2-20-7 Arakawa Arakawaku Tokyo Japan

International journal of protection, security & investigation

2020 5(1)

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J-INSTITUTE

International Journal of Protection, Security & Investigation

Publication state: Japan ISSN: 2423-8368

Publisher: J-INSTITUTE Website: http://www.j-institute.jp

Corresponding author E-mail: wk11106@kmu.ac.kr

Peer reviewer E-mail: protection@j-institute.jp

http://dx.doi.org/10.22471/protective .2020.5.1.01

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INVESTIGATION on the Relation among the Body Composition, Physical Fitness, and Field Test of Female Softball Players

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Abstract

The purpose of this study was to investigate the relevance of body composition and physical fitness to field tests representing the performance of women's softball players. The subjects of the study were 22 players from women's softball teams located in "D" city, and they signed a consent form after confirming their willingness to participate voluntarily. The correlation analysis of Pearson was conducted to determine the relevance of field tests(three items: bat speed, throw distance, and base running) to body composition(10 items) and physical fitness(14 items). Results: In field test and body composition, female softball players showed a positive correlation with the forearm circumference in bat speed, and base running with the muscle-related variables(muscle mass and LBM), and the fat-related variables(fat ratio and abdominal fat ratio) showed negative correlation. Results: In field test and body composition, women's softball players showed a positive correlation with the forearm circumference in bat speed, and base running with the muscle-related variables(muscle mass and LBM), and the fat-related variables(fat ratio and abdominal fat ratio) showed negative correlation. In field test and physical fitness, there was a correlation between throw distance and lower limbs muscular endurance(repeating jump), response(standing long jump and vertical jump), agility(side step), and flexibility(trunk forward flexion). Base running showed a significant relevance with muscular strength(grip power), muscular endurance(sit up), response(standing long jump and vertical jump), agility(side step), and flexibility(trunk forward flexion). Body composition and physical fitness were divided into muscle-related and fatrelated variables. To sum up, the continuous management of physical composition and the increase in basic and professional physical fitness of female softball players are important factors in improving performance and preventing injury.

[Keywords] Bat Speed, Throw Distance, Base Running, Body Composition, Physical Fitness

1. Introduction

Softball has three critical variables for the outcome of the game. To explain these three variables, there are throwing, hitting, and running skills[1]. Improving these basic skills is a goal for softball players to train every day, and to develop specialized training methods. It is essential to improve the performance of an individual or team by developing these basic skills and training programs and applying them to the players[2].

One of the first factors in softball, throwing is the most representative ability regardless of position, and the fielders throw upward or sideways, but the pitcher has the characteristics of throwing downward rather than upward[3]. Throwing motion has a mechanism that transmits the force from the feet of the lower body to the upper limbs through core muscles and upper body[4]. Body composition and physical fitness are important factors in creating this mechanism

of motion. Throwing motion also requires accuracy and strong throwing ability, and the main factors are muscle mass of body composition, strength, flexibility, and equilibrium[5].

The second factor is the bat speed. Batting requires bat speed and accuracy, and fast bat speed is the most important factor among many hitting factors. Similar to the throwing motion, the mechanism of batting is transmitted from the toe of the lower limbs to the hips, core muscles, and upper body and limbs. It is delivered in a very short period of time and can be explained by the movements made by contraction, relaxation, and rotation of the muscles[6]. When all the processes are done like one movement and softness and strength work at the same time, one can achieve a good batting posture. In the whole process of swing, bat speed is represented by the force derived from these sequential movements of the body[7]. Thus, bat speed is the result of individual body composition and physical fitness. In addition, the type of muscular contraction and the angle of body segments during a swing are among the other variables[8]. These factors are closely related to body composition and physical fitness, and the players are repeating their training every day to automate their muscles under the control of the nervous system[9][10]. So the way to improve softball performance is to improve body composition and physical fitness[11].

The third element is base running. Running through the bases is called base running, and one hits the ball and reaches first base in 4.0-4.4 seconds[12]. Base running is an important factor in scoring because one has to turn around the bases and come back home quickly when in the offense. Also, "stealing" bases are one of the offense tactics with the ability to advance one more base[13]. Running is an important factor in tracking and catching the ball not only in offense but also in defense. Running is a process in which the lower and core muscles repeatedly contract and stretch. Softball has this characteristic of base running. To be good at this kind of running, one needs to improve the muscle strength and power[14].

In defense, one has to catch the ball that rolls on the ground or flies in the air. To catch, one visually judges and the brain directs the muscles that are dominated by motor nerves. This reaction is a sequence of processes from the brain to the peripheral nerves, in which the nervous system can be taught through repeated training activities to automate them. Through this repetitive training, the players are training to reduce the range of error in their movements. Muscles under the control of the neuromuscular system are adapted and characterized in the form appropriate to these movements[15]. The fundamental platform for this is body composition and physical elements. It is important for coaches and trainers of softball to create and apply training programs to improve individual players' abilities and team performance, taking this into account. In addition, injury prevention and rehabilitation are also important[16][17].

Measuring and evaluating body composition is important for athletic ability and improvement and maintaining physical health. The level of individual ability of the players shall be assessed by measuring and evaluating the body composition. Personalized training programs should be applied to individual players to observe their athletic performance during the season and offseason. The ways to improve body composition can be found with this approach[18]. To operate the physical fitness programs, measurement and evaluation of body composition must be conducted, through which training in the field and auxiliary training must be combined[19]. In particular, the batting or throwing action requires muscular strength and endurance and instantaneous power, and muscle mass is the basis of these forces. Therefore, body composition is important in all sports events, including softball. Such factors include LBM(lean body mass) and muscle mass. More muscle mass usually means more muscle strength, and it increases muscle strength and power along with the adjustment of the nervous system. These muscle mass or LBM's per-weight ratios play an important role in the performance of throwing, batting, and sprinting. It is important that the distribution of LBM and FM(fat mass) is clearly identified as a major variable in relation to motor ability. Therefore, measuring and assessing how the body's components are distributed will be an important factor in preventing and rehabilitating shoulder and elbow injuries for the players[20]. Accordingly, it is important to investigate the relevance of players' health, athletic ability, and injury prevention to obtain basic data on body composition and motor skills to match the characteristics of softball[21]. Also, coaches and trainers must be interested in body composition to create training programs to manage these body composition during the season[22].

The body composition varies depending on the gender, season, or off-season, and there are studies related to male body composition, but studies on the changes in the body composition of female athletes are somewhat lacking. Also, there are many papers on female softball players related to injury, but there are not enough papers on their body composition[23][24].

Physical fitness is the most important factor for athletes, and there are various factors such as muscle strength, muscle endurance, flexibility, equilibrium, response, agility, and coordination, and they are closely related to each other[25][26]. The way to improve bat speed, throw distance, and base running in softball is to improve physical fitness. Therefore, trainers and coaches are putting a lot of effort into organizing physical training programs. Muscle strength is related to all elements of batting, throwing, and running[27] and flexibility and equilibrium are additionally important to further upgrade your athletic ability. In softball games, physical fitness is not just one factor, but also an improvement in athletic ability when it consists of one or more complex elements[28]. Therefore, female softball players are committed to muscle improvement and conditioning for many hours a week, and they invest their time to improve their physical fitness. Most of these muscle and conditioning programs focus on improving muscle strength, power, speed, and turning skills[29]. By applying these improvements, most coaches and sports scientists are trying to prescribe them as programs that enhance the strength and power to improve the combined athletic abilities.

Examining the relation between body composition and physical fitness by field test(bat speed, throw distance, and base running ability) for female softball players will be valuable as data that can be used for collecting basic data on players' body composition and physical fitness, as well as for injury prevention and rehabilitation programs. Therefore, the purpose of this study is to investigate body composition and physical fitness of female softball players by field test category.

2. Research Method

2.1. Research subjects

The subjects of this study were female softball players of "D" company located at "D" city. The purpose and contents of the experiment were explained in advance, confirming their willingness to participate voluntarily and receiving consent. The general characteristics of the subjects are as shown in <Table 1>.

Ν	Age	Height(cm)	Weight(kg)	BMI
	24.10	162.95	63.14	23.43
22	±5.07	±5.64	±7.97	±3.45

Table 1. The general characteristics of the research subjects.

Note: Values are mean and SD.

2.2. Measurement items and method

2.2.1. Body composition items

The height(cm) was measured using BSM 370(Biospace. Korea) and the body composition items(weight, LBM, muscle mass, fate ratio, BMI, abdominal fat ratio, thigh, and lower leg) were measured using Inbody 720(Biospace, Korea). They were measured after removing all metal objects attached to the body that may affect the measurement, maintaining the measurement position presented in the equipment manual for stability.

2.2.2. Physical fitness

To check for changes in physical fitness factors, muscle strength(grip power and back muscle strength), muscle endurance(sit up, push up, repeating jump), response(standing long jump and vertical jump), full-body reaction test(light and sound), agility(side step), equilibrium(one foot standing with eyes closed and dynamic equilibrium), coordination(visual perception response), and flexibility(trunk forward and backward flexion).

2.2.3. Field ability

Throw distance: The maximum throw distance measured the maximum distance the players threw a softball from the home plate. A reference line was made at the home plate location for measurement, and an additional 2m line was set rearward to enable two-step run-up. Distance measurements were made by standing on the home plate and using a laser pro XE(USA) and marking the spot where the ball fell with a flag. The maximum distance was recorded in meters(m) by conducting a total of five times per player.

Bat Speed: Measurements of bat speed were made five bat swings at bat after warming up for 10 minutes. Speed gun(Bushnell Velocity Speed Gun, USA) was set to measure, and average speed(km/h) was recorded for 3 times excluding the highest and lowest values from 5 measured values.

Base running: To evaluate players' base running speed after hitting, the players started with a batting position at bat, and the time to return to home through the first, second, and third base was measured with a stopwatch. Arrival was based on stepping on the plate at each point, measured twice each, recording the fastest time in seconds.

2.3. Data analysis

The data processing method of this study was used to calculate the mean and standard deviation of all measurement items using the SPSS Ver.25.0(Statistical Package for Social Science SPSS, Inc., Chicago, IL, USA) for Windows and to analyze the relevance. Pearson's correlation analysis was conducted to determine the correlation between field test(bat speed, throw distance, base running(first, second, third base and home) and body composition and physical fitness. The statistical significance level is set to p<.05.

3. Result and Discussion

The results of the correlation analysis for female softball players to examine the relation between field test and body composition and physical fitness are as follows.

3.1. Correlation of body composition by field test

The results of analyzing the correlation between field test(bat speed, throw distance, and base running) and body composition are shown in <Table 2>.

Table 2.	Correlation	of body	composition	by field	test
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Bat sp	Bat speed	Throw		Base runni	ng(seconds)	
item	(km/h)	distance	1st base	2nd base	3rd base	Home

		(m)				
Weight(kg)	0.181	-0.104	-0.074	0.025	-0.032	-0.021
LBM(kg)	0.395	-0.009	-0.334	-0.309	-0.383	-0.468*
Muscle mass(kg)	0.402	0.001	-0.335	-0.311	-0.385	-0.472*
Fat ratio(%)	-0.264	-0.138	0.328	0.432*	0.458*	0.584**
BMI(kg/m ²)	0.015	-0.126	-0.044	0.018	0.052	0.087
Abdominal fat ratio (%)	-0.201	-0.229	0.281	0.439*	0.414	0.496*
Left thigh(cm)	0.227	0.138	0.308	0.337	0.273	0.225
Right thigh(cm)	0.240	0.173	0.276	0.314	0.261	0.212
Left forearm(cm)	0.613**	0.012	433*	-0.326	-0.163	-0.323
Right forearm(cm)	0.458*	0.197	-0.201	-0.139	0.087	-0.079

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

Significant trends were shown in bat speed and muscle mass(p=.064) and LBM(p=.068), and a significant relevance was shown with left forearm(r=.613, p=.002) and right forearm(r=.458, p=.032). In throw distance, there was no significant relevance in all items. There were significant relevance in base running: for the 1st base with left forearm(r=.433, p=044), for the 2nd base with fat ratio(r=.432, p=.044) and abdominal fat ratio(r=.439, p=.041), for the 3rd base with fat ratio(r=0.458, p=.032), and for the home with LBM(r=.468; p=.028), fat ratio(r=.584, p=.004), muscle mass(r=.472, p=.027), and abdominal fat ratio(r=.496, p=.019).

