidemic, it will lose more than US\$3.1 billion in sponsorship fees provided by 62 domestic organizations and nearly US\$1 billion in broadcast revenues [12]. It can be predicted what a serious dilemma sports industry in China will face if China government is also forced to postpone or cancel the 2022 Beijing Winter Olympics due to COVID 19. If the public health crisis could not be solved, it would also have an impact on the public and social security of China's 2022 Beijing Winter Olympic Games [13]. At that time, s sports industry in China will suffer a heavy shock again. In addition, since the outbreak of COVID-19, there was a rumor and about the COVID-19 manufactured in Chinese laboratories and political conspiracy theories between China and US[14]. It has been and spread political conspiracy theories and the United States. These public relations crises have also had an impact on the hosting of the 2022 Beijing Winter Olympic Games and the development of sports industry in China.

2.2. The impacts of COVID-19 outbreak on fitness and leisure sports in China

In the industry of fitness and leisure sports, those affected by COVID-19 are mostly fitness clubs, various sports venues and fitness activities organized by the public. During the worst times of the outbreak, all fitness clubs and various sports venues in China were closed, and all spontaneously organized sports activities were cancelled, leading to the suspension of development of entire industry. Not counting non-profit sports activities organized by the public, pre-

sales constitute the main source of income for practitioners in the industry and Chinese New Year has always been a golden period for making pre-sales. However, due to the outbreak of COVID 19, those practitioners not only missed a golden opportunity for making income but also faced expenditure issues such as refunds, rent, and employee salaries because they were forced to close. According to a survey from the 100 Chinese companies in the sports industry: 77.19% of respondents reported a significant drop in operating income, 21.05% of them are facing employment difficulties, 66.67% of them has postponed their business operations and 14.04% of them reported that their operations were seriously affected by the epidemic [15]. Although Chinese government has introduced preferential policies calling for tax exemptions and rent reductions, the epidemic still is a very serious threat to those in the industry of fitness and leisure sports because they are mostly small and medium-sized private enterprises which lack the antirisk capabilities. During the outbreak, some fitness clubs have resorted to online training, but some of them lack corresponding qualifications for the practice and are more likely to make errors in online teaching, which may dampen users' enthusiasm for participation and damage the healthy development of the industry. Therefore, judging from the current situation, for the industry of fitness and leisure sports in China, COVID 19 has not only brought a blow to overall income but also a huge negative impact on its future development, which has even eroded the sound foundation it has established by previous efforts.

2.3. The impacts of COVID-19 outbreak on sports travel in China

As one of the emerging sports industries, Sports travel covers many categories, including hiking, interest development, fishing, car tours and winter sports. During COVID-19 outbreak, all sports travel products were forced to be called off, the situation improved after the epidemic in China but the recovery has been slow which does not meet the needs. Similar to the industry of fitness and leisure sports, the sports travel industry in China mostly consists of small and medium-sized enterprises which are seriously affected by the outbreak and do not possess the anti-risk capacities of large enterprises. As a result, the entire industry is on the verge of closure. Since the outbreak of COVID 19 happened in winter and the epidemic was under control near summer, winter sports sector of the industry have suffered the most severe damage. According to previous statistics, the number of tourists participating in winter sports from February to April each year accounts for 40%-50% of the total number of winter sports participants of the whole year. In 2020, the number of such participants dropped by 47.37% year-on-year and preliminary estimates indicated that China's winter sports industry has already lost about RMB 100 billion as a result [16]. Previously China had been vigorously developing its winter sports industry in preparation for the Beijing 2022 Winter Olympics. According to the "National Plan for Construction of Winter Sports Facilities(2016-2022)" issued by the General Administration of Sport of China, the total scale of China's winter sports industry shall reach RMB 600 billion(US\$ 84billion) by 2020 and the country shall have more than 650 ice-skating venues and more than 800 skiing fields by 2022[17]. The huge number of skiing resorts suffered even more serious losses, because they had to pay high maintenance costs without operation and income. Judging from the current situation, it will take a long time and enormous manpower and material resources for China's winter sports industry to get back on track. In addition, the idling of a large number of stadiums will also lead to the loss of the collective memory of the Chinese people, which will affect the cultural value of sports venues [18] and hinder the development of other industries.

2.4. The impacts of COVID-19 outbreak on China's sports education and training industry

Physical education and training in China consist of school physical education and physical training. School physical education is affected by covid-19 in two main ways :(1)"myopia", "obesity", "physical decline" and other sub-health phenomena have always been the main problems for the safety of physical education in Chinese colleges and universities [19]. The long-term semiclosed life makes students stay at home, which leads phenomenon more serious. (2)After

COVID-19 was effectively controlled, long-term semi-isolation and attention to health led to a large increase in the number of extracurricular physical activities. The probability of occurrence of safety risks in extra-curricular sports activities is much higher than other forms of school sports activities[20], which virtually increases the difficulty of risk protection. But these problems will be improved over time, and the main damage is still in sports training.

In generally, China's sports training industry was still in early stage. However, it attracted small and medium-sized companies attracted by its industrial characteristics such as higher tolerance, longer development cycle, stronger industrial linkage, lower entrance threshold, larger market space, etc. While promoting the development of the entire industry, all of such characteristics have also led to many problems such as insufficient scaling, low anti-risk ability, unbalanced industry development, etc. In order to further promote the development of the sports training industry in China, the Chinese government has stated in its Action Plan to Further Promote Sports Consumption (2019-2020) that it shall vigorously develop the domestic sports training market and actively promote sports events with high popularity and large market space [21]. including providing guidance and support for domestic development of sports training courses suitable for different groups of people and for the provision of more varied and targeted instructions on sports and fitness exercises by making full use of the Internet and other methods. However, the outbreak of COVID 19 has been a huge blow to the industry of sports education and training just as it has been to the other sports industries. Due to the cessation of business caused by the outbreak, most organizations in the industry are now facing issues such as cash exhaustion, layoffs, suspension of leases and loss of talents. According to relevant statistics, salaries and venue rental constitute most of the operating costs of companies in China's sports education and training industry, and during the first quarter of 2020, 66.67% of those companies have obtained only 10% of their expected operating revenue for the period and 23.81% of them have made approximately 11%-20% of theirs [22]. It can be seen that without making some effective adjustments in a timely manner, most of the companies in the industry won't be able to continue their operations or even go bankrupt, and most of them won't be able to resume normal operations as before even after China has effectively controlled the outbreak.

3. Reflections on COVID-19 by Sports Industry in China

Undoubtedly, COVID-19 has already shocked sports industry in China, plunging the industry into a crisis, which was undergoing rapid development originally [23]. While analyzing the impacts and looking for countermeasures, sports industry in China should also reflect on its own problems. Although the cancellation of large-scale gatherings due to the outbreak of COVID-19 and the semi-closed life of Chinese people were two of the main reasons for the decline of physical, tourism, training, and competition businesses of the industry during the epidemic, the existing problems in the development process of sports industry in China or the problems exposed due to the COVID-19 outbreak are equally worth-noting. Therefore, learning lessons from the COVID-19 epidemic is beneficial to the industry's future development. It is also of great significance to have effective responses and cut losses in time when facing the outbreak of public health crises again. Through the analysis of the current situation of the impact, this paper found that causing economic losses and hindering the industry's development are major influences. The group with the biggest shock is small and medium-sized private enterprises. They are the foundation of sports industry in China. If they could not resume normal operations, it would have significantly negative impacts on the development of sports industry in China. Based on this, it focused on small and medium-sized enterprises and reflected on their problems in development and operation.

3.1. Insufficient prevention of public health emergencies

Crisis prevention is an important part of crisis management or crisis response [24]. Adequate prevention plans enable enterprises to make timely and effective adjustments to reduce the damage caused at the beginning of the crisis. Existing examples have also stressed the importance of crisis prevention plans. For example, when avian influenza broke out in some areas of Yanzhou in 2004, KFC, which specialized in chicken business, faced a huge crisis. But KFC quickly launched a crisis prevention plan and conducted crisis management within two weeks. It introduced new pork products while proving that the chicken they used was free of sanitation problems, which reduced the losses caused by the public health crisis. As far as the COVID-19 incident is concerned, due to its short outbreak period and rapid spread, the Chinese government has made timely and effective decisions of martial law and semi-lockdown in a short period. Large-scale and state-owned enterprises have also implemented response plans within the validity period to prevent the spread of COVID-19 while also reducing losses. However, small and medium-sized enterprises do not have or cannot implement response plans within the validity period due to limitations of a series of factors including their scale and financial base. Their original marketing and operational plans were disrupted by COVID-19, thus leading to increased losses. However, if public health crisis prevention plans could be formulated or implemented throughout the industry, they would be able to make up for the shortcomings of small and medium-sized enterprises and reduce their losses.

3.2. Single operating model and insufficient capability of adjustment

Sports industry in China owns numerous consumer groups, broad development space, and policy support from the Chinese government, which have attracted plenty of emerging small and medium-sized enterprises to establish their footholds and existing ones to switch their business. Small and medium-sized enterprises have not only become the foundation of sports industry in China, but also promote the formation and development of the entire industrial chain in a short period. However, most of such enterprises have single operating mode and small operating scales^[25]. Improvement would gradually be made in this situation if these enterprises continued to grow. But the outbreak of COVID-19 has exposed and significantly amplified the disadvantages in advance. In the COVID-19 incident, small and medium-sized enterprises cannot operate normally mainly because of reduced market demands in the physical business and the severe loss of consumers during the epidemic prevention and control period. Although some enterprises have already launched online businesses, their revenues cannot meet their operational needs due to non-standard operating methods and small scales. Currently, the Chinese government has been actively promoting digitalization, and high-quality online apps like "TikTok" and "KEEP" have emerged. While enhancing physical businesses, small and mediumsized enterprises should also vigorously develop online businesses and switch from a single operating model to a diversified one so that they can rely on diversified operations to overcome difficulties and maintain normal operations when encountering public health emergencies again.

3.3. Insufficient post-crisis recovery capabilities

Post-crisis recovery capabilities refer to the capabilities of sports industry in China to recover and develop after COVID-19 is contained. COVID-19 has already been effectively controlled in China and Chinese people have paid more attention to health and sports consumption after the epidemic. Large sports enterprises like Li-Ning and ANTA have come out of the downturn. In order to further accelerate the recovery of the sports industry, the Chinese government has introduced numerous policies to help small and medium-sized enterprises resume operations. For example, the Ministry of Finance has formulated a new tax policy after COVID-19; the Beijing Municipal Bureau of Sports has issued a notice to reduce or cancel the rent of small, mediumsized and micro enterprises; and the Jilin Provincial Department of Culture and Tourism has responded to the national call and put forward 13 measures to support the ongoing development of sports and tourism. Unfortunately, some struggling small and medium-sized enterprises still cannot resume normal operations. The primary reason for this problem is that the funding gap generated during the epidemic was too large, which was beyond the recovery capabilities of some small and medium-sized enterprises[26]. Another reason is that, during the epidemic, most medium-sized companies lacked advertising and promotions regarding resuming operations after the epidemic and insufficient customer care and operations have resulted in slow business recovery. In addition, most Chinese people earned less income due to the epidemic. Large companies have been able to implement preferential activities to achieve short-term income generation while small and medium-sized enterprises have seen slower capital flow as their capabilities are overshadowed. Therefore, it is particularly important to reflect on how small and medium-sized enterprises can improve their own recovery capabilities and maintain their growth in the future.

4. Development Suggestions on Sports Industry in China

4.1. Establishing a public health emergency crisis prevention plan for the sports industry

The public health prevention plan is the first means of defense in the face of public health emergency crisis which can effectively reduce adverse impacts [27]. At present, China's large scale sports enterprises have had prevention or emergency protection plans, which are mainly applicable to a large number of small and medium-sized enterprises that have not yet owned or cannot be effectively implemented. There are two main points to be noted in establishing this plan. First of all, due to China's vast territory, different levels of economic development and sports industry development in different regions. Therefore, protection plans should be established according to the division of provinces and municipalities directly under the Central Government and combined with the actual situation. Secondly, due to the limitations of their own scale, funds, management level and other factors, small and medium-sized enterprises are unable to establish a high-quality and efficient protection plan, it is suggested that small and medium-sized enterprises complete a prevention plan combining with crisis early warning and emergency response with the help of the local government.

4.2. Conducting diversified online business

Diversified Online Service refers to promote the digitalization and intelligentization of the sports industry and promote the integration of online and offline sports products and services based on big data and the Internet [28]. Due to the restriction of isolation, the total loss of consumers of entities had a devastating impact on the revenue of small and medium-sized enterprises that have not yet owned online businesses or have immature online businesses, especially in sports and leisure sports, physical education and training industries. In order to change the simple operation mode of small and medium-sized enterprises and to diversify their operations to generate income when similar crisis occurs again, China's sports industry should promote the development of online businesses of small and medium-sized enterprises. Through the analysis of Internet information and big data, the consumption potential of customers can be fully tapped to provide accurate services for dealers and consumers. Using digital network information as the medium can improve the operation mode, realize the linkage between online e-commerce platform and offline stores, channel offline customers to online, and finally achieve diversified development. However, there are certain consumption risks in online business, so it is suggested that the government strengthen supervision to ensure the rights and interests of consumers and promote the standardized and benign development of online business in the sports industry.

4.3. Carrying out epidemic sports industry insurance business

The decline in economic returns is the most serious negative impact of COVID-19 on China's sports industry. It is also the main reason of financial deficits and close down of small and medium-sized enterprises. Although the Chinese government has issued welfare policies and encouraged Chinese people to increase their sports consumption, it will still take some time for the sports industry to develop normally and return to normal operation. While the quickest way to solve this problem is insurance payouts, which can provide a huge amount of start-up capital in a short time. At present, the insurance of sports industry in China is still at the primary stage, with small coverage and few sales types[29], and there is no insurance type specially designed for the loss of sports industry caused by public health emergency crisis. Therefore, it is suggested to carry out the epidemic sports industry insurance business, which can not only create the industry GDP, but also ensure the rapid resumption of normal operation of small and medium-sized enterprises mainly engaged in sports industry.

5. Conclusions

The outbreak of the COVID-19 has had a huge shock to China's sports industry. Sports competition and performance activities, sports fitness and leisure activities, sports tourism services, and sports education and training have been severely affected. With the COVID-19 being effectively controlled in China, the Chinese sports industry is gradually out of its dilemma. The problems exposed by COVID-19 should be rethought with the sports industry coming back on track. Small and medium-sized enterprises are the basic structure of the sports industry and the group which suffered the most negative impact. If China's sports industry wants to develop in an allround and high speed, it must pay more attention to the reform of small and medium-sized sports enterprises. This study reflects the deficiencies of small and medium-sized sports enterprises and puts forward some Suggestions based on the overall situation. However, due to the lack of specific thinking about different industries in the sports industry, there are still some limitations. The following research will aim to be more specific and detailed to provide more theoretical guidance for the development of China's sports industry.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
		-Set of concepts 🔽
Lead Author	VB	-Design 🗹
	AD	-Getting results 🔽
		-Analysis 🔽
	HBS	-Make a significant contribution to collection $\ igsilon$
Corresponding		-Final approval of the paper 🛛
Author*		-Corresponding 🔽
		-Play a decisive role in modification 🔽
		-Significant contributions to concepts, designs,
Co-Author	¥7	practices, analysis and interpretation of data $\ igside V$
CO-Adtiloi	٨L	-Participants in Drafting and Revising Papers $ arnow $
		-Someone who can explain all aspects of the paper $\ igsqcap$

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The Relationship of Gender and Age to the Causes and Results of VIOLENCE in MULTICULTURAL FAMILIES in KOREA

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Abstract

Purpose: The main purpose of this study is to analyze the link between the demographic variables of multicultural families in the causes and outcomes of violence in multicultural families in Korea. Specifically, this study aims to verify whether the gender and age variables of multicultural families have statistically significant relationships with the causes and consequences of violence in multicultural families.

Method: First, frequency analysis was conducted to identify the general characteristics of the survey sample using SPSS 23.0. Second, the Cronbach's α coefficient was calculated to verify the reliability of the questionnaire. Third, t-test was conducted to identify the differences in each question by gender. Fourth, One Way ANOVA was conducted to identify the differences in each question by age. Fifth, Cross Tabulation(Chi-Square) was conducted to identify the connection differences in gender and age.

Results: The level of response was derived differently depending on the gender and age of the couples of multicultural families in some cases of the causes and results of violence in multicultural families. The analysis results of this study suggest that the central and local governments need a customized strategy considering the gender and age of policy recipients in establishing and implementing policies to support multicultural families.

Conclusion: Despite the practical contribution of this study, the following limitations exist, and they should be addressed in follow-up studies on multicultural families. First, the cause and result of violence in multicultural families used in the analysis of this study are not clear on the meaning classification for each of the questions. Second, since this study only validates the association among the variables, it can be pointed out that the limitations of the failure to verify the causal relationship between them.

[Keywords] Violence, Multicultural, Family, Gender, Age

1. Introduction

1.1. Research purpose

Due to the increase in international marriages and foreign workers, Korea is seeing an influx of various foreign cultures, and the proportion of multicultural families is increasing. However, the level of public awareness of multicultural and multi-ethnic societies is not adapting to the rapid pace of change in the multicultural society[1]. As a result, negative social phenomena such as domestic violence in multicultural families, crimes of multicultural children, and prejudice against multicultural families are becoming more serious[2]. The main purpose of this study is to analyze the link between the demographic variables of multicultural families in the causes and outcomes of violence in multicultural families in Korea. Specifically, this study aims to verify whether the gender and age variables of multicultural families have statistically significant relationships with the causes and consequences of violence in multicultural families.

1.2. Theoretical background

According to Yun(2016), policies for multicultural families in Korea are mainly focused on Korean language education and welfare. However, it is pointed out that this is poor in both quantitative and qualitative terms, and above all, the cooperative system between the relevant institutes is not effective, limiting the creation of policy effects for multicultural families[3]. Kwon(2018) typifies the causes of the difficulties migrant women in Korean multicultural families face in Korean society as language barriers, cultural differences, economic poverty, and domestic violence, and difficulties in marital relations[4]. Another study by Kwon points out that the main causes of violence suffered by migrant women in multicultural families in Korea are misconceptions such as ownership toward women, connivance at rampant violence, and the rapidly changing social environment[5].

Kwon(2017) analyzed the main causes of maladjustment in the school life of children from multicultural families. Typical causes were limitations in improving academic performance due to communication difficulties[6], differences in appearance, differences in parental culture, and economic difficulties[7]. Kwon(2019) argues that in order for children of multicultural families to better adapt to school life, it is urgent to provide programs to promote the use of Korean and bilingualism, to raise social interest for multicultural understanding[9], and to overhaul the police system to immediately respond to such problems as crime and negative behavior[10].

Research on domestic violence was conducted in neighboring studies of counseling psychology, including social welfare studies and domestic science, on the characteristics of domestic violence actors, and on programs to reduce violent behavior[11][12]. In addition, psychologists studied the causes of domestic violence at various psychological levels, including the characteristics of abused women and relational issues such as marital communication[13]. Choi(2011) presents the seriousness of the problem of violence in multicultural families at the family legal level with respect to multicultural families[14]. Among the various factors of domestic violence, it has been found to be seriously induced by psychological factors such as stress, negative view of ego, low self-esteem, and delusional jealousy of one's spouse[15].

2. Research Method

2.1. Research subjects and sampling method

In this study, 200 people were surveyed with convenience sampling, men and women from multicultural families residing in Korea as of 2020. The survey was conducted under the self-administration method. The final effective sample of this study was 169 question-naires, excluding those whose answers were unfaithful or some parts of the survey were omitted.

		N(%)	Total
Gender	Male	106(62.7)	169

	Female	63(37.3)	
Age	20~29	64(37.9)	
	30~39	53(31.4)	160
	40~49	19(11.2)	109
	50~	33(19.5)	

2.2. Research tools

2.2.1. Composition of the questionnaire

The questionnaire method was used to achieve the purpose of this research, and the composition of the questionnaire items was drafted based on the fact-finding data of multicultural families from the review of literature and press coverage. Once a draft is made, it was discussed with experts from multicultural social facilities organizations and revised and supplemented to form the causes and results of multicultural family violence. The specific survey details are as follows.

Table 2.	Composition of the questionnaire.
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No.	Questions	
1	I enjoy the food from my spouse's country.	
2	I can speak at least a little of the language of my spouse's country.	
3	I am well aware of the lifestyle of my spouse's country.	
4	I teach my spouse my native language well.	
5	Other people are prejudiced against me because I married a foreigner.	Causa
6	I'm angry that other people regard people who marry foreigners as inferior.	Cause
7	Since marrying a foreigner, I have had many pains.	
8	I'm upset when people around me don't understand international marriages.	
9	I feel that my status in society is low because I married a foreigner.	
10	I feel uncomfortable adjusting to my spouse's cultural values.	
11	I've spoken ill of, sworn, and ignored my spouse.	
12	I've yelled at my spouse.	
13	I was angry with my spouse, so I kicked the floor with my feet or slammed the door.	
14	I've said bad things to my spouse.	
15	I've tried to throw things at my spouse.	Effocto
16	I've broken things or kicked them up.	Effects
17	I've pushed my spouse's body hard.	
18	I've slapped my spouse on the cheek.	
19	I've beaten my spouse mercilessly.]
20	I've threatened or wounded my spouse with dangerous objects.	