Looking at the correlation between bat speed and body composition, there was a tendency of relevance between bat speed and muscle mass and LBM, but it was not significant. Muscle mass and LBM are known to increase bat speed, but this study did not show any relevance. In addition, significant correlation in left and right forearm suggests that forearm is involved. According to a study by Ebben & Fotsch(2006)[1], multimode resistance training increases batting power in baseball, while Petushek, at al.(2018)[30] reported the importance of developing and verifying efficient evaluation tools to increase muscle mass through these muscle training. These results suggest that in the case of female softball players, bat speed is related to muscle mass and that improving bat speed of softball players requires the development of training programs that increase muscle mass and circumference. There was no significant association in all categories when it comes to throw distance. These results are believed to be the result of measuring the long throw of softball players. Unlike short distance, long distance throw with overall body force is more related to physical fitness than body composition, and most studies have reported on pitchers' ball speed and injury[31][32]. It is believed that the method of measuring throw speed measured at the distance between bases should be considered for future research on the relevance of the throw ability. Significant correlations were found in left forearm for the 1st base, fat ratio for the 2nd base, abdominal fat ratio for the 3rd base, and LBM, muscle mass, fat ratio, and abdominal fat ratio for the home. These results are consistent with studies[33][34] that higher muscle mass increases the running speed and that increased fat-related factors slow the running speed, and coaches and trainers should consider this in the process of setting up programs by measuring and evaluating the body composition of softball players[35].

3.2. Correlation between field test and physical fitness

3.2.1. Correlation between muscular strength and muscular endurance by field test

The results of analyzing the correlation between field test(bat speed, throw distance, base running) and muscle strength(grip power and back muscle strength) and muscle endurance(sit up, push up, repeating jump) are shown in <Table 3>.

			Throw	Base running(seconds)				
	ltem	(km/h)	distance (m)	1st base	2nd base	3rd base	Home	
Strength	Grip	0.363	0.343	-0.587**	-0.570**	-0.609**	-0.683**	
(kg)	Back muscle	0.373	0.313	-0.224	-0.303	-0.316	-0.321	
Muscle	Sit up	0.063	-0.007	-0.391	-0.506*	-0.521*	-0.526*	
Endur-	Push up	0.349	0.333	0.338	-0.091	0.001	-0.201	
ance (Count)	Repeating jump	0.418	0.556**	-0.152	-0.318	-0.598**	-0.597**	

 Table 3. Correlation between muscular strength and muscular endurance by field test.

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

Grip power, back muscle strength, and repeating jump tended to be significant. In throw distance, repeating jump showed a significant relevance(r=-.556, p=.007). In base running, there were significant relevances in grip power for the 1st base(r=-0.587, p=0.004), grip power(r=-.570, p=.006) and sit up(r=-.506, p=.016) for the 2nd base, grip power(r=-.609, p=.003), sit up(r=-.521, p=.013), and repeating jump(r=-.598, p=.003) for the 3rd base, and grip power(r=-.683, p=.001), sit up(r=-.526, p=.012), and repeating jump(r=-.597, p=.003) for the home.

Looking at the correlation between bat speed and muscular endurance, grip power, and repeating jump tended to be significant, and throw distance showed a significant correlation with repeating jump. For base running, a significant correlation was shown with grip power, sit up, and repeating jump. Plummer & Oliver(2014)[36] reported in a study of female softball players that activation of hip muscles determines the relation of the motor function of the torso. These results show that muscular strength and muscular endurance are important variables for all athletes and are important factors in improving the level of athletic ability. It can be seen that repeating jump representing the muscular endurance of the lower body increases the long-distance throw and it suggests that they are also an important factor in improving the base running ability. Therefore, since all movements of batting, throwing, and running in relation to the characteristics of softball are closely related to muscular strength and muscular endurance[37], training programs for improving athletic ability are believed to prevent injuries and improve performance.

3.2.2. Correlation between response and response time and agility by field ability

Correlation results of response(standing long jump and vertical jump), response time(sound and light), and agility(side step) by field test(bat speed, throw distance, base running) are shown in <Table 4>.

Bat speed showed a significant relevance with standing long jump(p=.081) and vertical jump(p=.062). Throw distance showed a significant relevance with standing long jump(r=.502, p=.017), vertical jump(r=.475, p=.025), and Side step(r=-.503, p=.017). For base running, a significant relevance was shown for the 3rd base with standing long jump(r=-.670, p=.001), vertical jump(r=-.463, p=.030) and side step(r=-.430, p=.046) and for the home with standing long jump(r=-.683, p=.001), vertical jump(r=-.511, p=.015), and side step(r=-.479, p=.024).

 Table 4. Correlation between response and response time and agility by field ability.

		Bat speed Throw			Base runr	ning(seconds)	
	Item	(km/h)	distance (m)	1st base	2nd base	3rd base	Home
Leg power	Standing long jump	.380	.502*	241	409	670**	683**

(cm)	Vertical jump	.405	.475*	328	393	463*	511*
Full body	Sound	185	065	.102	.027	.062	.136
response (sec)	Light	191	.013	.098	.056	.146	.224
Agility (times)	Side step	.292	.503*	028	226	430*	479*

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

Looking at the correlation between bat speed and response and response time and agility, there was a significant trend but no relevance with bat speed and standing long jump and vertical jump. A significant correlation was shown between throw distance and base running and standing long jump, vertical jump, and side step. Magrini & Dawes et al.(2018)[13] suggested that power, speed, and agility are important in the characteristics of softball, and physical fitness and conditioning experts are recommended to apply these training programs. These results suggest that the ability to throw and base run in softball is related to lower limb power and agility.

3.2.3. Correlation between coordination and equilibrium and flexibility by field ability

Correlation results of coordination(visual perception coordination), equilibrium(one foot standing with eyes closed and dynamic equilibrium), and flexibility(trunk forward/backward flexion) by field test(bat speed, throw distance, base running) are shown in <Table 5>.

ltem		Bat	Throw		Base runnir	ng(seconds)	
		speed (km/h)	distance (m)	1st base	2nd base	3rd base	Home
Coordination (sec)	Visual perception	398	532*	138	125	172	.168
Balance	One foot standing with eyes closed	.202	.303	.213	.232	012	.010
(sec)	Dynamic equilibrium	.099	.256	273	288	312	341
Flexibility	Trunk forward flexion	.183	.484*	040	098	487*	.365
(cm)	Trunk backward flexion	.055	047	092	144	143	.209

Table 5. Correlation between coordination and equilibrium and flexibility by field ability.

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

No items showed significant relevance for bat speed. When it comes to throw distance, there was a significant relevance with visual perception coordination(r=.532, p=.011), and trunk forward flexion(r=.484, p=.023). There was a significant relevance between the 3rd base running and trunk forward flexion(r=.487; p=.022).

Looking at the results of the correlation between bat speed and coordination, equilibrium, and flexibility, there was no significant association in all categories in bat speed. For throw distance, there was a significant relevance with visual perception coordination and trunk forward flexion. For base running, the 3rd base running had a significant relevance with trunk forward flexion. Throwing a ball in softball is composed of complex mechanisms and the complex stability of hip and pelvis is important[37] and to prevent injury by distortion of upper and lower bodies flexibility and equilibrium are important[38]. These results were consistent with the significant relevance of the visual perception coordination and flexibility of the

throwing motion in this study. In addition, equilibrium is highly related to the motor function in softball, and players with joint or muscle injuries experience a sharp decline in balance [39][40].

3.3. Analysis of correlation between body composition and physical fitness

The results of analyzing the correlation between body composition(weight, LBM, muscle mass, fat ratio, BMI, abdominal fat ratio, and circumference) and physical fitness are shown in <Table 6>.

	Weig		Muscle	Fat		Ab-	Thigh	n(cm)	Forea	rm(cm)
ltems	ht (kg)	LBM (kg)	mass (kg)	ratio (%)	BMI (kg/m²)	dominal fat ratio (%)	Left	Right	Left	Right
Grip power(kg)	0.089	0.544**	0.551**	-0.550**	-0.019	-0.419	-0.001	0.012	0.451*	0.365
Back muscle power(kg)	0.227	0.508*	0.513*	-0.325	0.096	-0.268	0.227	0.191	0.369	0.296
Sit up(times)	-0.405	0.223	0.224	-0.795**	-0.435*	-0.691**	-0.256	-0.233	0.058	-0.075
Push up(times)	-0.430*	-0.076	-0.071	-0.495*	-0.240	-0.521*	-0.109	-0.126	-0.012	-0.147
Repeating jump (times)	-0.121	0.372	0.380	-0.639**	-0.352	-0.528*	-0.031	-0.008	0.120	0.128
Standing long jump(cm)	-0.234	0.350	0.355	-0.760**	-0.453*	-0.671**	-0.267	-0.270	-0.027	-0.118
Vertical jump(cm)	- 0.595**	0.053	0.057	-0.846**	-0.654**	-0.862**	-0.405	-0.365	-0.063	-0.152
Sound(sec)	-0.172	-0.455*	-0.459*	0.288	0.164	-0.014	-0.212	-0.245	-0.405	-0.456*
Light(sec)	-0.118	-0.502*	-0.503*	0.410	0.272	0.113	-0.151	-0.204	-0.352	-0.366
Side step(times)	-0.424*	0.090	0.096	-0.682**	-0.561**	-0.641**	-0.192	-0.132	-0.101	-0.041
One foot standing with eyes closed (sec)	-0.244	-0.152	-0.150	-0.132	-0.097	-0.144	0.091	0.052	-0.009	-0.043
Dynamic equilibrium(sec)	- 0.550**	-0.131	-0.130	-0.565**	-0.504*	-0.576**	-0.497*	-0.466*	-0.110	-0.197
Trunk forward flexion(cm)	0192	0.273	0.276	-0.589**	-0.419	-0.465*	-0.157	-0.165	-0.167	-0.270
Trunk backward flexion(cm)	-0.213	0.307	0.306	-0.631**	-0.336	-0.515*	-0.084	-0.131	0.021	-0.141

 Table 6. Analysis of correlation between body composition and physical fitness.