2.2.2. Validity and reliability of the questionnaire

In this study, appropriate methods were used to verify the content validity and construct validity of the questionnaire. In particular, the content validity was secured through consultation with experts in the relevant research field to adopt a questionnaire suitable for the purpose of this study. Reliability is the degree to which results are consistent when the same or homogeneous tests are performed repeatedly. Reliability relates to stability and consistency in establishing research methods and is of great importance because it is a matter of whether a manipulated definition or indicator has consistently and reliably measured the object of measurement. In this study, reliability was verified based on the results of the questionnaire and was analyzed using Cronbach's α coefficient.

2.2.3. Data processing and statistical method

In order to achieve the objectives of this study, statistical verification was conducted using SPSS 23.0 as follows: First, frequency analysis was conducted to identify the general characteristics of the survey sample using SPSS 23.0. Second, the Cronbach's α coefficient was calculated to verify the reliability of the questionnaire. Third, t-test was conducted to identify the differences in each question by gender. Fourth, One Way ANOVA was conducted to identify the differences in each question by age. Fifth, Cross Tabulation(Chi-Square) was conducted to identify the connection differences in gender and age.

3. Analysis Results

	Gender	Mean	SD	t-value	Sig	
01	Male	3.4434	1.08742	460	.741	
QI	Female	3.5238	1.06039	409		
03	Male	2.8019	.84425	1 252	027	
QZ	Female	2.9841	1.02378	-1.252	.027	
Q3	Male	3.1415	1.22232	401	702	
	Female	3.0476	1.16990	.491	.703	
04	Male	3.0660	1.15692	2 1 2 6	465	
Q4	Female	3.4286	.91077	-2.126	.465	
Q5	Male	3.4151	1.25636	011	641	
	Female	3.2381	1.16001	.911	.041	
	Male	3.4151	1.25636	007	700	
QB	Female	3.2381	1.17383	.907	.706	
07	Male	4.0377	.19146	1 5 6 2	.001	
Ų/	Female	4.0000	.00000	1.502		
08	Male	3.7736	.83133	1 200	474	
Q8	Female	3.6032	.81398	1.299	.474	
00	Male	3.7736	.83133	1 200	474	
Ц9	Female	3.6032	.81398	1.299	.474	
010	Male	3.8113	.92698	F 4 1	170	
QIU	Female	3.7302	.97064	.541	.1/9	

Table 3. Differences in the causes of domestic violence among multicultural families by gender.

<Table 3> is the result of the verification of differences in the causes of domestic violence in multicultural families by gender. In question 2(the ability to use the language of spouse's country), women(2.9841±1.02378) were found to be at a significant level of 5% higher than men. On the other hand, in Question 7(the existence of pain after marrying a foreigner), male(4.0377±.19146) showed a higher significance level of 0.1% than that of women.

	Gender	Mean	SD	t-value	Sig	
011	Male	2.7358	.83154	1 210	464	
QII	Female	2.5714	.71198	1.310	.464	
	Male	2.8679	1.01489	1.000	272	
QIZ	Female	2.7143	.86934	1.002	.373	
013	Male	2.9057	.94141	220	740	
QI3	Female	2.8571	.91329	.328	.740	
014	Male	2.7358	.83154	1 1 9 4	.410	
Q14	Female	2.5873	.71018	1.184		
Q15	Male	3.1887	1.08771	015	454	
	Female	3.0317	1.06208	.915	.434	
016	Male	2.7358	.77216	1 202	775	
Q16	Female	2.5714	.68895	1.392	.775	
017	Male	2.6509	.86236	2 2 2 7	054	
QI7	Female	2.3651	.70257	2.227	.054	
018	Male	2.1415	.63903	<u>CEE</u>	197	
QI8	Female	2.0794	.51749	.055	.102	
010	Male	1.0189	.13670	1.064	024	
	Female	1.0476	.21467	-1.004	.034	
030	Male	1.0094	.09713	1 501	002	
Q20	Female	1.0476	.21467	-1.301	.002	

Table 4. Differences in the results of domestic violence in multicultural families by gender.

<Table 4> is the result of the verification of differences in the results of domestic violence in multicultural families by gender. Woman(1.0476±.21467) in question 19(the degree of violence against the spouse) was found to be at a significant level of 5% higher than that of men. Also, in question 20, women(1.0476±.21467) was higher than that of men at a significant level of 1%.

Table 5. Differences in the causes of domestic violence among multicultural families by age.

		N	Mean	SD	F	Sig	Post hot
Q1	20~29	64	3.4375	1.06719	9.446	.000	D>A
	30~39	53	3.0000	1.07417			D>C>R
	40~49	19	3.7368	1.09758			

	50~	33	4.1515	.61853			
	20~29	64	2.6875	.87060			
03	30~39	53	3.0943	.86077	2.665	050	
Q2	40~49	19	3.1053	1.10024	2.005	.050	
	50~	33	2.7273	.91079			
	20~29	64	3.0781	1.23834			
03	30~39	53	3.3019	1.10218	1 210	272	
Q3	40~49	19	3.2105	1.31567	1.310	.273	
_	50~	33	2.7879	1.19262			
	20~29	64	3.1875	1.11091			
30~39	30~39	53	2.9057	1.19718	2 1 1 0	020	D: D
Q4	40~49	19	3.3684	.76089	3.119	.028	D>R
50~	33	3.6061	.86384				
	20~29	64	3.2031	1.26214			
05	30~39	53	3.6226	1.14735	4.546	.212	
Q5 40	40~49	19	3.4211	1.16980	1.516		
	50~	33	3.1515	1.25303			
	20~29	64	3.2188	1.27825			
	30~39	53	3.6038	1.14924	1.319	.270	
Q6	40~49	19	3.4211	1.16980			
	50~	33	3.1515	1.25303			
	20~29	64	4.0000	.00000			
07	30~39	53	4.0566	.23330	4 500	.210	
Q7	40~49	19	4.0000	.00000	1.526		
	50~	33	4.0303	.17408			
	20~29	64	3.6719	.81756			
00	30~39	53	3.8868	.82416	1 404	224	
Q8	40~49	19	3.6842	.82007	1.484	.221	
	50~	33	3.5152	.83371			
	20~29	64	3.6719	.81756			
	30~39	53	3.8868	.82416			
Q9	40~49	19	3.6842	.82007	1.484	.221	
	50~	33	3.5152	.83371			
	20~29	64	4.0625	.94070			
	30~39	53	3.6038	.88447			
Q10	40~49	19	3.5263	.90483	3.288	3.288 .022	A>B
	50~	33	3.6667	.95743	1		
			1		l		1

Note:A:20~29,B:30~39,C:40~49,D:50~.

<Table 5> is the result of the verification of differences in the causes of domestic violence among multicultural families by age group. Question 1(the degree of preference for food of the spouse's country) showed that those in their 50s and older were higher than those in their 20s, 30s, and 40s. In question 4(teaching one's native language to the spouse), people in their 50s and older were found to be higher than those in their 30s. Question 10(the degree of discomfort to the cultural value of one's spouse) shows that people in their 20s are higher than those in their 30s.

		Ν	Mean	SD	F	Sig	Post hot						
	20~29	64	2.6094	.80902									
011	30~39	53	2.8679	.76051	1 697	170							
QII	40~49	19	2.6316	.76089	1.087	.172							
	50~	33	2.5152	.79535									
	20~29	64	2.8750	1.10554									
Q12 30~39 40~49 50~	30~39	53	2.9434	.86414	1 71 0	166							
	40~49	19	2.7895	.91766	1./13	.100							
	50~	33	2.4848	.79535									
	20~29	64	2.8594	.95730									
012	30~39	53	3.0377	.80771	022	402							
Q13 40~49 50~	40~49	19	2.8421	.95819	.022	.483							
	33	2.7273	1.03901										
	20~29	64	2.6250	.80672									
014	30~39	53	2.8868	.75091	2.049	100							
Q14	40~49	19	2.6316	.76089	2.049	.109							
	50~	33	2.4848	.79535									
	20~29	64	2.9375	1.05221	1.366	.255							
015	30~39	53	3.3396	.95964									
QIS	40~49	19	3.1579	1.11869									
	50~	33	3.1515	1.25303									
	20~29	64	2.6250	.76636									
016	30~39	53	2.8491	.69049	1 609	190							
QID	40~49	19	2.6316	.76089	1.008	.189							
	50~	33	2.5152	.75503									
	20~29	64	2.5156	.83556									
017	30~39	53	2.6415	.76194	270	760							
Q17	40~49	19	2.4737	.84119	.576	.709							
	50~	33	2.4848	.87039									
	20~29	64	2.1563	.62281									
010	30~39	53	2.2642	.59326	2 6 4 2	014							
Q18	40~49	19	2.0526	.62126	3.042	.014	R>D						
	50~	33	1.8485	.44167									
Q19	20~29	64	1.0313	.17537	.232	.874							

Table 6. Differences in the results of domestic violence in multicultural families by age.

	30~39	53	1.0377	.19238			
	40~49	19	1.0000	.00000			
	50~	33	1.0303	.17408			
	20~29	64	1.0156	.12500			
030	30~39	53	1.0377	.19238	270	700	
Q20	40~49	19	1.0000	.00000	.379	.768	
	50~	33	1.0303	.17408			

Note:A:20~29,B:30~39,C:40~49,D:50~.

<Table 6> is the result of the verification of differences in domestic violence among multicultural families by age group. Question 18(whether beating the spouse in the face) showed that people in their 30s are higher than those in their 50s or older.

	20~29	30~39	40~49	50~	Sum
Male	43	34	12	17	106
	(40.6%)	(32.1%)	(11.3%)	(16.0%)	(100.0%)
Female	21	19	7	16	63
	(33.3%)	(30.2%)	(11.1%)	(25.4%)	(100.0%)
X ² (p)	2.366(0.500)				

 Table 7. The relation between sex and age.

Note:p*<0.05,p**<0.01,p***<0.001.

As shown in <Table 7>, an analysis of the association between gender and age showed that it was =2.366, p=0.500, indicating that there was no association between gender and age at the significant level of <0.05.

4. Conclusion

The main purpose of this study was to verify whether the gender and age variables of multicultural families couples have statistically significant relationships with the causes and consequences of violence in multicultural families. As a result of the analysis, the level of response was derived differently depending on the gender and age of the couples of multicultural families in some cases of the causes and results of violence in multicultural families. The analysis results of this study suggest that the central and local governments need a customized strategy considering the gender and age of policy recipients in establishing and implementing policies to support multicultural families.

Despite the practical contribution of this study, the following limitations exist, and they should be addressed in follow-up studies on multicultural families. First, the cause and result of violence in multicultural families used in the analysis of this study are not clear on the meaning classification for each of the questions. Second, since this study only validates the association among the variables, it can be pointed out that the limitations of the failure to verify the causal relationship between them. To solve this problem, follow-up studies on multicultural families will require quantitative research to verify causality among variables and qualitative research on the causes and consequences of domestic violence of multicultural families for theoretical development.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution
		-Set of concepts 🔽
	SGJ	-Design 🗹
Lead Author		-Getting results 🗹
		-Analysis 🗹
		-Make a significant contribution to collection $ abla$
		Final approval of the paper 🔽

practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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Q-Methodological Approach to the Perception of Meridian Massage for HEALTH MANAGEMENT

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Abstract

Purpose: Modern society, according to the change of social demand due to the improvement of living standards, the rapid increase of aging population and healthy life extension comes to have a high interest in health promotion from the perspective of prevention as well as disease treatment. This study conducted a subjectivity study on the subjects of workers in the skin care industry who performed meridian massage on the field.

Method: To analyze the perception, attitude, use, and satisfaction of the skin care industry workers about meridian massage, after the survey of 30 people sampled with P-sample was completed, the collected data were coded according to the location on the Q-sample distribution map. The input data was analyzed using the QUNAL-PC program, and for factor analysis, principle component factor analysis was used. And among the results calculated by inputting the number of factors variously based on the Eigen value of 1.0 or higher, three types judged to be the best were selected and examined with Z-score.

Results: Three types were extracted from the results of analysis. Type I was categorized as subjectivity of high experienced people with more than 20 years of experience and a strong positive perception on the natural healing effect and health intervention function of meridian massage. Type II was categorized as subjectivity of low experienced people with less than 10 years of experience, and a subjective perception that was sensitive to the trends in the skin care industry. Type III was categorized as subjectivity of middle experienced workers with experience between more than 10 years and less than 20 years and a strong positive subjectivity for the pain relief effect of meridian massage.

Conclusion: Therefore, this study is meaningful in that it explored the subjective meaning of the workers in the skin care industry for meridian massage, grasped the intrinsic reasons, and derived a general view of meridian massage.

[Keywords] Q-Methodology, Meridian Massage, Perception, Health, Natural Healing

1. Introduction

In modern people, the major mortality rate is increasing as the incidence of chronic diseases increases due to the aging of the population, changes in lifestyle and diet, and increased environmental pollution, and as the number of patients with chronic diseases increases, preference for natural healing therapy is increasing as an alternative. This means that it can be seen as a trend of increasing interest of modern people in natural healing therapy related to health promotion in terms of prevention other than not only treatment of diseases, but also the forms of treatment that are being carried out in hospitals [1][2].

Due to the increasing preference for natural healing treatments and the flow of increasing demand, the skin care industry is also taking an approach in terms of health management with

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a broad concept including healthy living, disease prevention and promotion, and real-time care[3]. The skin care industry is expanding into the health care industry based on the beauty industry, and in terms of health management, consumer satisfaction and service improvement are achieved by combining natural healing therapy. Thus, the skin care industry has begun to change from simple skin management to health management areas such as body shape management, obesity management, stress management, and pain management[4][5].

It is said that meridian massage, one of the most commonly used natural healing treatments used in the skin care industry, enhances the energy flow of the human body to be smooth by stimulating acupuncture points mentioned in oriental medicine. By linking the meridian concept to massage, it can be applied more systematically to health supplementary therapy, obesity management therapy, and treatment therapy[6][7]. Meridian massage has been known as a traditional health promotion therapy based on oriental medicine along with Qigong exercise [8][9]10].

Originally, meridian massage has been applied in various ways as a means of supporting therapy. It is said that it can relax stiff muscles, correct skeletal abnormalities naturally, and control abnormalities of the autonomic nerve. In addition, it is said that it improves the natural healing power of the body by smoothing the functioning of human organs and strengthening the immune function, thereby relieving abnormal symptoms of the body [11].

A number of previous studies verifying the health improvement effect of meridian massage prove that meridian massage is effective in health promotion. Therefore, high interest in health promotion and increased preference for natural healing therapy in a preventive dimension add more importance to meridian massage with natural healing power[4][6][12]. However, there are not many studies on the perception as a health care solution incorporating systematic health management. Therefore, in order for meridian massage to develop into a systematic health care concept in the health care industry in the future, it can be said that is necessary to conduct perception research on meridian massage.

This study attempts to explore the perceptions of workers in the skin care industry who are practicing meridian massage, and to derive a comprehensive view of meridian massage as a natural healing therapy. In this study, a Q-methodology was used to describe and analyze the characteristics of the skin care industry workers' subjectivity for meridian massage. The Q-methodology is a research methodology used throughout social science for the study of human subjectivity, and what is peculiar is the research method and at the same time the analysis method [13][14]. The type analysis of meridian massage conducted in this study could be provided as basic data to develop as a method of systematic health management in the health care industry.

2. Methods

2.1. Participant

For research participants selected for in-depth interviews for the establishment of the Q-recruitment group, the skin care industry workers with more than 10 years of experience in starting meridian massage were randomly extracted into a total of six people, including 1 person in their 30s, 1 person in their 40s, 2 people in their 50s, and 2 people in their 60s. A total of 31 people were selected for P-sample, and the data of 30 subjects were analyzed, excluding one who had insufficient responses. The ages of the P-sample study subjects were found to be 2 in their 20s, 5 in their 30s, 9 in their 40s, 8 in their 50s, and 6 in their 60s, and meridian massage experience was distributed in 11 people over 20 years, 6 people in 15-20 years, 5 people in 10-15 years, 7 people in 5-10 years, and 1 person under 5 years.

2.2. Instruments

For the Q-sample statement, which is a measurement tool used in this study, a Q-population was established, and only content related to the subject was selected through in-depth interviews and literature search analysis. The extracted 216 statements were reviewed again and the final 37 items were selected. As for the Q-sample, ambiguous meanings or redundant statements are deleted from the Q-population, and it refers to a collection of final Q-statements created through the categorization process of grouping the same subjects [15].

2.3. Data analysis

To analyze the perception, attitude, use, and satisfaction of the skin care industry workers about meridian massage, after the survey of 30 people sampled with P-sample was completed, the collected data were coded according to the location on the Q-sample distribution map. There are 1 point, 2 points(-3), 3 points(-2), 4 points(-1), 5 points(0), 6 points(+1), 7 points(+2), and 8 points(+3), for the most disagreeable items(+4) and there are 9 points for the most agreeable item(+4), with the score from 1 point to 9 points. The input data was analyzed using the QUNAL-PC program, and for factor analysis, principle component factor analysis was used. And among the results calculated by inputting the number of factors variously based on the Eigen value of 1.0 or higher, three types judged to be the best were selected and examined with Z-score.

3. Results

3.1. Results of factor analysis type of p-sample

The skin care industry workers' subjectivity types for meridian massage were categorized into three types. The three types were 56% of the total variance, and the explanatory power by each type was 23% for type 1, 18% for type 2, and 15% for type 3. <Table 1> below shows the results of the factor analysis by type of P-sample.

	15	- 4	- 2	T 0	Backgr	ound variable
NO.	ID	Type 1	Type 2	Type 3	Age	Years of work
1	skin01	.2645	.2587	.1687	39	18
2	skin02	.3207	.3194	.8072*	47	17
3	skin03	.4212	.8118*	.2405	45	20
4	skin04	.3027	.1048	0068	49	25
5	skin05	.2014	.3517	.0643	56	19
6	skin06	.3469	.3370	.4003	45	19
7	skin07	.2367	1926	.8569*	47	10
8	skin08	.7871*	.0284	1221	40	15
9	skin09	.1948	.0461	.1136	53	23
10	skin10	0553	.9431*	.0688	42	10
11	skin11	.6600*	.2004	.2781	30	10
12	skin12	.3401	.0915	.0358	61	25
13	skin13	.5724	.0306	.2938	59	20
14	skin14	.8421*	1003	.2755	62	30
15	skin15	.8184*	.0558	.0389	57	30
16	skin16	.3445	.3934	.3672	54	25
17	skin17	.1195	.1515	.9092*	39	17
18	skin18	0327	.3316	0764	65	25
19	skin19	.1529	0435	.1582	50	10
20	skin20	.2369	.1103	.0514	41	11
21	skin21	.7302*	.2269	.2054	43	16
22	skin22	.6033	.1793	.2540	62	30

Table 1. Results of factor analysis by type of p-sample.

 23	skin23	.3025	.4650	.6794*	34	10
 24	skin24	.6053	.1306	.0262	67	34
 25	skin25	.8295*	.1802	.0978	56	12
 26	skin26	.6189*	.0271	.3908	58	20
 27	skin27	.6837*	004	.3108	64	30
28	skin28	1147	.7214*	.3587	33	9
 29	skin29	.0278	.8871*	.1344	29	6
 30	skin30	.3045	.7432*	0001	24	3
 %	expl. var	23	18	15		
 Cum	% expl. var	23	51	56		
 F	Persons	8	5	4		

Note: *p<.05.

3.2. Results factor value by type of q-statement sensation

As for the composition of subjects by each type, it was found that out of 30 P-sample, 8 subjects were included in type 1, 5 were in type 2, and 4 were in type 3. A total of 17 subjects were included in the classification. <Table 2> below shows the total Z-value of the Q-sample statements, and among the perceptions that skin care industry workers have about meridian massage, positive or negative perceptions can be identified.

Table 2. Results of factor	r analysis by type	of p-sample.
----------------------------	--------------------	--------------

	O statement		Z-value		
item	Q-statement	Type1	Type2	Туре3	
1	It helps improve health	4	-1	1	
2	Improves natural healing power	4	-2	0	
3	The pain is relieved	-1	-2	2	
4	Not scientifically verified	-3	2	-3	
5	There is no consistency in the meridian massage program	-1	3	-4	
6	Helps cure chronic diseases	-2	-4	0	
7	No side effects due to no drug use	1	0	-1	
8	Help with mental health	-1	0	-2	
9	It is effective in preventing diseases	2	-3	0	
10	It is a Korean style massage	-4	-1	-3	
11	It is more effective when practiced with usual health care therapy	0	1	-2	
12	The effect appears differently depending on the customer's satisfaction.	-1	2	0	
13	Helps with insomnia	3	-1	2	
14	Helps relieve fatigue	3	1	-2	
15	It is effective in improving constipation	2	0	-1	
16	Helps in removing waste products from the body	1	2	0	
17	Helps improve edema	1	2	0	
18	It is effective in facial asymmetry and facial reduction.	-1	4	3	
19	It is effective for menstrual pain	-2	-2	-1	
20	Helps with frozen shoulders (shoulder pain)	0	-1	4	
21	Helps relieve headaches	1	-1	3	
22	Helps with menopausal symptoms	-2	-2	-1	
23	It is effective in relieving back pain	0	0	3	
24	Effective as a growth massage	-1	-4	1	
25	Head hair becomes thicker (scalp massage)	-3	-3	2	
26	The body becomes flexible	-2	-1	2	
27	Effective for obesity management	1	4	0	
28	It relieves tight muscles	2	0	4	
29	Helps blood circulation and lymph circulation	3	0	1	
30	Helps by stimulating internal organs	0	1	-1	
31	Systematic education on the meridian massage program is necessary	0	3	-3	
32	Physical strength management by a manager is necessary	0	1	1	

33	Meridian massage is effective only when it is strong	-4	0	-4
34	Implement according to customer's individuality	2	1	1
35	Used as an adjuvant therapy for treatment	0	-3	-1
36	There is an economic burden on the user	-3	1	-2
37	Management results may vary from person to person	1	3	1

Note: Variance = 4.378, St. Dev. = 2.092.