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

In muscle power and endurance, there was a significant correlation with grip power and LBM(r=.544, p=.009) and muscle mass(r=.551, p=.008) and a negative significant correlation with fat ratio(r=-.550, p=.008). There was a significant correlation with back muscle power with LBM(r=.508, p=.016) and muscle mass(r=.513, p=.015). For sit up, there was a negative significant correlation with fat ratio(r=-.795, p=.001), BMI(r=-.435, p=.043), and abdominal fat ratio(r=-.691, p=.001). For push up, there was a negative significant correlation with weight(r=-.430, p=.046), fat ratio(r=-.495, p=.019), and abdominal fat ratio(r=-.521, p=.013). For repeating jump, there was a negative significant correlation with fat ratio(r=-.528, p=.012). For standing long jump, there was a negative significant correlation with fat ratio(r=-.671, p=.001). For vertical jump, there was a negative significant correlation with fat ratio(r=-.671, p=.001). For vertical jump, there was a negative significant correlation with fat ratio(r=-.654, p=.001), and abdominal fat ratio(r=-.846, p=.001), BMI(-.654, p=.001), and abdominal fat ratio(r=-.862, p=.001). There was a negative significant correlation with fat ratio(r=-.846, p=.001), BMI(-.654, p=.001), and abdominal fat ratio(r=-.455, p=.033) and muscle

mass(r=-.459, p=.032) and for light with LBM(r=-.502, p=.017) and muscle mass(r=-.503, p=.017). For side step, there was a negative significant correlation with weight(r=-.424, p=.049), fat ratio(r=-.682, p=.001), BMI(r=-.561, p=.007), and abdominal fat ratio(r=-.641, p=.001) For dynamic equilibrium, there was a negative significant correlation with weight(r=-.550, p=.008), fat ratio(r=-.565, p=.006), BMI(r=-.504, p=.017), and abdominal fat ratio(r=-.576, p=.005). For trunk forward flexion, there was a negative significant correlation fat ratio(r=-.589, p=.004) and abdominal fat ratio(r=-.465, p=.029), and for trunk backward flexion, there was a negative significant correlation fat ratio(r=-.515, p=.014). For the correlation between the circumference of body composition and physical fitness, grip power and left forearm(r=.451, p=.035) showed a significant correlation, and for sound response, there was a negative significant correlation in dynamic equilibrium and left thigh(r=-.497, p=.019) and right thigh(r=-.466, p=.029) No significant correlation was shown in all other items.

Looking at the relation between physical fitness and body composition, it was found that there was a significant correlation between muscular variables(LBM and muscle mass) of body composition, muscular variables of physical fitness(grip power and back muscle strength), and response time variables(sound and light). These results suggest that increased muscle variables increase muscle strength and faster response time[41]. The increase in muscle mass caused by exercise directly affects the neuromuscular system, which improves the growth of the muscle and the conductivity of the nervous system[42].

In contrast, fat-related variables(fat ratio, BMI, and abdominal fat ratio) were found to be negatively related to muscle endurance(sit up, push up, and repeating jump), response(standing long jump and vertical jump), agility(side step), dynamic equilibrium, and flexibility(trunk forward/backward flexion) variables. It suggests that an increase in fat-related variables results in a decrease in the motor skills of physical fitness-related variables[18][43][44].

Significant relevances have been shown in the circumference of the body composition(left forearm) and in grip power and response to sound, which means that the greater thickness of forearm the greater grip power and the faster response to sound. However, there was a negative relevance for thigh and dynamic equilibrium, which, if not clear, is attributed to the accumulation of fat in the lower body parts of female softball players[45].

4. Conclusion

In field test and body composition, women's softball players showed a positive correlation with the forearm circumference in bat speed, and base running with the muscle-related variables(muscle mass and LBM), and the fat-related variables(fat ratio and abdominal fat ratio) showed negative correlation. In field test and physical fitness, there was a correlation between throw distance and lower limbs muscular endurance(repeating jump), response(standing long jump and vertical jump), agility(side step), and flexibility(trunk forward flexion). Base running showed a significant relevance with muscular strength(grip power), muscular endurance(sit up), response(standing long jump and vertical jump), agility(side step), and flexibility(trunk forward flexion). Body composition and physical fitness were divided into muscle-related and fat-related variables. To sum up, the continuous management of physical composition and the increase in basic and professional physical fitness of female softball players are important factors in improving performance and preventing injury. In addition, further studies of body composition and physical fitness related to field tests are required in future studies.

5. References

5.1. Journal articles

- [1] Ebben WP & Fotsch A & Hartz KK. Multimode Resistance Training to Improve Baseball Batting Power. *Strength and Conditioning Journal*, 28(3), 32-36 (2006).
- [3] Downs J & Friesen K & Anz AW & Dugas JR & Andrews JR & Oliver GD. Effects of a Simulated Game on Pitching Kinematics in Youth Softball Pitcher. *International Journal of Sports Medicine*, 41(3), 189-195 (2020).
- [4] Chalmers PN & Wimmer MA & Verma NN & Cole BJ & Romeo AA. The Relationship between Pitching Mechanics and Injury: A Review of Current Concepts. *Sports Health-a Multidisciplinary Approach*, 9(3), 216-221 (2017).
- [5] Lockie RG. A 6-week Base Strength Training Program for Sprint Acceleration Development and Foundation for Future Progression in Amateur Athletes. *Strength and Conditioning Journal*, 40(1), 2-12 (2018).
- [6] Nevins D & Smith L & Kensrud J. Sensitivity of Batted-ball Speed to Swing Speed Models. *Journal of Sports Engineering and Technology*, 233(3), 416-423 (2019).
- [7] Lyu B & Smith LV. Evaluation of Wireless Bat Swing Speed Sensors. *Sports Engineering*, 21(3), 229-234 (2018).
- [8] Kim Y & Jo Y & Kim S & Park K. Shoulder Pain and Rotational Range of Motion of the Trunk, Shoulder, and Hip in Baseball Players. *Journal of Athletic Training*, 54(11), 1149-1155 (2019).
- [9] Zaremski JL & Wright TW & Herman DC. Humeral Stress Fracture with Median Nerve Injury in a Baseball Player: A Case Report and Discussion. *Current Sports Medicine Reports*, 17(6), 183-186 (2018).
- [10] Pean F & Tanner C & Gerber C & Furnstahl P & Goksel O. A Comprehensive and Volumetric Musculoskeletal Model for the Dynamic Simulation of the Shoulder Function. *Computer Methods in Biomechanics and Biomedical Engineering*, 22(7), 740-751 (2019).
- [11] Barfield JW & Oliver GD. Sport Specialization and Single-legged-squat Performance among Youth Baseball and Softball Athletes. *Journal of Athletic Training*, 54(10), 1067-1073 (2019).
- [13] Magrini M & Dawes JJ & Spaniol FJ & Roberts A. Agility Training for Baseball/Softball. *Strength & Conditioning Journal*, 40(1), 68-74 (2018).
- [14] Massey KP & Brouillette KM & Martino M. A Comparison of Base Running Start Techniques in Collegiate Fastpitch Softball Athletes. *Journal of Human Sport and Exercise*, 13(1), 29-35 (2018).
- [15] Scarborough DM & McCunney RC & Berkson EM & Oh LS. The Relationship of Elbow Alignment and Kinematics on Shoulder Torque during the Softball Pitch: A Biomechanical Analysis of Female Softball Pitchers. *Journal of Shoulder and Elbow Surgery*, 28(2), 357-364 (2019).
- [18] Czeck MA & Raymond-Pope CJ & Christiana J & Bosch TA & Ransone JW & Oliver JM & Carbuhn A & Stanforth PR. Body Composition of Collegiate Baseball and Softball Athletes, Consortium of College Athlete Research(C-CAR) Study. *Medicine and Science in Sports and Exercise*, 50(5), 381-382 (2018).
- [19] Sanfilippo J & Krueger D & Heiderscheit B & Binkley N. Dual-energy X-ray Absorptiometry Body Composition in NCAA Division I Athletes: Exploration of Mass Distribution. *Sports Health-a Multidisciplinary Approach*, 11(5), 453-460 (2019).
- [20] Oliver GD & Saper MG & Drogosz M & Plummer HA & Arakkal AT & Comstock RD & Fleisig GS. Epidemiology of Shoulder and Elbow Injuries among US High School Softball Players, 2005-2006 through 2016-2017. Orthopaedic Journal of Sports Medicine, 7(9), 1-7 (2019).
- [21] Oliver GD & Friesen K & Barfield JW & Giordano K & Anz A & Dugas J & Andrews J. Association of Upper Extremity Pain with Softball Pitching Kinematics and Kinetics. *Orthopaedic Journal of Sports Medicine*, 7(8), 1-6 (2019).

- [22] Nepocatych S & Balilionis G & O'Neal EK. Analysis of Dietary Intake and Body Composition of Female Athletes over a Competitive Season. *Montenegrin Journal of Sports Science and Medicine*, 6(2), 57-65 (2017).
- [23] Wasserman EB & Register-Mihalik JK & Sauers E & Currie D & Pierpoint L & Dompier TP & Kerr ZY. Comparison of High School Girls' and College Women's Softball Injury Incidence, 2004/05-2013/14. *Medicine and Science in Sports and Exercise*, 49(5), 418-418 (2017).
- [24] Oliver GD & Gilmer GG & Friesen KB & Plummer HA & Anz AW & Andrews JR. Functional Differences in Softball Pitchers with and without Upper Extremity Pain. *Journal of Science and Medicine in Sport*, 22(10), 1079-1083 (2019).
- [25] Mallace A & Schilling D & Elazzazi A. Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) in DIII Collegiate Baseball and Softball Players. *Medicine and Science in Sports and Exercise*, 50(5), 607-607 (2018).
- [26] Montalvo AM & Kimura B. The Effects of a Shoulder Stretching and Strengthening Intervention on Shoulder Benchmarks and Disability in Collegiate Softball Players. *Medicine and Science in Sports and Exercise*, 50(5), 784-784 (2018).
- [27] Fry KE & Wittman K & Gerke D & Parr A. Clinical and Biomechanical Evaluation of the Softball Pitcher: A Review of Current Concepts and Clinical Commentary. *Clinical Journal of Sport Medicine*, 29(5), 406-412 (2019).
- [28] Girard J & Feng B & Chapman C. The Effects of High-intensity Interval Training on Athletic Performance Measures: A Systematic Review. *Physical Therapy Reviews*, 23(2), 151-160 (2018).
- [29] Miller RM & Strohmeyer HS & Bemben MG. Comparisons between Jump Power, Swing Velocity, and Hitting Measures in Collegiate Baseball and Softball Athletes. *Medicine and Science in Sports* and Exercise, 49(5), 622-622 (2017).
- [30] Petushek E & Clarke SB & Dorgo S & Ebben W & Myer GD & Krosshaug T. Development and Validation of Efficient Assessment Tool to Quantify Strength Training Technical Expertise. *Medicine and Science in Sports and Exercise*, 50(5), 432-432 (2018).
- [31] Scarborough DM & Linderman SE & Cohen VA & Berkson EM & Eckert MM & Oh LS. Neuromuscular Control of Vertical Jumps in Female Adolescents. *Sports Health-a Multidisciplinary Approach*, 11(4), 343-349 (2019).
- [32] Smith L & Kensrud J. Field and Laboratory Measurements of Softball Player Swing Speed and Bat Performance. *Sports Engineering*, 17(2), 75-82 (2014).
- [33] Barbieri D & Zacagni L & Babic V & Rakovac M & Misigoj-Durakovic M & Gualdi-Russo E. Body Composition and Size in Sprint Athletes. *Journal of Sports Medicine and Physical Fitness*, 57(9), 1142-1146 (2017).
- [34] Abe T & Kawamoto K & Dankel SJ & Bel ZW & Spitz RW & Wong V & Loenneke JP. Longitudinal Associations between Changes in Body Composition and Changes in Sprint Performance in Elite Female Sprinters. *European Journal of Sport Science*, 20(1), 100-105 (2020).
- [35] Rumpf MC & Lockie RG & Cronin JB & Jalilvand F. Effect of Different Sprint Training Methods on Sprint Performance over Various Distances: A Brief Review. *Journal of Strength and Conditioning Research*, 30(6), 1767-1785 (2016).
- [36] Plummer HA & Oliver GD. The Relationship between Gluteal Muscle Activation and Throwing Kinematics in Baseball and Softball Catchers. *Journal of Strength and Conditioning Research*, 28(1), 87-96 (2014).
- [37] Oliver GD & Plummer H. Ground Reaction Forces, Kinematics, and Muscle Activations during the Windmill Softball Pitch. *Journal of Sports Sciences*, 29(10), 1071-1077 (2011).
- [38] Helmkamp JK & Bullock GS & Rao A & Shanley E & Thigpen C & Garrigues GE. The Relationship between Humeral Torsion and Arm Injury in Baseball Players: A Systematic Review and Metaanalysis. *Sports Health-a Multidisciplinary Approach*, 12(2), 132-138 (2020).
- [39] Kim Y & Lee J & Wellsandt E & Rosen AB. Comparison of Shoulder Range of Motion, Strength, and Upper Quarter Dynamic Balance between NCAA Division I Overhead Athletes with and without a History of Shoulder Injury. *Physical Therapy in Sport*, 42, 53-60 (2020).