3.3. Results of correlation analysis

Correlation analysis was conducted to determine the relevance between the three types classified through factor analysis. The following correlation numbers show the degree of similarity between each type, with the correlation numbers of Type 1 and Type 2 in the three types being .1156, and Type 1 and Type 3 being .3919, showing a positive correlation. Meanwhile, Type 2 and Type 3 are shown as -1544, indicating a negative correlation. <Table 3> below shows the results of the correlation analysis.

Division	Type 1	Type 2	Туре 3
Type 1	1	-	-
Type 2	.1156	1	-
Туре 3	.3919	1544	1-

 Table 3. Results of correlation analysis.

3.4. Characteristic analysis by type

Type 1 has a positive perception on items #1, #2, #13, #14, and #29 in the results of examining the perception of meridian massage as a Z-value mainly as highly experienced people for over 20 years. In addition, it was confirmed that they had strong negative or generally negative perception for the items #4, #25, #36, #10, and #33. <Table 2> below is the results of checking the Z-value of Q-statements for Type 1.

Type 2 is mainly those with less than 10 years of experience, and in the result of looking at the perception of meridian massage in Z-value, they had a positive perception of items #5, #18, #27, #31, and #37. In addition, it was confirmed that they had strong negative or generally negative perceptions for items #6, #9, #24, #25, and #35. <Table 3> below is the results of checking the Z-value of Q-statements for type 2.

Type 3 is mainly those with intermediate experience between 10 years or more and 20 years or less, and in the results of examining the perception of meridian massage in Z-value, they had a positive perception for the items #18, #20, #21, #23, and #28. In addition, it was confirmed that they had strong negative or generally negative perceptions for the items #4, #5, #10, #31, and #33. <Table 3> below is the results of checking the Z-value of Q-statements for type 2.

4. Discussion

The beauty health industry is a labor-intensive industry with higher dependence on human resources than other industries, that is, a human-centered service industry, and the technological power of human resources occupy a large part of the quality of service[16][17]. In particular, as the 4th Industrial Revolution became visible, many changes are taking place throughout society, and among them, the beauty health industry is expanding into a more specialized service industry as it evolves into an increasingly complex industry[18][19]. Therefore, in this study, the results of analysis using the Q-methodology are discussed for each type as follows to find out the perceptions, attitudes, use, and satisfaction of the skin care industry workers, and to identify the type of subjectivity. First, type 1 was classified for the subjectivity of highly experienced people with more than 20 years of experience. Workers with a large age and relatively high experience can be identified as those who have used meridian massage in the skin beauty industry at an early stage, and through long experience and healing cases, they had a strong positive perception of the natural healing effect and health mediation function of meridian massage. Such results of this study are similar to those of other previous studies[7][12].

In particular, the constituents of type 1 had a clear subjectivity about the science of meridian massage, and negative opinions were made on meridian massage treatment and non-scientific cases. In the end, constituents of Type I perceive that meridian massage is of high value as a natural healing therapy, and that considering individual differences, the massage treatment was more effective.

Second, Type 2 was classified for the subjectivity of those with less than 10 years of experience. As workers of younger age and relatively low experience, they can be identified as those who recently learned and treated meridian massage. The subjects of Type 2 can be judged as being sensitive to the trend of the skin care industry. It was strongly perceived that meridian massage had an effect on obesity management, facial asymmetry, and facial reduction.

In particular, they were positively aware of the need for a meridian massage program and systematic education through an improved meridian massage learning environment and education. These contents can be said to be similar results to the previous studies that insisted on improving the scope of skin care work, the use of skin care devices, the reinforcement of training hours, and improvement of learning requirements [16][20]. After all, the constituents of Type 2 perceive that meridian massage is of higher value as a therapy for well-being and health care in relation to the trend of the skin beauty industry rather than as a natural healing therapy, and that the effectiveness of treatment such as disease prevention was limited.

Third, type 3 was classified on the subjectivity of those with medium experience of 10 to 20 years of experience. The subjects' age ranges from the mid-30s to the mid-40s, with relatively moderate career experience, and through experienced cases of meridian massage for skin beauty, they had a strongly positive subjectivity for the pain relief effect.

In other words, it was perceived that meridian massage, a treatment method combined with oriental medicine, was suitable for pain reduction, and these contents are consistent with other previous studies confirming that meridian massage has a significant effect on pain reduction [21][22]. After all, constituents of Type 3 perceive that meridian massage is highly effective especially in relieving pain, among natural healing therapies, and it was also found that they also had a perception of the science of meridian massage.

As above, the results of this study attempted to derive a comprehensive view by grasping the subjective perception of the skin beauty industry workers on meridian massage used as a natural healing therapy. Through this study, it is expected that the practical use of meridian massage in the beauty health industry will increase.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution	
		-Set of concepts 🔽	
Lead	SIK	-Design 🗹	
Author	311	-Getting results 🔽	
		-Analysis 🗹	
	JBL	-Make a significant contribution to collection $\ oxtimes$	
Corresponding		-Final approval of the paper 🛛	
Author*		-Corresponding 🔽	
		-Play a decisive role in modification $\ igside{ u}$	
		-Significant contributions to concepts, designs,	
Co-Author	EGN	practices, analysis and interpretation of data $\ oxdot$	
	LON	-Participants in Drafting and Revising Papers 🛛	
		-Someone who can explain all aspects of the paper $ abla$	

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Effects of Resistance Exercise and Fermented Soybean Ingestion on the Appearance of Inflammatory Cytokine, METABOLIC RISK FACTORS, and the Body Composition in Obesity-Induced White Rats

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Abstract

Purpose: The study induced obesity in 50-week-old white rats with high fat intake for eight weeks. Then for 12 weeks, we analyzed how resistance exercise with anaerobic properties and fermented soybean ingestion with a nutritional approach affect the potential mechanisms underlying body composition, metabolic risk factors, and inflammatory cytokine of aortic tissue.

Method: The experimental animals were randomly assigned to four groups: Control(Con), Soybean(Soy), Resistance Expense(Re), and Soybean + Resistance Expense(Soy+Resistance). For the resistance exercise, the ladder climbing is applied, and the soy supplement made up 24% of the total calories of soy protein. After eight weeks of high-fat diets, obesity was induced and treated for 12 weeks. The appearance of inflammatory cytokine was analyzed for IL-6, TNF- α , IL-10, and IL-4 in the aortic tissue.

Results: In Soy and Soy+Re groups, the fat content decreased compared to those in Con and Re groups(Figure 2A), and body fat was higher in Soy and Soy+Re groups than in Con and Re groups. The appearance of IL-6 cytokine associated with infectious diseases showed significant differences in Soy, Re, and Soy+Re groups over Con groups(p < 0.05). The appearance of other cytokine, such as TNF- α , IL-4, and IL-10, showed no significant differences between the groups.

Conclusion: As a result, the positive effects of fermented soybean ingestion on changes in inflammatory factors associated with vascular inflammation cannot be clearly identified in improving the function in the aortic tissue. Therefore, since it cannot be seen as a positive effect, it is necessary to choose the intake and type according to the purpose of the ingestion and to apply it compiling prior studies and literature regarding the form, frequency, intensity, and time settings of exercise.

[Keywords] Resistance Exercise, Soybeans, Obesity, Metabolic Risk Factors, Inflammatory Cytokine

1. Introduction

It is known that diet and exercise should be combined for continuous weight control [1][2]. Regular practice of systematically organized nutrition and exercise programs not only increases energy consumption but also increases lean mass[3][4]. As with the prior study results, it is thought that if nutrition and exercise were applied in combination, there would have been other physiological changes in addition to weight loss. Nevertheless, research on combining various foods and exercise is insufficient. In particular, further research combining the ingestion of fermented food with resistance exercise is needed.

Fermented food is essential to the human diet, and the production and consumption of them are being carried out with the development of civilization[5]. Fermented food is food made by

conversion of enzymes as a result of various and complex reactions of microorganisms depending on the ingredients Maria(2017) and has recently become a part of the longevity diet in many countries, starting in Asia, due to its potential for health promotion [6][7]. Studies have shown that fermented soybeans reduce the risk of premenopausal female diseases(Lee HP 1991 : Seo YH 2017), and studies have shown positive effects on metabolic diseases and cancer [8][9][10]. Fermented soybeans increase the biological availability of vitamins, minerals, and isoflavones, recognized for their stability, and distributed as a new type of food [11]. It is also a health functional food that contains the potential to affect the immune system through lactic acid bacteria[12]. And soy protein in fermented soybeans has been shown to improve low-density cholesterol levels and has shown positive results in controlling dyslipidemia caused by obesity [13][14].

To analyze the effects of soy protein on factors related to metabolic diseases, Cheik(2008) reported in animal testing that lipid metabolism was improved as a result of daily intake of soy protein for eight weeks and that internal and central fat tissues were reduced to help improve obesity, metabolic-related diseases and inflammation [13]. Similarly, Cheik (2008) reported a significant effect on white adipose tissue(WAT) in young male rats in research to identify the efficacy of isoflavone in fermented soybeans, reducing the size of fat cells. In addition, a recent study has reported the positive effects of natural fermented food on anti-fatigue, anti-aging, changes in athletic performance, and physiological variables [13][15]. In contrast, research by Kim(2018) in humans shows that changes in the glucose level in the blood are also associated with metabolic diseases, and when the performance of a combined exercise combining aerobic and resistance exercises is applied to middle-aged women, it shows a positive change in CRP, Fibrinogen and insulin resistance(HOMA-IR), but for improved cardiopulmonary functions, CRP, Fibrinogen has significantly independent effects compared to body fat decrease and interaction effect[16]. Similarly, most researchers said that people with higher cardiopulmonary functions and physical activity have a lower incidence of metabolic diseases, while those with obesity, but higher physical fitness levels due to higher levels of physical activity have a lower risk of developing metabolic diseases. A study conducted eight weeks of walking exercise for obese elderly women showed significant differences between timing in improving blood lipid and body composition Kim(2017), and in a study by Ahn(2019) of experimental animals, short-term resistance exercise improved levels for non-functional HDL structure changes and TLR4 protein appearance [17][18]. These prior studies show that improvement of inflammation levels in vascular endothelial cells, which are the pathways of blood, is an important factor in solving the problems in relation to the fundamental causes of the metabolic and inflammatory diseases related to obesity.