- [40] Bullock GS & Faherty MS & Ledbetter L & Thigpen CA & Sell TC. Shoulder Range of Motion and Baseball Arm Injuries: A Systematic Review and Meta-analysis. *Journal of Athletic Training*, 53(12), 1190-1199 (2018).
- [41] Carbuhn AF & Fernandez TE & Bragg AF & Green JS & Crouse SF. Sport and Training Influence Bone and Body Composition in Women Collegiate Athletes. *Journal of Strength and Conditioning Research*, 24(7), 1710-1717 (2010).
- [42] Caldemeyer LE & Brown SM & Mulcahey MK. Neuromuscular Training for the Prevention of Ankle Sprains in Female Athletes: A Systematic Review. *Physician and Sportsmedicine*, 32067546, 1-1 (2020).
- [43] Chen KT & Yang RS. Effects of Exercise on Lipid Metabolism and Musculoskeletal Fitness in Female Athletes. *World Journal of Gastroenterology*, 10(1), 122-126 (2004).
- [44] Bell DR & Sanfilippo JL & Binkley N & Heiderscheit BC. Lean Mass Asymmetry Influences Force and Power Asymmetry during Jumping in Collegiate Athletes. *Journal of Strength and Conditioning Research*, 28(4), 884-891 (2014).
- [45] Sousa AS & Fonseca I & Pichel F & Amaral TF. Effects of Posture and Body Mass Index on Body Girth Assessment. *Nutrition in Clinical Practice*, 31(5), 690-694 (2016).

5.2. Additional references

- [2] Lam ETC & Gordon I & Day-Eyler J & Bae J & Pearson DW. Preferred and Perceived Coaching Behaviors by Baseball and Softball Players. Research Quarterly for Exercise and Sport, 88, A130 (2017).
- [12] Haag SJ. Getting to First Base: Running is Faster than Sliding in Collegiate Baseball and Softball Players. International Journal of Sports Science & Coaching, UNSP 1747954120913858 (2020).
- [16] Barfield J & Oliver G. What Do We Know about Youth Softball Pitching and Injury? Sports Medicine-Open, 4, UNSP 50 (2018).
- [17] Cole A & Hiatt JL & Arnold C & Sites T & Ylanon R. Chronic Exertional Compartment Syndrome in the Forearm of a Collegiate Softball Pitcher. Sports Medicine-Open, 3, UNSP 11 (2017).

6. Contribution

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Load		-Getting results 🔽
Lead Author	PJS	-Analysis 🔽
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		collection \checkmark
		-Final approval of the paper 🗹
Corresponding	CINIK	-Corresponding 🗹
Author*	CVVK	-Play a decisive role in modification $ igsidemodeset$
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- The Effects of AMPK Activation Induced by Endurance Exercise on Glucose Uptake Via AKT/AS160, Korean Journal of Sport Studies, 57(6) (2018).
- An Estimation Model for Anaerobic Power of Taekwondo Athletes Based on Field Tests, Journal of Martial Arts Anthropology, 19(1) (2019).
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- Vessel Remodeling after Intima-to-intima Contact Anastomosis, Archives of Plastic Surgery, 44(2) (2017).
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International Journal of Protection, Security & Investigation

Publication state: Japan ISSN: 2423-8368

Publisher: J-INSTITUTE Website: http://www.j-institute.jp

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http://dx.doi.org/10.22471/protective .2020.5.1.14

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An Investigation on the Influence of TAEKWONDO Demonstration Team Activities on College Life Adaptation

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Abstract

The study was conducted to find out how taekwondo demonstration team activities affect college life adaptation for students who are participating in taekwondo demonstration teams at colleges and universities nationwide. To achieve the purpose of the study, a survey was conducted on 232 college students who were active in taekwondo demonstration teams at colleges and universities nationwide. Frequency analysis using SPSS 26.0 was conducted on the data collected through the survey to identify the general characteristics of the study participants. T-test and one-way ANOVA were conducted to find out how taekwondo demonstration team activities affect college life adaptation. The conclusions from the analysis are as follows. First, after verifying the differences in college life adaptation by gender among college students participating in taekwondo demonstration teams, no significant differences were found in all the variables. Second, a significant difference in social adaptation factor was found after verifying the differences between college students participating in taekwondo demonstration teams by their college years. Third, the results of verifying the differences in college life adaptation by the experience of college students participating in demonstration competitions showed a significant difference in the academic adaptation factor. Fourth, the results of verifying the differences in college life adaptation by experience of college students who are active in taekwondo demonstration teams winning an demonstration competition showed significant differences in all factors.

[Keywords] Investigation, Taekwondo, Taekwondo Demonstration, College Life Adaptation, Influence

1. Introduction

Taekwondo is largely divided into sparring, forms, and breaking. Sparring in particular has developed into an international sporting event, while forms have been examined by Kukkiwon based on individual training[1]. Taekwondo demonstration, which includes all three, began in 1959 with the Korean Military Taekwondo Demonstration Team, which was dispatched to Vietnam and Taiwan, and later Kukkiwon Demonstration Team was formally established in 1974. And taekwondo demonstrations were carried out as a means to promote taekwondo as an official Olympic event. Therefore, taekwondo demonstration has contributed greatly to spreading taekwondo worldwide and establishing itself as an official Olympic event[2].

Taekwondo demonstration introduces the overall content to a large audience, including basic movements, forms, sparring, breaking, self-defense, taekwondo gymnastics, etc., which are widely known as Korean culture by showing not only visible skills but also inherent mental aspects[3]. Since the establishment of taekwondo departments at Yongin University in 1982 and Kyunghee University in 1983 to foster excellent leaders with expertise in theory and practice at universities across the country, taekwondo departments have increased since the 1990s[4],

with 136 universities in Korea setting up taekwondo departments or selecting taekwondo specialists by 2009 and producing thousands of leaders a year from these universities[5].

In addition, universities with taekwondo majors across the country operate mostly sparring and forms teams[5]. And there are also taekwondo demonstration teams to promote schools and departments and the excellence of taekwondo. In particular, college students who are active in taekwondo demonstration teams hope to be part of the demonstration teams under the three organizations representing Korea: Kukkiwon, the World Taekwondo Federation, and the Korea Taekwondo Association. National team members for sparring and forms are selected through competitions, but demonstration teams are run by organizations from the Kukkiwon, the World Taekwondo Federation and the Korea Taekwondo Association[6].

Among the students participating in taekwondo demonstration teams at colleges, some belong to several organizations that represent the country[7] and those in the department of taekwondo faithfully fulfill their role as a member of the demonstration team and taekwondo clubs at colleges have the largest number of active members across the country[8]. Exercise participation satisfaction, the result of participation in taekwondo demonstration team, is a level of personal satisfaction with the demonstration and a factor that determines the participation, continuation, and interest in the demonstration team activities[9][10]. Exercise participation satisfaction has been shown to be deeply related to exercise stress through prior research on exercise stress and college life satisfaction[11], and it has been confirmed that it also affects campus life satisfaction[12]. Research on quality of life, such as stress and satisfaction with campus life, is reported to be helpful in daily life or demonstration activities[13]. If the taekwondo demonstration team activities have a positive impact on college life, then ways to encourage demonstration team activities could also be considered. However, despite the link between participation satisfaction, stress, and campus life, research on college taekwondo demonstration team members is currently insufficient. Therefore, the study aims to determine how the taekwondo demonstration team activities actually affect college life adaptation of students who belong to taekwondo demonstration teams at colleges and universities across the country.

2. Research Method

2.1. Research participants

Research participants were selected as the purposive quota sampling for students who are active in taekwondo demonstration teams at universities across the country and a survey was conducted for 232 students. The results of the frequency analysis by dividing the characteristics of the participants into gender, college year, experience in participating in the demonstration, and winning the demonstration competitions are as shown in <Table 1>.

Item	Description	Frequency	Percentage(%)
	Male	185	79.7
Gender	Female	47	20.3
	Freshmen	69	29.8
	Sophomore	71	30.6
College year	Junior	62	26.7
	Senior	30	12.9

Table 1. General characteristics of the research participants.

Whether participated in competition	Yes	183	78.9
	No	49	21.1
Wether won a	Yes	131	56.5
competition	No	101	43.5
Total		232	100

2.2. Measuring tool

In order to measure how taekwondo demonstration team activities affect college students' adaptability to college life, 67 questions based on Student Adaptation to College Questionnaire(SAQ) that were developed by Baker & Sirky[14], adapted by Hyun Jin-won[15] and reconstructed by Kwon Hye-jin with the Likert 5-point scale[16]. The college life adaptation scale consists of four factors: academic adaptation, social adaptation, personal emotional adaptation, and college environment adaptation.

2.3. Data processing

In this study, frequency analysis using SPSS 26.0 was conducted for data collected through questionnaires to identify the general characteristics of the research participants. T-test and one-way ANOVA were conducted to find out how taekwondo demonstration team activities affect college life adaptation. The significance level for all statistics is set to .05.

3. Results and Discussions

3.1. Differences in college life adaptation by gender with taekwondo demonstration team activities

The results of analyzing the differences in college life adaptation according to the gender of university students participating in taekwondo demonstration teams are as shown in <Table 2>. Taekwondo demonstration team activities do not show statistically significant differences in academic adaptation with t=.962 and p=.768, in social adaptation with t=.557 and p=.606, in personal emotional adaptation with t=.359 and p=.882, and in college environment adaptation with t=1.974 and p=.282. These results are consistent with the results of a study by Kang Seolhee and Jang Kwon[13] that there is no difference in college life satisfaction by the gender and show that participation in taekwondo demonstration team does not make significant difference in adapting to college life by gender.

Description	Gender	n	М	SD	t
A and a with a departmention	Male	185	3.32	.47	0(2)
Academic adaptation	Female	47	3.40	.47	962
Social adaptation	Male	185	3.53	.46	F F 7
	Female	47	3.48	.43	.557
Personal emotional	Male	185	3.26	.55	250
adaptation	Female	47	3.23	.56	.559
College environment adaptation	Male	185	4.00	.71	1 07/
	Female	47	3.78	.67	1.374

 Table 2. Differences in college life adaptation by gender.

3.2. Differences in college life adaptation by college year with taekwondo demonstration team activities

The results of analyzing the differences in college life adaptation according to the college year of the students participating in taekwondo demonstration teams are as shown in <Table 3>. Social adaption showed a statistically significant difference with F=5.270, p=.002. Postmortem analysis showed that there was a difference among freshmen(M=3.36), sophomores(M=3.53), and juniors(M=3.67). Academic adaptation(F=1.791, p=.150), personal emotional adaptation(F=.671, p=.570), college environment adaptation(F=.929, p=.427), and technical mental capacity(F=.155, p=.856) showed no statistically significant differences. These results are supported by a study by Kim Ji-young[17], who said that participation satisfaction varies depending on the athletic experience of leisure sports participants. In particular, given the differences only in social adaptation, taekwondo demonstration team activities can be interpreted as having a positive impact on the social development of college students.