Inflammatory reactions in vascular endothelial cells increase the risk of coronary artery disease due to the secretion of infectious cytokine such as tumor necrosis factor- α (TNF- α) and the secretion of cytokine such as Interleukin-6(IL-6) and Interleukin-18(IL-18) in active mononucleus and vascular smooth muscle cells[19]. On the contrary, anti-inflammatory cytokine such as Interleukin-4(IL-4) and Interleukin-10(IL-10) are considered to be contained[19]. A study on ultramarathon(with characteristics of high-intensity aerobic exercise) runners with high blood pressure symptoms highlighted the effects of exercise by showing significant differences in infectious cytokine(IL-6, TNF- α) and anti-inflammatory cytokine IL-10, Monocyte chemoattractant protein-1(MCP-1)[20]. There are many studies on changes in the inflammatory response caused by aerobic exercise and metabolic diseases, but the analysis of other forms of exercise such as anaerobic or resistance exercise and metabolic disease-related changes is insufficient.

This study analyzed the effects of the potential mechanism on the inflammatory cytokine of the aortic tissue by applying the anaerobic resistance exercise and the ingestion of nutritional approach based fermented soybean for 12 weeks after inducing obesity of 50-week-old white rats with high fat intake.

2. Research Method

2.1. Research subjects

This study was conducted by purchasing 40 50-week-old male Wistar rats(Doo Yeol Biotech co., Korea). After a one-week environmental adaptation period, a high fat diet(45% cal from fat) was conducted for eight weeks to induce obesity, and 10 were assigned to each group of Con, Soy, Re, and Soy+Re. During the 12-week treatment period after the assignment, feed and water were freely consumed, and two were bred in a cage of 300(W)×500(D)×200mm(H) dimension.

2.2. Experiment method

2.2.1. Diet and exercise treatment

8 during the eight-week obesity induction period, high fat diet(45% cal from fat) was provided. For 12 weeks after the end of the period, different types of proteins were ingested for each group: 24% casein protein of total calories for the control group(Con), 24% soybean protein of total calories for soybean intake group(Soy), 24% casein protein of total calories+ladder climbing(3day/week) for resistance group(Re), and 24% soybean protein of total calories+ladder climbing(3day/week) for soy intake+Resistance group(Soy+Re).

2.2.2. Exercise method

Reflection	Intensity(%)	Training frequency(set/day)
1st week	30%	12set
2nd week	50%	12set
3rd week	75%	12set
4th week~12th week	50%, 75%, 90% 100%	8set(repeat 2 time for each load)

 Table 1. Twelve-week resistance training protocol.

Note: The resistance exercise was carried out in the form of a vertical ladder made of wood and steel (1.1 × 0.18 m, 2 cm lattice, 80° slope) with rest areas placed at the top(20 cm × 20 cm × 20 cm). The exercise method was one that was used in the study of Helen L(2019)[21]. A weight was attached to the tail of a rat, so the stair dimbing exercise in the form of resistance exercise was carried out three times a week for 12 weeks until the exhaustion. During the first week of adaptation, the weight was not applied and ladder dimbing was conducted four times a day, and after the period, a weight was attached to the tail. In the third of the subject. In the first week, 30% of the weight was attached to the tail, and in the second week, 50% of the weight was attached to the tail. In the third week, 75% of the weight was attached to the tail. From the fourth week, the load was increased until the subject was unable to perform the exercise. After a session of the exercise, they took a rest every minute. The application of exercise loads is as shown in <Table 1>. The weight was measured on the first day of each week to be the basis for the application of the exercise loads.

2.2.3. Tissue extraction

To obtain tissue samples of the subjects, 48 hours of recovery were applied after 12 weeks of training to exclude the last-bout exercise. Zoletil(0.04 to 0.06 ml/kg) and Rompun(0.12 ml/kg) were injected into the abdominal cavity for general anesthesia, and the first part of the aortic tissue from the left ventricle was quickly extracted, quickly frozen in liquid nitrogen(-180°C), and stored at -70°C until analysis was performed.

2.2.4. Measurement items and analysis method

2.2.4.1. Measuring weight and dietary intake

During the 12-week experiment, weight and dietary intake were measured to the first decimal place using a scale(A&D Company Limited, Japan) at around 9 a.m. every other day.

2.2.4.2. Body composition

Zoletil(0.04 - 0.06 ml/kg) and Rompun(0.12 ml/kg) were injected into the abdominal cavity to anesthetize the whole body, and the lean mass and body fat were measured using DEXA(DSC-3000, Aloka, Tokyo, Japan).

2.2.4.3. Peroral load check

After a 12 hour fast, blood sugar was measured on an empty stomach using blood collected from the tail vein. After measuring blood sugar on an empty stomach, glucose was dissolved in sterilized distilled water to give oral administration(1g/1kg) to each subject and blood sugar was measured at 15 minutes, 30 minutes, 60 minutes, and 120 minutes. After the measurement was completed, sterilized distilled water(10ml) was injected through the oral cavity and moved to a cage for three days of rest, and exercise was performed.

2.2.4.4. Western blotting

PVDF membrane(Bio-rad, USA) wet with methanol and 3M paper(Whatman) wet with transfer buffer(190mM glycine,50mM Tris-base, 0.05% SDS, 20% methanol) were folded and set in Minitrans-blotcell(Bio-Rad, CA, USA) for one and a half hour at 80 volts. When metalized to the membrane, it was at the blocking process on the rocker platform for 90 minutes with 5% w/v BSA solution(10mM Tris-base, HCl-pH7.6, 0.5M NaCl, 0.05% Tween20). Then the primary antibody anti-IL-6(#SC-57315, Santa Cruz, CAL, USA), anti-IL-4(#53084, Santa Cruz, CAL, USA), anti-IL-10(#365858, Santa Cruz, CAL, USA), anti-GAPDH(#SC-20357, Santa Cruz, CAL, USA), and anti-LaminB(#ab45848, Abcam, UK) were diluted at a 1:1000 concentration as blocking solution(5% w/vBSA) for a 12 hour blocking. And, it was cleansed three times for 10 minutes with TBS-T solution, and the secondary antibody (horseradish peroxidase-conjugated goat anti-rabbit 65-6120, ZYMED, CA, USA; horseradish peroxidase-conjugated goat anti-mousesc-2005, Santa Cruz, CAL, USA) was diluted 1:5,000 with blocking solution for a 90-minute treatment. Then it was cleansed three times for 10 minutes with TBS-T solution, and the membrane was submerged in WBLR solution(Western Blotting Luminol Reagent SC-2048, Santacruz Biotechnology, USA) with films for development in a darkroom for 1 minute, and the obtained band was scanned. After the scanning, the protein amount was calculated with Image-J Analysis Software(National Institutes of Health: NIH, USA).

2.2.4.5. Data processing method

The results for each measurement item are calculated as mean and standard error(Mean \pm SE), and statistical analysis is performed using the SPSS 20.0 statistical program. For statistical processing, one-way ANOVA was performed to verify differences among the groups after 12 weeks of treatment, and two-way ANOVA was performed to verify differences among the groups in terms of weight and dietary intake. For the post-test, Tukey method was used, and the statistical significance level was set at α =.05.

3. Analysis Results

3.1. Diet intake and weight change

Figure 1. Changes in calorie intake(A) and weight(B) for three weeks.



Note: As a result of the 12-week treatment of fermented soybean intake or resistance exercise in obese middle-aged white rats, dietary intake increased incrementally for three weeks, but there was no significant difference among the groups <Figure 1A>, and weight change was lower in the other groups than in Con group from the 6th week of the treatment, but there was no significant difference <Figure 1B>.

3.2. Comparison of body composition



Figure 2. Comparison of lean mass(A), fat mass(B), and body mass index(C).

Note: p<.05(Compared to the Con group). The weight of lean mass and body fat for the changes in body composition were measured using DEXA after 12 weeks of fermented soybean ingestion or resistance exercise among the 50-week-old obese white rats. As a result, the lean mass in Soy and Soy+Re groups decreased compared to those in Con and Re groups <Figure 2A>, while body fat in Soy and Soy+Re groups was higher than those in Con and Re groups. The body fat of the Re group was significantly reduced compared to the other three groups. The body mass index did not show any differences among the groups <Figure 2C>, which was not statistically significant <Figure 2B>.

3.3. Peroral load check





Note: p<.05(Compared to the Con group), p<.05(Compared to the Re group). In order to verify insulin resistance in an empty stomach, glucose was administered directly to the oral cavity, and blood glucose was measured with blood collected from the vein after the tip of the tail was cut. As a result, all experimental groups showed a peak of blood sugar after 30 minutes <Figure 3> and continued to decrease after that. After 30 minutes, blood sugar levels were significantly higher in the Con group than in the Soy, Re, and Soy+Re groups, and blood sugar reactions in Soy and Soy+Re groups improved significantly over the Con and Re groups(p<.05) <Figure 3>.







Note: *; p<05(compared to the Con group). In order to verify the vascular acute inflammatory factors associated with metabolic diseases, the level of glucose and insulin resistance in the blood were analyzed in the empty stomach, and the levels of associated CRP and nitric oxide were analyzed. As a result, the glucose level was low in the Re and Soy+Re groups, but no significant difference was shown (Figure 4A). In the insulin resistance, it was lower in the Re and Soy+Re groups, which was significant <Figure 4D>. The level of CRP, the vascular acute inflammatory factor, was lower in the Re and Soy+Re groups, which was a significant difference <Figure 4B>, and for nitric oxide, which is related to vascular expansion, was higher in the Soy, Re, and Soy+Re groups than in the Con group <Figure 4C>, but no significant difference was shown.

3.5. Change in cytokine





Note: *; p<05(compared to the Con group). Cytokine were quantitatively analyzed by extracting the aorta, which is a path for large amounts of oxygen and blood from the heart when a ladder dimbing exercise was carried out, to determine the effect of fermented soybean intake or resistant exercise on the appearance of cytokine related to inflammation of the aortic tissue. IL-6 cytokine <Figure 3A> associated with infectious diseases showed significant differences in the Soy, Re, and Soy+Re groups compared to the Con group(p <0.05). Other cytokine such as TNF-α, IL-4, and IL-10 did not show significant differences among the groups <Figure 3>.

4. Discussion

This study would like to discuss the results of an analysis of the effects of obesity-induced white rats's resistance exercise and fermented soybean intake on the inflammatory cytokine changes according to body composition and insulin resistance levels in aortic tissue. In this study, the ingestion of fermented soybeans and resistance exercise had no significant effect on body composition. Middle-aged obese white rats ingested fermented soybeans had reduced lean mass and increased body fat. For the obese white rats that did not eat fermented soybeans, the lean mass increased and the body fat decreased. The results of the study(2017) by Jeong which reported that the amount of muscle that accounts for a large portion of the lean mass in the group that treated fermented soybean consumption and resistance movement, are believed to support this study[22]. Further studies need to review and implement methods of direct oral administration in addition to methods of ingestion that do not limit fermented soybean provision.

In the oral glucose test, blood glucose levels in the Soy, Re, and Soy+Re groups significantly decreased compared to the Con group. In a study by Nam H(2012), the effect of ingestion of fermented soybean extracts on blood sugar, HbA1c, hemoglobin, and insulin secretion in diabetic rats was analyzed, and fasting blood sugar and two-hour blood sugar were significantly lower in the group that ingested fermented soybean extracts than in the control group [23]. HbA1c also showed lower levels than in the control group. Inulin secretion ability in plasma was reported to be higher than the control group, which indicated an anti-diabetic effect. As with these findings, most prior studies showed increased lean mass, decreased body fat, and interaction effects in the blood glucose after the ingestion of fermented soybeans. However, this study did not show any weight loss, and body fat increased and lean mass fat decreased. Therefore, it can be thought that fermented soybeans may help control the constancy of glucose metabolism while lowering the glucose concentration in the blood without having a clear effect on weight loss. Taniguchi(2008) provided 11 healthy middle-aged women with a 12-week diet of fermented soybeans(50g) and demonstrated that the level of blood triglycerides and glucose were significantly reduced, which indicated that they were effective in alleviating diabetes and cardiovascular diseases [24]. Fujita H(2001) also reported that diabetic rats were injected with cheonggukjang(fast-fermented bean paste) containing 5% fermented soybeans for eight weeks, reducing after-meal blood sugar levels and HbA1c levels and improving liver function [25]. In the preceding study results and this study results, it is judged that the improvement of blood insulin by the ingestion of fermented soybeans is due to blood insulin control mechanisms rather than changes in body composition. Given the results of significant differences in blood insulin and CRP concentrations in the Re and Soy+Re groups, no significant differences were seen in nitric oxide(NO), which is an important modulator of cardiovascular activity and acts as a transporter of the central and peripheral nervous systems and is also involved in hormone secretion. John R(2000), who studied the relationship between blood pressure and NO, reported that when exercise was applied to rats, activations of NO not only inhibited blood clot production but also inhibited the production of white blood cells [26]. In this study, the levels of NO in the Re and Soy+Re groups were higher than those in the Con and Soy groups, which can be seen as a result of the blood CRP and insulin effect as vascular resistance factors were degraded due to exercise. However, to support the mutual results of risk factors related to metabolic diseases in the blood, it is believed that specific research on body composition and interrelationship between risk factors of metabolic diseases in the blood is needed.

Based on the study of Helen L(2019), the aortic tissue from the first part of the left ventricle was extracted to analyze the inflammatory response from the stimulus resulting from the performance of resistance exercise. In this study, inflammatory cytokine were analyzed in aortic tissue to identify changes in inflammation[21]. Lee(2014) analyzed inflammatory cytokine and anti-inflammatory cytokine in this study based on the results of reduced body fat in experiments with medium and high-intensity aerobic exercises, and decreased interaction effects in the medium and high-intensity groups[27].

IL-6, an inflammatory cytokine, is produced by fat cells, macrophages, and T-cells, engaging in acute-response inflammation and stimulating acute-stage proteins such as CRP in the liver[28]. In the preceding study, oral administration of cheonggukjang(16 mg) made from fermented soybeans to white rats reduced the appearance of infectious cytokine such as IL-1 β and IL-1 α in nerve tissues(Lee 2013) and the application of fermented soy ingredients to epithelial tissues that grow colorectal cancer-causing cells in human colon decreased inflammatory cytokine of IL-8[29][30]. In this study, the appearance of IL-6, an inflammatory cytokine, also showed a significant decrease in the Re and Soy+Re groups compared to the Soy group, which is assumed to have been affected by an increased tolerance to insulin resistance and by inhibiting and reducing nerve hormones in the hypothalamus. TNF- α is also an inflammatory cytokine that is involved in acute reaction inflammation and found in peripheral nerve and obesity conditions, and, as with IL-6, is found to regulate the action of leptin in the hypothalamus[31]. Unlike the results in IL-6, however, there were no significant results in the RE and Soy+Re groups and rather increased somewhat. Although this study cannot be concluded clearly, it is believed that the ability to secrete by macrophages was not inhibited due to an increase in inflammation during the obesity induction process. Inflammatory cytokine such as IL-6 and TNF- α induce the production of IL-4 and IL-10 to create an environment of anti-inflammatory cytokine, but in IL-4 and IL-10, the appearance of cytokine did not show significant differences among the groups. Interestingly, however, the results of the analysis of the triceps tissue in a study by Jeong(2017) showed that mTOR activity significantly increased in the Re group, and the results of this study could be supported by the results of their study by deriving that "in the group that performed both the diet and exercise, no changes in the activity of myopachynsis and myoatrophy factors"[32].

5. Conclusion

To examine changes in inflammatory cytokine that affect obesity and metabolic diseases caused by aging, the study conducted 12 weeks of resistance exercise and fermented soybean intake in 50-week-old middle-aged white rats, and the comparative analysis of the results showed that body fat increased and lean mass decreased in the Soy and Soy+Re groups. In addition, the analysis of changes in inflammatory cytokine in the aortic tissue showed no significant differences in cytokine changes other than IL-6. As a result, it is necessary to choose the dosage and type for the purpose of ingestion of fermented soybean, since the change in the inflammatory factor associated with vascular inflammation could not clearly confirm the positive effect of improving the function in the aortic tissue. It is also thought that prior research results and literature on the form, frequency, intensity, and time setting of exercise need to be compiled and applied anew.

6. References

6.1. Journal articles

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
	LGH	-Set of concepts 🗹 -Design 🗸
Lead Author		-Getting results 🗹 -Analysis 🕅
		-Make a significant contribution to collection \square
Corresponding Author*	KKJ	-Final approval of the paper 🔟 -Corresponding 🗹
		 -Play a decisive role in modification -Significant contributions to concepts, designs, practices, analysis and interpretation of data -Participants in Drafting and Revising Papers
		-Someone who can explain all aspects of the paper $\ igsidentum{arsigma}$

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Search for SNB-Program Participation Experience and Constituent Factors for HEALTH INTERVENTION: Using the Colaizzi Method

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Abstract

Purpose: This study conducted the exploration using the Colaizzi method, a phenomenological research method to identify the constituents of the experience of the SNB-program, one of Terahertz therapy, which is receiving much attention as a thermal treatment method recently.

Method: The data collection method of the first study using the Colaizzi method consisted of literature review for theoretical extraction, narrative observation and interview. For the first analysis of the data, the Colaizzi 6step analysis method, a phenomenological research method, was used to identify the participants' SNB-program experience and explore the constituent factors of the human body's natural healing experience. Second, a questionnaire was created based on the constituent factors of the participant's experience identified through in-depth interviews, and the principle component analysis of 123 questionnaires collected was conducted to verify the inner validity of the research results.

Results: In the results of this study, the SNB-program experience was confirmed based on two categories such as positive experience and uncomfortable experience. In detail, eight types of uncomfortable experiences including eight physical changes, six emotional changes, five social education changes, and improvements were derived. In addition, to verify the validity and reliability of the extracted constituent factors, from the results of constructing preliminary items and conducting exploratory factor analysis, lastly, it was confirmed with two categories, five theme clusters, and 27 formulated meanings.

Conclusion: In this study, the SNB-program participant's experience was verified in vivid language through the Colaizzi method, and the procedure was verified through social science analysis. The results of this study are meaningful in that the user's experience of thermotherapy using Terahertz waves has been generalized.

[Keywords] SNB-Program, Colaizzi Method, Health Intervention, Experience, Constituent Factors

1. Introduction

This Modern society is undergoing many changes in daily life due to the wave of the 4th industrial revolution. Particularly in the revolution of information and communication, due to the development of equipment, devices, software, and applications, now is the era when the work that only experts did in the past can be done the same way by ordinary people like experts [1].

From this point of view, what should be noted in Korea is that as for the hospital-centered disease management, an individual patient is now becoming an active health consumer through exercise, diet, and use of personal medical devices for individual health interventions [2][3]. In particular, to treat one's own disease, the use of personal medical devices is increasing widely. Therefore, the miniaturization and specialization of medical equipment that is used as an auxiliary to mediate health at home is expected to be accelerated further in the future by the choice of smart health consumers.

Korea is a country with a fast aging rate in the world, and it is predicted that by 2026, 20.6% of the Korean population will become aging and reach a super aging society. With such rapid aging, exercise therapy is being actively implemented as a health intervention method, and previous studies have shown various positive effects on exercise therapy[4][5][6]. However, due to the recent pandemic of Covid-19, there are many restrictions on daily life. Access to the hospital was also difficult due to the threat of infectious diseases, and as individuals of the whole people become the subject of pandemic control, social distancing and wearing masks are obligated[7][8]. Therefore, people have more time to stay at home, and efforts for health interventions have become more often centered around the family rather than outside life.

One of the therapies that have been widely used for personal health intervention in Korean homes since long ago is thermotherapy. Thermotherapy is one of the most commonly used physical therapy methods that heat local or whole body from outside or use conducted heat, and it is known that it has an analgesic and relieves muscle tone by promoting blood increase and activating metabolic activity[9][10]. In addition, systemic thermotherapy is known to improve physical symptoms such as pain, loss of appetite, vomiting, and chronic inflammation in cancer patients, as well as to relieve mental anxiety[11][12].

Thermotherapy uses conducted heat, and among them, the Terahertz therapy using radiant heat is receiving much attention. Terahertz electromagnetic waves are transmissive electromagnetic waves that are a combination of Tera, which means the 12th power of 10, and hertz, which is a frequency unit[13]. That is, a unit of electromagnetic waves that vibrate 1 trillion (tera) times per second, and it is written as 'THz'. In general, Terahertz is a frequency between infrared rays with good air permeability due to the long wavelength of microwaves, and as electromagnetic waves with relatively low energy, they are in the spotlight as a substrate used for cancer treatment in the human body[14][15].

That is, because Terahertz waves have a longer wavelength than visible or infrared rays, as with X-rays, it has a strong penetrating power, and has less energy than X-rays, so it does not harm the human body[16]. This is because when Terahertz electromagnetic waves encounter molecules like water they transfer energy within a short time and disappear, it is known that it stimulates the human body less than the X rays. Therefore, it is treated by intensively emitting electromagnetic waves to cancer cells to raise energy [17].