Description	Year	п	М	SD	F	post-hoc
	Freshmen	69	3.26	.39		
	Sophomores	71	3.34	.47	4 704	
Academic adaptation	Juniors	62	3.44	.50	1.791	
	Seniors	30	3.29	.54		
	Freshmen	69	3.36	.40		
Casial adaptation	Sophomores	71	3.53	.49	F 270**	A <b< td=""></b<>
Social adaptation	Juniors	62	3.67	.44	5.270	A <c< td=""></c<>
	Seniors	30	3.54	.44		
	Freshmen	69	3.22	.58		
Personal emotional	Sophomores	71	3.22	.54	671	
adaptation	Juniors	62	3.34	.55	.071	
	Seniors	30	3.24	.53		
	Freshmen	69	3.99	.68		
College environment adaptation	Sophomores	71	3.89	.74	020	
	Juniors	62	3.92	.64	.929	
	Seniors	30	4.13	.83		

Table 3. Differences in college life adaptation by college year.

Note: A: Freshmen, B: Sophomores, C: Juniors, D=Seniors

*p<.05, **p<.01.

3.3. Differences in college life adaptation by experiences of participating in taekwondo demonstration competitions

The results of analyzing the difference in college life adaptation by the experience of participating in taekwondo demonstration competitions are as shown in <Table 4>. The experience of participating in taekwondo demonstration competitions showed a significant difference in academic adaptation with t=2.710, p=.019. On the other hand, no statistically significant differences were found in social adaptation(t=1.898, p=.231), personal emotional adaptation(t=2.064, p=.584), and college environment adaptation(t=.429, p=.097). The results showed in a study by Jang Kwon and Kim Jong-su[18] that taekwondo competitions have been steadily increasing since 2009, allowing them to experience a lot of participation, and a study by Kim Jong-su and Choi Kwang-geun[8] found that participation in the competitions was treated as an opportunity to enhance their status at their respective college. These results confirm that being a member of a taekwondo demonstration team and participating in demonstration competitions highly strengthens the sense of belonging to the college and the status of the department and has a positive impact on academic adaptation.

Description	Whether participated in the competition	n	М	SD	t
Acadamic adaptation	Yes	183	3.38	.49	2 710*
Academic adaptation	No	49	3.18	.33	2.710
Social adaptation	Yes	183	3.55	.46	1.898
	No	49	3.41	.41	
Personal emotional	Yes	183	3.29	.56	2 064
adaptation	No	49	3.11	.52	2.004
College environment adaptation	Yes	183	3.97	.73	120
	No	49	3.92	.64	.429

Table 4. Differences in college life adaptation by experiences of participating in taekwondo demonstration competition.

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

3.4. Differences in college life adaptation and participation satisfaction by experiences of winning taekwondo demonstration competitions

The results of analyzing the difference in college life adaptation according to the experience of winning a demonstration competition by students participating in taekwondo demonstration teams are as shown in <Table 5>. The experience of winning a taekwondo demonstration competition showed statistically significant differences in all areas of academic adaptation(t=3.341, p=.001), social adaptation(t=2.831, p=.013), personal emotional adaptation(t=2.738, p=.003), and college environment adaptation(t=.395, p=.009). These results are consistent with the results of a study comparing the winners and non-winners of shooting competition[19] and a study on male middle school taekwondo players[20], which showed that the winners were less anxious and more confident. This result attests that the experience of participating in taekwondo demonstration teams and winning a demonstration competition has a positive effect on adapting to college life.

Description	Whether won the competition	n	М	SD	t
A se de mis e de station	Yes	131	3.43	.52	2 2 4 4 * * *
Academic adaptation	No	101	3.22	.36	3.341***
Social adaptation	Yes	131	3.59	.49	2.831*
	No	101	3.42	.39	
Personal emotional	Yes	131	3.34	.60	2 720**
adaptation	No	101	3.14	.46	2.750
College environment adaptation	Yes	131	3.97	.76	205**
	No	101	3.94	.64	.575

Table 5. Differences in college life adaptation and participation satisfaction by experiences of winning taekwondo demonstration competitions.

Note: *p<.05, **p<.01, ***p<.001.

4. Conclusion and Suggestion

The study was conducted to find out how taekwondo demonstration team activities affect college life adaptation for students who are active in the taekwondo demonstration team at colleges and universities nationwide. To achieve the purpose of the study, a survey was conducted on 232 college students who were active in taekwondo demonstration teams at colleges and universities nationwide. The conclusions from the analysis are as follows.

First, after verifying the differences in college life adaptation by gender among college students participating in taekwondo demonstration teams, no significant differences were

found in all the variables. Second, a significant difference in social adaptation variables was found after verifying the differences between college students participating in taekwondo demonstration teams by their college years. Third, the results of verifying the differences in college life adaptation according to the experience of college students participating in demonstration competitions by taekwondo demonstration team showed a significant difference in the academic adaptation factor. Fourth, the results of verifying the differences in college life adaptation according to the experience of college students who are active in taekwondo demonstration teams winning a demonstration competition showed significant differences in all factors.

Based on the results of this study, we would like to make suggestions for follow-up research as follows.

First, this study was conducted only for college students who were active in taekwondo demonstration teams. Recently, not only the college demonstration team but also the demonstration team of each city and provincial branch has been activated, and the age of students working in the demonstration teams is also varied from elementary school students to high school students. As such, conducting research on teenagers other than college students will produce meaningful results.

Second, the study only dealt with the relationship between college life adaptation and the taekwondo demonstration team activities. More studies should be conducted to analyze the relationship between the factors covered in this study, as well as the relationship between the various variables, in addition to finding out and quantitative analysis including interviews.

5. References

5.1. Journal articles

- [1] Lee JH & Lee SK. Influence of Taekwondo Poomsae Player's Uniform Selection Attribute on Consumer Attitude, Quality Satisfaction and Repurchase Intentions. *Journal of Sport and Leisure Studies*, 47(1), 281-292 (2012).
- [2] Kim KD & Jang K. World Taekwondo Hanmadang's Transition Process. *The Korean Journal of Sport*, 12 (2), 259-270 (2014).
- [4] Hwang YT & Kim JH & Uhm DY & Choi MS. Humanities & Social Sciences: The Effects of Taekwondo Department Students' Career Awareness on Major Class Satisfaction. *Korean Journal* of Physical Education, 45 (5), 253-262 (2006).
- [5] Yoon ON & Jeong MJ & Kim BJ. Analysis of Research Trends Related to Taekwondo Leaders. Journal of the Korean Martial Arts Society, 11 (3), 19-34 (2009).
- [6] Kim JS. The Exploration of Factors Causing Injuries in Taekwondo Demonstration. *The Korean Journal of Sport*, 16, 709-717 (2018).
- [7] Kim JS. Exploring Psychological Factors Affecting Taekwondo Demonstration Performance. *Kukki-won Taekwondo Research*, 8 (1), 45-72 (2017).
- [8] Kim JS & Choi KK. An Exploratory Examination of Participation Motivation Majoring in World Taekwondo Hanmadang: Targeting University Student. *The Korean Journal of Sport*, 16(3), 43-50 (2018).
- [9] Nam IS & Nam KW & Kim JC. The Effects of Male University Students' Leisure Motivation on Leisure Satisfaction and Psychological Happiness. *Journal of Korean Leisure Recreation Society*, 33 (2), 27-38 (2009).
- [10] Beard JG & Ragheb MG. Measuring Leisure Satisfaction. *Journal of leisure Research*, 12(1), 20-33 (1980).

- [13] Kang SH & Jang K. The Effects of University Taekwondo Demonstration Members' Participation in Exercise on Exercise Stress and School Life Satisfaction. *The Korean Journal of Sport*, 14(4), 67-80 (2016).
- [14] Baker RW & Siryk B. Measuring Adjustment to College. *Journal of Counseling Psychology*, 31, 179-189 (1984).
- [18] Jang K & Kim JS. Exploring the Factors of Failures in Taekwondo Demonstration. *The Korean Journal of Sport*, 15(1), 111-119 (2017).

5.2. Thesis degree

- [11] Kim KH. The Influence Given to a Leisure Satisfaction from a Life Styles of the Users in the Bowling Center and the Way They Participate. Wonkwang University, Master's Thesis (2013).
- [12] Yoon JY. Impacts of Students' Leisure Satisfaction on Their Job Skills and School Life Satisfaction. Kyungpook National University, Master's Thesis (2012).
- [15] Hyun JW. The Effect of 'Perfectivism' Tendency and Evaluation Level on Task Performance. Yonsei University, Master's Thesis (1992).
- [16] Kwon HJ. An Analysis of the Relationship between Student Adaptation to College and Scholastic Achievement with the University Environment Climate Perception. Yonsei University, Master's Thesis (2007).
- [17] Kim JY. The Influence That the Participating Satisfaction of Leisure Sports Participants have on the Intent to Continue Sports. Dankook University, Master's Thesis (2009).
- [19] Jeong TS. Relationship among Competitive State Anxiety, Imagery Control and Psychological Skills through Combined Mental, Training Program Applied to Shooting Athletes. Woosuk University, Master's Thesis (2012).
- [20] Yim YJ. The Analysis of Difference for Anxiety Level of Men's Junior Taekwondo Players before the Game -Based on Prize Winners and Losers-. Kookmin University, Master's Thesis (2011).

5.3. Books

[3] Lee KH. What is Taekwondo Poomsae?. Osung (2010).

6. Contribution

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	Initial name	Contribution
		-Set of concepts 🔽
		-Design 🔽
Lood		-Getting results 🔽
Author	CYN	-Analysis 🔽
, autor		-Make a significant contribution to
		collection \square
		-Final approval of the paper 🛛
Corresponding		-Corresponding 🗹
Author*	LSJ	-Play a decisive role in modification $ igside S $
		-Significant contributions to concepts, de- signs, practices, analysis and interpreta- tion of data 🔽
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- The Effects of AMPK Activation Induced by Endurance Exercise on Glucose Uptake Via AKT/AS160, Korean Journal of Sport Studies, 57(6) (2018).
- An Estimation Model for Anaerobic Power of Taekwondo Athletes Based on Field Tests, Journal of Martial Arts Anthropology, 19(1) (2019).
- The Analysis of Research Trends on Psychological Factors in Taekwondo Demonstration: Systematic Review, Korea Sport Society, 17(2) (2019).
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International Journal of Protection, Security & Investigation

Publication state: Japan ISSN: 2423-8368

Publisher: J-INSTITUTE Website: http://www.j-institute.jp

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http://dx.doi.org/10.22471/protective .2020.5.1.22

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A Study on Phytosterols or Phytostanols Consumption and the PROTECTION from Cardiovascular Disease

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Abstract

Cardiovascular disease(CVD) is the main cause of death in the adult population of industrialized societies, and it is well known that as oxidized low-density lipoprotein(LDL) is an inflammatory component of the atherosclerotic process, hypercholesterolemia is one of the main risk factors contributing to the appearance and progression of CVD. On the other hand, plant sterols and plants stanols, commonly known as phytosterols, are substances found in the cells of plants and are long been known to be effective in reducing serum cholesterol concentration by competing with dietary and biliary cholesterol for intestine absorption. With this reason, it has been suggested that these cholesterol-lowering effect of phytosterols may ultimately help for preventing CVD. However, some research has shown that not all phytosterols supplementation may be beneficial, and those individual with sitosterolemia may be susceptible to overload. Also, limited evidence supports a decrease in fat soluble vitamins and carotenoid concentrations through the decrease in the number of available lipoprotein carriers by phytosterols consumption. However, it has been demonstrated that supplementation with food rich in carotenoids can attenuate these adverse effects. Thus, normal populations consuming a healthy diet and not exceeding their daily intake of sterols should be of no concern. With regard to phytosterols intake associated with therapeutic effects, intake of phytosterol-enriched products of about 1.5~2.5g/day has been recommended to reduce plasma lowdensity lipoprotein cholesterol(LDL-C) without any reported side effects based on pertinent research on phytosterols. In several meta-analyses, a dose- response relationship was found between the amount of phytosterol intake and the LDL-C lowering effect of phytosterols. In addition, there was no difference in cholesterol-lowering effect between phytosterol enriched foods and phytosterol supplements provided by capsule or tablet. Thus, the proposed method is to decrease total cholesterol(TC) through exercise and controlled dietary mechanisms to free up carrier molecules for these fat-soluble vitamins. In conclusion, it is wise to consider the supplementation of phytosterols/stanols in the human diet, and appropriate intake of phytosterols/stanols could be used in place of statin drugs with reduced side effects as an alternative treatment.

[Keywords] Protection, Cholesterol, Plant Sterol, Plant Stanol, Cardiovascular Disease

1. Introduction

Health is determined by social, economic, environmental and physical factors, as well as individual characteristics and behaviors[54][55][56]. However, if we are not physically healthy, we cannot achieve the meaning of health on other components of health. Therefore, it can be said that physical health is relatively more important than other health components. In addition, physical health can be achieved by an individual's healthy eating habits and regular physical activity[57][58]. However, in a modern society represented by industrialization, economic growth, and automation, it is difficult to maintain regular exercise and a healthy diet in daily life. On the contrary, hypokinetic diseases such as CVD, diabetes, and obesity by insufficient movement or exercise including excessive calorie intake are becoming a social problem[1].

Among them, CVD is the leading cause of death worldwide, especially in industrialized societies[1]. According to the Causes of Death Statistics in 2018 of the Statistics Korea, it was reported that approximately 62.4% of all death was accounted for CVD in 2018[2]. Dyslipidemia represented by high levels of total cholesterol, low-density lipoprotein, and triglycerides(TG), and low levels of high-density lipoprotein(HDL-C) is known to one of the major risk factors leading to CVD[3][4]. Although there are various medications such as Lovastatin and Vytorin that help improve hypercholesterolemia by inhibiting cholesterol formation in the body[5], the relevant experts generally emphasize therapeutic lifestyle changes such as exercise, diet, smoking cessation, and weight control to improve blood lipid profiles[6]. Of course, smoking cessation, exercise, and diet are all represented as the cost-effective therapeutic lifestyle change strategies for reducing the risk of CVD[7][8][9], but dietary control, in particular, could be the most important strategy in that it is easiest to maintain in our daily life. According to some reports, incorporating foods enriched with plant sterols or stanols into the daily diet can substantially enhance the cholesterol-lowering effect of diet and ultimately reduce CVD[10][11]. It is well established that dietary plant sterols reduce plasma cholesterol concentrations by inhibiting intestinal cholesterol absorption. It was also suggested that daily intake of 2g of plant sterols or stanols can reduce LDL-C by about 10%[12][13], and a recent study reported that plant sterol containing food consumption(plant sterol 2g/day for 6 weeks) had lowering effect on LDL-C and TG[53].

Considering the action of phytosterols/stanols associated with the cholesterol-lowering effect in the body, it may be worthwhile to comprehensively summarize the basic information of phytosterols/stanols and the effects of phytosterols/stanols based on the most recent studies in terms of health care and nutrition. Therefore, the purpose of the present study was to examine the nutritional function of plant sterols or stanols as cholesterol lowering agents and to provide an insight about their possible protective effect on CVD.

2. Phytosterols Biochemistry

Plant sterols, also known as phytosterols, are found in the cell membranes of plants and function in permeability and fluid exchange within the cell. Sitosterol, campesterol, and sigmasterol are the primary forms of phytosterols found in nature, and these phytosterols are abundant in fat-rich vegetable food including fruits, nuts, legumes, cereals, and vegetable oils[14][15]. Phytosterols cannot be synthesized in the human body, so they are derived solely from vegetables and vegetable products[16]. The structure of the phytosterol is similar to that of cholesterol with exception of a change in the side chain at carbon 24. The difference in the side chain of sitosterol is an ethyl group whereas the side chain of the campesterol is a methyl group. The stigmasterol has an ethyl group attached, similar to sitosterol with a double bond formed at carbon 22. As the plant stanols or phytostanols are a saturated version of the phytosterols with no double bond in the sterol ring[17], phytostanols are not abundant in nature.

3. Metabolism of Phytosterols/Stanols

Phytosterols and cholesterols from diet and liver must be encircled by the bile salts that form micelles for absorption. The micelles transport lipids such as sterols and fatty acids to the cells lining of the intestinal walls, at which time lipids are released from the micelles and passively diffused into the interior of the intestinal cells. Within the intestinal cell, water-soluble glycerol and short and medium-chain fatty acid directly diffuse into the bloodstream, but cholesterol is

esterified by acyl cholesterol acyl transferase(ACAT), combined with chylomicrons, and then entered into the lymphatic system. On the other hand, unesterified cholesterol and phytosterols are transported back into the intestinal lumen by the adenosine triphosphate-binding cassette(ABC) transporter A1[18]. Those phytosterols and cholesterol that are incorporated into chylomicrons enter the circulation and are taken by the liver. In the liver, cholesterol and phytosterols from chylomicrons are repackaged into other lipoproteins or excreted from the liver in the bile. Approximately 95% of bile acids are reabsorbed in the small intestines, and remainder are excreted in the feces[19].

4. Plausible Mechanisms of Phytosterols/Stanols on the Prevention of Cardiovascular Disease

4.1. Effects of phytosterols/stanols on cholesterol absorption

The benefits of phytosterols/stanols over cholesterol-lowering effect have been evidenced in a number of studies, and the possible mechanisms for this can be discussed by the effects of these two substances on cholesterol absorption and metabolism.

Phytosterols/stanols can cause cholesterol-lowering effect by interfering with the absorption of dietary and biliary cholesterol from the intestinal lumen. As mentioned earlier, cholesterol must be solubilized in the form of micellar for absorption. However, phytosterols/stanols are more hydrophobic than cholesterol, and they have a higher affinity with micelles than cholesterol. That is, phytosterols/stanols compete with cholesterol for absorption in the intestines. Therefore, this mechanism could decrease overall amount of cholesterol absorption because it inhibits the binding of cholesterol with micelles in the gastrointestinal track[20].

In addition, it was reported that campesterol absorption is approximately three times slower than cholesterol absorption[21][22]. Different absorption rates were also found between phytosterols; sitosterol is three times slower than campesterol absorption in the intestines[21][22]. Due to this slow absorption rate of phytosterols, approximately 95% of dietary phytosteols are absorbed through the colon. These means that a different intestinal absorption rate of phytosterols/stanols from cholesterol absorption can also affect their hypocholesterolemic effects by interfering with the absorption of cholesterol from the small intestines to the large intestine.

In contrast to the rate of phytosterol intestinal absorption, the biliary excretion rate of phytosterols is much faster than cholesterol when it is transferred from the liver in the bile. While both sitosterol and campesterol are excreted faster than cholesterol, sitosterol is excreted faster than campesterol[23]. This fast excretion of phytosterols are also effective in reducing cholesterol absorption by displacing cholesterol from micelles and result in low net cholesterol absorption from dietary and biliary cholesterol in the intestinal tract[20].

Phytosterol/stanol-induced liver X receptor(LXR) gene activation also decreases the level of cholesterol[24]. ABC transporter A1 is considered to be the cholesterol gatekeeper in the intestine membrane because it actively pumps phytosterol and unesterified cholesterol out of the enterocytes and send back into the intestinal lumen[18]. When the LXR is activated, it has positive relationship with ABC transporter A1 mRNA expression which regulate cellular cholesterol levels by transporting cholesterol back into the intestinal lumen[18]. The higher ABC transporter A1 expression by LXR agonists may induce reducing intestinal cholesterol absorption[25]. Therefore, the ABC transporter A1 elevating effects of phytosterols/stanols were then considered to be a plausible explanation of how cholesterol is absorbed into the intestinal lumen.

4.2. Effects of phytosterols/stanols on cholesterol metabolism

As describe above, phytosterols/stanols appear to lower cholesterol concentrations by not only interfering with miceller absorption of cholesterol in the intestines, but also by disrupting cholesterol homeostasis by affecting cholesterol efflux through the ABC transporters. For this reason, a decrease in intestinal-derived cholesterol supplied in the form of chylomicrons into the body causes several mechanisms to restore cellular cholesterol homeostasis.

Cells may increase endogenous cholesterol synthesis to restore cellular cholesterol homeostasis, and Miettinen, Tilvis and Kesäniemi(1990) reported that phytosterol consumption increased endogenous cholesterol synthesis[26]. Also, cellular cholesterol homeostasis can be maintained by receptor-mediated cholesterol uptake. In response to the decreased intestinal cholesterol absorption, LDL-receptor expression of cell surface is up-regulated to enhance circulating LDL-C absorption, and this process rather reduces the concentration of serum cholesterol[27]. In addition, the increased cholesterol concentration by these mechanisms inhibits the activation of sterol regulatory element-binding protein and suppresses the transcription of the genes coding for 3-hydroxy-3-methylglutaryl coenzyme A reductase involved in cholesterol and LDL-receptor synthesis[28][29]. As a final result, the mechanisms for maintaining cellular cholesterol homeostasis reduce serum LDL-cholesterol concentration, and ultimately can be positive for cardiovascular disease prevention.

5. Therapeutic Effects of Phytosterols/Stanols on Circulating Cholesterol

Cholesterol-lowering effect of phytosterols/stanols has been confirmed by multiple studies since the original literature on this relationship was reported by Pollak and Kritchevsky in 1951's[30]. Recently, it was suggested that phytosterols as a part of a heart-healthy diet have a non-pharmacological therapeutic effect on lowering serum concentrations of total cholesterol and LDL-C[31].

Recommended dietary intake for phytosterols/stanols ranges from 200mg to 2~3g a day. Phytosterols/stanols can be found in foods that are rich in dietary fibers and foods high in unsaturated fatty acids. For example, sources high in phytosterol concentration include corn oil(912mg), canola oil(668mg), wheat bran(200mg), and frozen broccoli(44mg)[17]. It has been reported a decrease in cholesterol concentrations in humans, associated with a diet supplemented with phytosterols/stanols incorporated into different fat matrices of common foods[32][33]. Maki et al.(2001) reported that a 50% fat spread incorporated with 1.1 and 2.2g of phytosterols per day reduced LDL-C 7.6% and 8.1%, respectively, whereas Davison et al.(2001) and Jones et al.(2003) reported no differences in LDL-C levels using reduced-fat spreads[32][34][35]. Mattson, Volpenhein and Erickson(1977)[36] found that esterification of sitostanol or sitosterol with fatty acids enhanced solubility in margarines, and Katan et al.(2003) reported that when phytosterols/stanols are added to foods such a margarine, up to a 15% reduction in serum TC and LDL has been reported[12].