In recent years, the use of Terahertz electromagnetic waves is also increasing in search machines that see through passengers at airports. It can also be used to diagnose pathological tissues and find hidden explosives or drugs in mail. Many countries around the world have selected and developed a measurement analysis technology using Terahertz waves as one of the promising technologies to lead the 21st century [18][19].

In this study, first, a qualitative approach was attempted to explore the SNB-program(Ceramic Plate of Terahertz Wave) participants' experiences and constituent factors using the phenomenological method, the Colaizzi method, and second, a quantitative study, principle component analysis, was conducted to verify the validity and reliability of the derived constituent factors. The results of this study will provide a systematic and in-depth scientific basis for the content and constituent factors experienced by participants in the SNB-program.

2. Methods

2.1. Participant

This Participants in the study were selected through expert consultation with recommendations from those participating in the SNB-program at the integrated healthcare center in Seoul, Korea. The qualitative research method should be based on the fact that participants should sample individuals who fit the research theme and can express their experiences well. Therefore, participants who are interested in participating in the program and who can provide a wealth of information while maintaining an active attitude in relation to the study were selected as subjects for the study. For the selection of participants, six women out of 12 subjects were selected as final study participants under the advice of the research team, and the general characteristics of the participants are shown in <Table 1>.

ID	Age	Period of use	Use per week	Time per day
Participant 1	63	3 months	2	60 minutes
Participant 2	68	3 months	7	90 minutes
Participant 3	51	3 months	7	30 minutes
Participant 4	49	2 months	6	30 minutes
Participant 5	58	2 months	4	30 minutes
Participant 6	53	3 months	3	60 minutes

Table 1. Characteristics of the participants.

In the secondary analysis process conducted in this study, participants were sampled by judgmental sampling from those who had continued the heat treatment for more than 3 months, and 123 effective response copies were analyzed. There were 25 males(20.3%) and 98 females(79.4%), and ages were identified as 26 people in their 40s(21.2%), 34 people in their 50s(27.6%), 42 people in their 60s(34.1%), and 21 people in their 70s or older(17.1%).

2.2. Research design

The data collection method of the first study using the Colaizzi method consisted of literature review for theoretical extraction, narrative observation and interview. The characteristic of the Colaizzi method is to focus on deriving the common attributes of all participants rather than individual attributes[20]. The formulated meaning was derived from the participants' meaning-ful statements, and categorization was attempted by checking the theme and theme cluster in the formulated meaning. In the second study, the validity and reliability of the participants' SNB-program experience constituent factors identified as qualitative studies were verified using a quantitative study method. <Figure 1> shows the Research design.

Figure 1. Research design.



2.3. Data analysis

For the first analysis of the data, the Colaizzi 6-step analysis method, a phenomenological research method, was used to identify the participants' SNB-program experience and explore the constituent factors of the human body's natural healing experience. To this end, in-depth interviews were conducted more than two times using an informed consent form and an open semi-structured interview format. In the process of analyzing the data, triangulation was used by dividing the research team into two groups to increase the external validity, and the final analysis data were supplemented through advice and point out from thermal healing experts. Second, a questionnaire was created based on the constituent factors of the participant's experience identified through in-depth interviews, and the Principle Component Analysis(PCA) of 123 questionnaires collected was conducted to verify the inner validity of the research results.

3. Results

3.1. Components of the participant's SNB-program experience

As a result of analyzing through Colaizzi's phenomenological approach in this study, 47 formulated meanings, five theme clusters, and two categories were derived. The analyzed results were confirmed as shown in <Table 2> below.

	Table	2.	Components of	of the	participant's	s SNB-program	experience.
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Fomulated meaning	Theme & theme cluster	Category
 Feel refreshed by sweating Body temperature rises Reduced hand numbness Can sleep deeply Insomnia has been resolved. I sweat and my skin feels better. Bowel movements improved The size of the lump on the breast has decreased. Fatigue has improved Back pain has improved Shoulder pain was relieved. Menstrual pain was improved. Reduced leg numbness 	Physical change experience	Positive experience

My body became lighter		
 The symptoms of rhinitis were alleviated. 		
 My head became refreshed 		
 I feel refreshed 		
I have a relaxed mind		
 My body improved and became fun. 		
 Thanks for being satisfied 	Emotional	
 I am happy because my health has improved 	change experience	
Depression has improved	5 1	
• Vitality arose		
• The fear is gone		
• The body is comfortable, so the mind is comfortable		
 Sensitive personality has stabilized 		
 It is easy to do at home and is comfortable 		
 It is good to study the effect of heat 		
 There are many people like me 		
 Become cheerful and see my surroundings again 	Social educational	
 Thanks for learning about the body 	experience	
 Reduced fear of cancer 	experience	
 Learned about detoxification from the body 		
 Special therapeutic lecture is a good learning process 		
 The quality of life seems to have improved. 		
 Uncomfortable in summer because the body gets hot 		
 Attached parts often come off 	l la constanta bla	
 It is inconvenient because of the equipment is narrow 	Uncomfortable	
 I feel like I need a timer 	experience	
 It is heavy and difficult to move 		
 It is difficult to buy quickly because the price is high 		Uncomfortable
 I wish I had a book on the heat effect 		experience
I wish the review was edited into a book		
Rental is also necessary, not purchase	Finding	
I hope there are more opportunities for free trials	improvements	
 I need information on how to use each symptom 		
 Hope that improved products will be released 		

3.2. Validation and reliability of the constituent factors of the participant's SNB-program experience

Based on the results analyzed through Colaizzi's phenomenological approach, 32 preliminary items were composed. The content of the items was structured to include one item, and the emphasis was placed on whether it could clearly include the SNB-program experience. The score of the question was conducted by adopting the 5-stage Likert scale.

R-type Principle Component Analysis(CPA) and the Varimax rotation method of the right angle rotation method were used for exploratory factor analysis. Looking at the analysis results, items 7, 10, 11, 13, and 20 with low commonality, which are the variance ratio values f variables, were deleted, and five factors were extracted from a total of 27 items. The Kaiser-Meyer-Ol-kin(KMO) measure and Bartlett's Test of Sphericity's X^2 test conducted for factor analysis were analyzed as 2111.675 and .000(p<.001), indicating that the factor analysis model is suitable, and it was found that there is a good explanatory power of 64.207%.

The extracted factors were named as physical change experience, emotional change experience, social education experience, uncomfortable experience, and discovery of improvement points. Cronbach's α which represents the reliability of these factors, showed 0.807, 0.774, 0.756, 0.749, and 0.838, which were found to be reliable levels. <Table 3> shows the validity and reliability results of the constituent factors related to the SNB-program experience.
Table 3. Validity and reliability results of the constituent factors related to the SNB-program.

Factor item	1	2	3	4	5
Physical change experience 5	.630	.243	.089	.246	.088
Physical change experience 1	.608	.125	.308	273	035
Physical change experience 8	.581	104	.065	.073	050
Physical change experience 2	.504	.062	318	177	.218
Physical change experience 3	.479	.460	309	046	087
Physical change experience 4	.443	153	.166	.192	.044
Physical change experience 9	.429	.246	.116	.151	.105
Physical change experience 6	.418	.580	.171	.022	.072
Emotional change experience 7	043	.670	082	147	.041
Emotional change experience 3	013	.582	096	.129	058
Emotional change experience 5	.205	.582	225	091	.195
Emotional change experience 6	.229	.545	.370	210	.047
Emotional change experience 1	.097	.489	367	.179	075
Emotional change experience 4	.310	.453	.330	.089	260
Social educational experience 5	.005	.106	.665	.083	023
Social educational experience 4	.313	.268	.543	010	141
Social educational experience 6	020	.132	.478	.062	166
Social educational experience 3	.088	.089	.451	.390	.087
Social educational experience 1	.168	.050	.438	.319	.067
Uncomfortable experience 1	.153	428	.054	.575	.169
Uncomfortable experience 2	.082	.154	169	.490	.213
Uncomfortable experience 3	135	.059	.070	.471	068
Uncomfortable experience 4	127	032	296	.464	102
Finding improvements 3	067	021	.050	185	.703
Finding improvements 2	020	.120	.061	002	.638
Finding improvements 1	.108	.222	.025	.243	.534
Finding improvements 4	265	.355	194	.072	.409
Eigenvalue	1.828	2.007	1.483	1.259	13.685
Variance%	5.793	6.36	4.699	3.99	43.365
Explanatory power%	5.793	12.153	16.852	20.843	64.207
Cronbach's α	.807	.774	.756	.749	.838

Note: KMO=.769 Bartlett's X²=2111.675, (p<001).

4. Conclusion and Recommendations

This study conducted the exploration using the Colaizzi method, a phenomenological research method to identify the constituents of the experience of the SNB-program, one of Terahertz therapy, which is receiving much attention as a thermal treatment method recently. The Colaizzi method extracted meaningful phrases from the descriptions from the study subjects, and based on this, it is characterized by describing general and abstract statements, composing meaning, and categorizing them into theme clusters[20]. In this categorization, it is a research method that describes the essential structure of experience, and the validity of the essential structure of experience is confirmed by participants.

In the results of this study, the SNB-program experience was confirmed based on two categories such as positive experience and uncomfortable experience. In detail, eight types of uncomfortable experiences including eight physical changes, six emotional changes, five social education changes, and improvements were derived. In addition, to verify the validity and reliability of the extracted constituent factors, from the results of constructing preliminary items and conducting exploratory factor analysis, lastly, it was confirmed with two categories, five t heme clusters, and 27 formulated meanings. The results of this study can be said to be a detailed explanation of the SNB-program experience perceived by participants.

It is widely known that the thermal effect smooths blood flow and relieves pain through nerve stimulation[11][21]. In general, to mediate the symptoms accompanying pain, drug therapy or injection therapy such as steroids or muscle relaxants is used, but use is limited by side effects, addiction and tolerance. However, it has been proven in previous studies that non-invasive interventional therapy such as the thermotherapy is easy to apply in daily life, has few side effects, and can be used easily[9][22].

In this study, the SNB-program participant's experience was verified in vivid language through the Colaizzi method, and the procedure was verified through social science analysis. The results of this study are meaningful in that the user's experience of thermotherapy using Terahertz waves has been generalized. In future studies, experimental studies should be continuously conducted for the clinical effect of the SNB-program, and in particular, research is needed to confirm the effect in terms of physiology.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution		
Lead Author	нін	-Set of concepts 🔽		
		-Design 🔽		
		-Getting results 🔽		
		-Analysis 🔽		
Corresponding Author*	JBL	-Make a significant contribution to collection $\ oxtimes$		
		-Final approval of the paper 🛛		
		-Corresponding 🔽		
		-Play a decisive role in modification \square		
Co-Author	ORL	-Significant contributions to concepts, designs,		
	GH	practices, analysis and interpretation of data $arnowdynambol{Q}$		
	HJK SSK	-Participants in Drafting and Revising Papers 🛛		
		-Someone who can explain all aspects of the paper $ igvee $		