Most recently, Salo and Kuusisto(2016) reported that yoghurt drinks containing 1.6 or 2.0g of plant stanols significantly decreased LDL-C by 9.4% and 8.1%, respectively[37]. Sarkkinen et al.(2018) investigated the effect of phytostanol enriched cereal-based snack bar consumption on serum TC and LDL-C, and they showed that 1.6g plant stanol containing cereal-based snack bar consumption (consumed twice a day for 4 weeks) significantly decreased LDL-C and non-HDL-C by 8.6% and 9.2%, respectively, as compared to the placebo group[33]. Also, Penchalaraju et al.(2018) examined cholesterol-lowering efficacy of phytosterol-enriched low fat foods(flavored milk, yogurt, fruit bar, and soya milk)[38]. They found that serum TC and LDL-C were significantly decreased after 30days consumption of phytosterol-enriched foods: flavored

milk(2.5 and 2.6%), yogurt(4.3 and 5.3%), fruit bar(5.0 and 9.1%), soya milk(8.7 and 12.6%), respectively[38].

The cholesterol-lowering effect of phytosterols/stanols also appears not only by phytosterol-enriched foods but also by consumption of phytosterol-containing supplement forms such as capsule or tablet[39]. In a recent study that was examined a cholesterol-lowering effect of a new phytosterol emulsion-containing supplements, they found significant decrease in LDL-C concentration(by 10.2%) through 4-week consumption of the supplment(1.5g/day phytosterol equivalents)[40]. Shaghaghi, Abumweis and Jones(2013) suggested that plant sterols/stanols-containing supplements were associated with clinically significant decrease in LDL-C levels, and plant sterol/stanol dose ranged from 1.0 to 3.0g/day during 4~6 weeks was effective for significant reduction in LDL-C in their study[41]. In addition, according to a meta-analysis examined cholesterol-lowering efficacy of phytosterol compositions of enriched product, it was confirmed that phytosterol and stanol were effective to reduce LDL-C levels, and there was a dose-response effect with LDL-C reductions[42].

The recommendations for intake with a single dose or periodically throughout the day remains to be questioned, although there was evidence that the time period of supplementation did not affect the capability of phytosterols to act as cholesterol-lowering agents[43]. Plat et al.(2000) investigated the effect of margarine and shortening enriched with plant stanol esters on serum lipids and lipoproteins when consumed three times per day or an equal dose of plant stanol esters once a day[43]. As a result, plant stanol ester consumption once a day or three times a day significantly reduced serum total and LDL cholesterol concentrations, and there was no significant difference on total and LDL cholesterol concentrations between the two different intake methods. This no relation between the consumption frequency of phytosterols/stanols and the reduction in LDL-C was confirmed by another well designed study[44]. Therefore, the distribution of phytosterol/stanol intake during a day on the cholesterol-lowering effect may not be an important determinant of efficacy.

6. Safety and Risks of Phytosterols/Stanols Consumption

According to extensive safety evaluation studies including animal and cell model, it is considered that phytosterols/stanols consumption is relatively safe. However, one of the concerns is the interaction of phytosterols/stanols with plasma level of fat-soluble vitamins, most notably tocopherols and carotenoids, because phytosterols/stanols inhibit the solubility of cholesterol in mixed micelles. However, limited evidence supported the disruption of fatsoluble vitamins and carotenoids concentration as a result of plant sterol supplementation[45]. But even in that study, the length of this acute study and the fact that they did not control the diet prior to the start of the study leaves question to the accuracy of its prediction. Indeed, most studies support that phytosterols/stanols intake does not cause a significant reduction in fat-soluble vitamins and carotenoids[46], and Noakes et al.(2002) reported that an increase in foods containing high levels of carotenoids could prevent the decline in carotenoid concentrations[47].

Another concern related to phytosterols/stanols consumption is the possibility that phytosterols/stanols intake may accelerate the atherosclerotic inflammatory process. This possibility is supported by certain individuals with sitosterolemia who have developed premature congestive heart failure[48]. Sitosterolemia is a condition which results in very high levels of plant sterols accumulation in the body. This condition is diagnosed as an increase in sterol levels and mutation in the gene that codes for its transporters, ABCG5 and ABCG8, which are responsible for carrying phytosterols and unesterified cholesterol from the enterocyte or the liver to the intestinal lumen. With regard to the association between high blood phytosterols/stanols levels and premature coronary heart disease(CHD) incidence, it was suggested that phytosterols are more readily oxidized than cholesterol, and these oxidative properties of phytosterols could affect the risk of atherosclerosis[49].

Despite the negative concerns about high phytosterol effect on sudden CHD, Kratz et al.(2007) demonstrated that the normal recommended supplementation of sterols(2g/d) in patient with diagnosed sitosterolemia increased blood phytosterol concentration moderately which indicated that the capacity to excrete the phytosterols is not completely diminished at higher intakes[50]. It was also reported that CHD risk was not significantly increased in genetically mutated mice without ABCG5 and ABCG8 transporters and plasma levels of sterols higher than 20-fold, and phytosterol concentration was not significantly higher in middle-aged men and women with coronary calcium[51]. In addition, Baumgartner et al.(2019) confirmed that the oxidation status of phytosterols are not associated with cardiovascular disease risk[52]. Although there are some negative concerns associated with phytosterols/stanols intake, it is assumed that the LDL-C lowering benefit of phytosterols outweighs any cardiovascular risk. Nevertheless, more research is needed to examine the effects of excessive plant sterol supplementation on this population with sitosterolemia, and excessive overload should probably not be recommended for the public in general.

7. Conclusion

Overall, most studies report total and LDL-cholesterol lowering effects of phytosterols/stanols supplementation with HDL-C benefit to only a lesser degree. Based on pertinent research on phytosterols/stanols and their advocacy for lowering cholesterol concentrations, and improving cardiovascular health, it is wise to consider the supplementation of phytosterols/stanols in the human diet. It can be adequately hypothesized based on past literature that the administration of these bioactive food components combined with reduced-caloric diets and structured exercise regimens can be substituted for expensive cholesterol lowering medications as the first line of defense in cardiovascular disease risk management. However, only a few studies on the interaction between phytosterols/stanols intake and exercise have been reported to date, and further research is needed on this topic.

8. References

8.1. Journal articles

- Rader DJ & Daugherty A. Translating Molecular Discoveries into New Therapies for Atherosclerosis. *Nature*, 451(7181), 904-913 (2008).
- [3] Libby P & Ridker PM & Maseri A. Inflammation and Atherosclerosis. *Circulation*, 105(9), 1135-1143 (2002).
- [4] Yusuf S & Hawken S & Ôunpuu S & Dans T & Avezum A & Lanas F & McQueen M & Budaj A & Pais P & Varigos J & Lisheng L. Effect of Potentially Modifiable Risk Factors Associated with Myocardial Infarction in 52 Countries(The Interheart Study): Case-control Study. *Lancet*, 364(9438), 937-952 (2004).
- [5] Alberts AW. Discovery, Biochemistry and Biology of Lovastatin. *The American Journal of Cardiology*, 62(15), J10-J15 (1988).
- [6] American Heart Association. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults(Adult Treatment Panel III). Third Report of the National Cholesterol Education Program(NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults(Adult Treatment Panel III) Final Report. *Circulation*, 106(25), 3143-3421 (2002).

- [7] Cummings SR & Rubin SM & Oster G. The Cost-effectiveness of Counseling Smokers to Quit. *Jour*nal of the American Medical Association, 261(1), 75-79 (1989).
- [8] Lindgren P & Fahlstadius P & Hellenius ML & Jönsson B & de Faire U. Cost-effectiveness of Primary Prevention of Coronary Heart Disease through Risk Factor Intervention in 60-year-old Men from the County of Stockholm- A Stochastic Model of Exercise and Dietary Advice. *Preventive Medicine*, 36(4), 403-409 (2003).
- [9] Hatziandreu El & Koplan JP & Weinstein MC & Caspersen CJ & Warner KE. A Cost-effectiveness Analysis of Exercise as a Health Promotion Activity. *American Journal of Public Health*, 78(11), 1417-1421 (1988).
- [10] Feeman WE. Executive Summary of the Third Report of the National Cholesterol Education Program(NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults(Adult Treatment Panel III). Expert Panel of Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. *The Journal of the American Medical Association*, 285(19), 2486-2497 (2001).
- [11] Moreau RA & Whitaker BD & Hicks KB. Phytosterols, Phytostanols, and Their Conjugates in Foods: Structural Diversity, Quantitative Analysis, and Health-promoting Uses. *Progress in Lipid Research*, 41(6), 457-500 (2002).
- [12] Katan MB & Grundy SM & Jones P & Law M & Miettinen T & Paoletti R & Participants SW. Efficacy and Safety of Plant Stanols and Sterols in the Management of Blood Cholesterol Levels. *Mayo Clinic Proceedings*, 78(8), 965-978 (2003).
- [13] Law M. Plant Sterol and Stanol Margarines and Health. *British Medical Journal*, 320(7238), 861-864 (2000).
- [14] Weihrauch JL & Gardner JM. Sterol Content of Foods of Plant Origin. *Journal of the American Dietetic Association*, 73(1), 39-47 (1978).
- [15] Normen L & Johnsson M & Andersson H & Van Gameren Y & Dutta P. Plant Sterols in Vegetables and Fruits Commonly Consumed in Sweden. *European Journal of Nutrition*, 38(2), 84-89 (1999).
- [16] Salen G & Ahrens EH & Grundy SM. Metabolism of β-sitosterol in Man. *The Journal of Clinical Investigation*, 49(5), 952-967 (1970).
- [17] Ellegård LH & Andersson SW & Normén AL & Andersson HA. Dietary Plant Sterols and Cholesterol Metabolism. *Nutrition Reviews*, 65(1), 39-45 (2007).
- [18] Plat J & Mensink RP. Increased Intestinal ABCA1 Expression Contributes to the Decrease in Cholesterol Absorption after Plant Stanol Consumption. *The FASEB Journal*, 16(10), 1248-1253 (2002).
- [19] Wolkoff AW & Cohen DE. Bile Acid Regulation of Hepatic Physiology: I. Hepatocyte Transport of Bile Acids. *American Journal of Physiology-Gastrointestinal and Liver Physiology*, 284(2), G175-G179 (2003).
- [20] Von Bergmann K & Sudhop T & Lütjohann D. Cholesterol and Plant Sterol Absorption: Recent Insights. *The American Journal of Cardiology*, 96(1), 10-14 (2005).
- [21] Heinemann T & Axtmann G & & Bergmann KV. Comparison of Intestinal Absorption of Cholesterol with Different Plant Sterols in Man. *European Journal of Clinical Investigation*, 23(12), 827-831 (1993).
- [22] Lütjohann D & Björkhem I & Beil UF & Von Bergmann K. Sterol Absorption and Sterol Balance in Phytosterolemia Evaluated by Deuterium-labeled Sterols: Effect of Sitostanol Treatment. *Journal* of Lipid Research, 36(8), 1763-1773 (1995).
- [23] Sudhop T & Sahin Y & Lindenthal B & Hahn C & Lüers C & Berthold HK & Von Bergmann K. Comparison of the Hepatic Clearances of Campesterol, Sitosterol, and Cholesterol in Healthy Subjects Suggests That Efflux Transporters Controlling Intestinal Sterol Absorption also Regulate Biliary Secretion. *Gut*, 51(6), 860-863 (2002).
- [24] Plat J & Nichols JA & Mensink RP. Plant Sterols and Stanols: Effects on Mixed Micellar Composition and LXR(Target Gene) Activation. *Journal of Lipid Research*, 46(11), 2468-2476 (2005).
- [25] Repa JJ & Turley SD & Lobaccaro JA & Medina J & Li L & Lustig K & Shan B & Heyman RA & Dietschy JM & Mangelsdorf DJ. Regulation of Absorption and ABC1-mediated Efflux of Cholesterol

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by RXR Heterodimers. *Science*, 289(5484), 1524-1529 (2000).

- [26] Miettinen TA & Tilvis RS & Kesäniemi YA. Serum Plant Sterols and Cholesterol Precursors Reflect Cholesterol Absorption and Synthesis in Volunteers of a Randomly Selected Male Population. *American Journal of Epidemiology*, 131(1), 20-31 (1990).
- [27] Plat J & Mensink RP. Plant Stanol and Sterol Esters in the Control of Blood Cholesterol Levels: Mechanism and Safety Aspects. *The American Journal of Cardiology*, 96(1), 15-22 (2005).
- [28] Goldstein JL & Brown MS. The LDL Receptor. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 29(4), 431-438 (2009).
- [29] Brown MS & Goldstein JL. The SREBP Pathway: Regulation of Cholesterol Metabolism by Proteolysis of a Membrane-bound Transcription Factor. *Cell*, 89(3), 331-340 (1997).
- [32] Maki KC & Davidson MH & Umporowicz DM & Schaefer EJ & Dicklin MR & Ingram & Chen S & McNamara JR & Gebhart BW & Ribaya-Mercado JD & Perrone G & Robins SJ & Franke WC. Lipid Responses to Plant-sterol-enriched Reduced-fat Spreads Incorporated into a National Cholesterol Education Program Step I Diet. *The American Journal of Clinical Nutrition*, 74(1), 33-43 (2001).
- [33] Sarkkinen E & Lyyra M & Nieminen S & Kuusisto P & Wester I. Cereal-based Snack Bar with Added Plant Stanol Ester(Benecol[®]) Consumed between Meals Lowers Serum Total and LDL Cholesterol Effectively in Mildly to Moderately Hypercholesterolemic Subjects. *Cholesterol*, 2, 1-9 (2018).
- [34] Davidson MH & Maki KC & Umporowicz DM & Ingram KA & Dicklin MR & Schaefer E & Lane RW & McNamara JR & Ribaya-Mercado JD & Perrone G & Robins SJ & Franke WC. Safety and Tolerability of Esterified Phytosterols Administered in Reduced-fat Spread and Salad Dressing to Healthy Adult Men and Women. *Journal of the American College of Nutrition*, 20(4), 307-319 (2001).
- [35] Jones PJ & Vanstone CA & Raeini-Sarjaz M & St-Onge MP. Phytosterols in Low- And Nonfat Beverages as Part of a Controlled Diet Fail to Lower Plasma Lipid Levels. *Journal of Lipid Research*, 44(9), 1713-1719 (2003).
- [36] Mattson FH & Volpenhein RA & Erickson BA. Effect of Plant Sterol Esters on the Absorption of Dietary Cholesterol. *The Journal of Nutrition*, 107(7), 1139-1146 (1977).
- [37] Salo P & Kuusisto P. Cholesterol Lowering Effect of Plant Stanol Ester Yoghurt Drinks with Added Camelina Oil. *Cholesterol*, 21, 1-12 (2016).
- [38] Penchalaraju M & Kuna A & Shailaja PSS & Kumar KV & Devi PU & Supraja T & Ramprasath V & Jones PJ. Cholesterol-lowering Efficacy of Plant Sterol-enriched Flavored Milk, Yogurt, Fruit Bar, and Soya Milk in Mild Hypercholesterolemic Indian Subjects. *Clinical Journal of Nutrition and Dietetics*, 1(1), 1-6 (2018).
- [39] Maki KC & Lawless AL & Reeves MS & Kelley KM & Dicklin MR & Jenks BH & Shneyvas E & Brooks JR. Lipid Effects of a Dietary Supplement Softgel Capsule Containing Plant Sterols/Stanols in Primary Hypercholesterolemia. *Nutrition*, 29(1), 96-100 (2013).
- [40] Reaver A & Hewlings S & Westerman K & Blander G & Schmeller T & Heer M & Rein D. A Randomized, Placebo-controlled, Double-blind Crossover Study to Assess a Unique Phytosterol Ester Formulation in Lowering LDL Cholesterol Utilizing a Novel Virtual Tracking Tool. *Nutrients*, 11(9), 1-13 (2019).
- [41] Shaghaghi MA & Abumweis SS & Jones PJ. Cholesterol-lowering Efficacy of Plant Sterols/Stanols Provided in Capsule and Tablet Formats: Results of a Systematic Review and Meta-analysis. *Journal of the Academy of Nutrition and Dietetics*, 113(11), 1494-1503 (2013).
- [42] Ying J & Zhang Y & Yu K. Phytosterol Compositions of Enriched Products Influence Their Cholesterol-lowering Efficacy: A Meta-analysis of Randomized Controlled Trials. *European Journal of Clinical Nutrition*, 73(12), 1579-1593 (2019).
- [43] Plat J & Van Onselen ENM & Van Heugten MMA & Mensink RP. Effects on Serum Lipids, Lipoproteins and Fat Soluble Antioxidant Concentrations of Consumption Frequency of Margarines and Shortenings Enriched with Plant Stanol Esters. *European Journal of Clinical Nutrition*, 54(9), 671-677 (2000).
- [44] Matvienko OA & Lewis DS & Swanson M & Arndt B & Rainwater DL & Stewart J & Alekel DL. A

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Single Daily Dose of Soybean Phytosterols in Ground Beef Decreases Serum Total Cholesterol and LDL Cholesterol in Young, Mildly Hypercholesterolemic Men. *European Journal of Clinical Nutrition*, 76(1), 57-64 (2002).

- [45] Richelle M & Enslen M & Hager C & Groux M & Tavazzi I & Godin JP & Berger A & Métairon S & Quaile S & Piguet-Welsch C & Sagalowicz L & Green H & Fay LB. Both Free and Esterified Plant Sterols Reduce Cholesterol Absorption and the Bioavailability of β-carotene and α-tocopherol in Normocholesterolemic Humans. *The American Journal of Clinical Nutrition*, 80(1), 171-177 (2004).
- [46] Raeini-Sarjaz M & Ntanios FY & Vanstone CA & Jones PJ. No Changes in Serum Fat-soluble Vitamin and Carotenoid Concentrations with the Intake of Plant Sterol/Stanol Esters in the Context of a Controlled Diet. *Metabolism-Clinical and Experimental*, 51(5), 652-656 (2002).
- [47] Noakes M & Clifton P & Ntanios F & Shrapnel W & Record I & McInerney J. An Increase in Dietary Carotenoids When Consuming Plant Sterols or Stanols is Effective in Maintaining Plasma Carotenoid Concentrations. *The American Journal of Clinical Nutrition*, 75(1), 79-86 (2002).
- [48] Salen G & Horak I & Rothkopf M & Cohen JL & Speck J & Tint GS & Shore V & Dayal B & Chen T & Shefer S. Lethal Atherosclerosis Associated with Abnormal Plasma and Tissue Sterol Composition in Sitosterolemia with Xanthomatosis. *Journal of Lipid Research*, 26(9), 1126-1133 (1985).
- [49] Plat J & Brzezinka H & Lütjohann D & Mensink RP & von Bergmann K. Oxidized Plant Sterols in Human Serum and Lipid Infusions as Measured by Combined Gas-liquid Chromatography-mass Spectrometry. *Journal of Lipid Research*, 42(12), 2030-2038 (2001).
- [50] Kratz M & Kannenberg F & Gramenz E & Berning B & Trautwein E & Assmann G & Rust S. Similar Serum Plant Sterol Responses of Human Subjects Heterozygous for a Mutation Causing Sitosterolemia and Controls to Diets Enriched in Plant Sterols or Stanols. *European Journal of Clinical Nutrition*, 61(7), 896-905 (2007).
- [51] Wilund KR & Yu L & Xu F & Vega GL & Grundy SM & Cohen JC & Hobbs HH. No Association between Plasma Levels of Plant Sterols and Atherosclerosis in Mice and Men. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 24(12), 2326-2332 (2004).
- [52] Baumgartner S & Ras RT & Trautwein EA & Konings MC & Mensink RP & Plat J. Plasma Oxyphytosterol Concentrations are not Associated with CVD Status in Framingham Offspring Study Participants. *Journal of Lipid Research*, 60(11), 1905-1911 (2019).
- [53] Trautwein EA & Koppenol WP & de Jong A & Hiemstra H & Vermeer MA & Noakes M & Luscombe-Marsh ND. Plant Sterols Lower LDL-cholesterol and Triglycerides in Dyslipidemic Individuals with or at Risk of Developing Type 2 Diabetes; A Randomized, Double-blind, Placebo-controlled Study. *Nutrition & Diabetes*, 8(1), 1-13 (2018).
- [54] Choi KB. A Study on Stress, Self-esteem and Resilience for Korean Nursing Student's Safety Management. *International Journal of Crisis & Safety*, 4(1), 8-18 (2019).
- [55] Sung HY & Park GY. Public Value of Music. *Public Value*, 4(2), 12-18 (2019).
- [56] Byeon MK & Park SJ & Choi EY. Effects of A Wonderful Life Program on the Wellbeing Behaviors, Life Satisfaction and Subjective Quality of Life of Community Elderly People in Korea: Wonderful Life Program Includes Safety. *International Journal of Crisis & Safety*, 4(1), 1-7 (2019).
- [57] Kang HR & Yang HJ. A Sports Nutrition Supplement, Albizia Julibrissin Extract Fermented with Kefir Yogut Regulates Lipopolysaccharide Induced Inflammatory Signal. *Kinesiology*, 4(2), 1-6 (2019).
- [58] Sung DS & Park JS & Lim WH. Analysis of the Healing Effect of Walking Activities according to the Difference in Forest Environment. *Public Value*, 5(1), 1-16 (2020).

8.2. Books

- [30] Pollak OJ & Kritchevsky D. Monograghs on Atherosclerosis. Basel (1981).
- [31] Simonen P & Sittiwet C & Nissinen MJ & Gylling H. Handbook of Nutrition in Heart Health. Wageningen Academic Publishers (2017).

8.3. Additional references

[2] http://kostat.go.kr/ (2020).

9. Contribution

9.1. Authors contribution

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

9.2. Authors profile

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International Journal of Protection, Security & Investigation

Publication state: Japan ISSN: 2423-8368

Publisher: J-INSTITUTE Website: http://www.j-institute.jp

Corresponding author E-mail: shinhb@kmu.ac.kr

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http://dx.doi.org/10.22471/protective .2020.5.1.32

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Analysis on the Risks Ensued during the 2022 Beijing Olympic Winter Games to Protect the Social SECURITY

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Abstract

Beijing will host the 2022 Olympic Winter Games after the Summer Olympics in 2008. It is the first Winter Olympics for Beijing and the second capital city to host Olympic Games. The success of the Summer Olympics and expectations for the Winter Olympics will place higher demands to Beijing. Prevention and control to secure society will be the key to the success of the Games. Security of society is the momentous part in the whole process and the essence to ensure stability of society, especially under the changes of domestic and foreign circumstances, this work will face more severe challenges. Therefore, in order to ensure the social stability of political and economic center in China during winter Olympic Games and the successful hosting, this study is trying to employ systematic reviews of past research literatures, summarize risk factors that might cause social problems during the Beijing Olympic Winter Games, classify, and then screen them. Finally it also puts forward corresponding prevention and control suggestions.

The results show that there are many risk factors that may cause social problems in Beijing during the winter Olympics. The characteristics of risk factors and the types that may cause social problems were classified into public security risks, life risks, economic risks, ecological environment risks, political risks, cultural risks and public health risks. Due to the large time span of retrieval, some risk factors are still possible to occur, but they are under control. Therefore, in order to further ensure the pertinence of the research results, this paper screened and removed the summarized factors according to the actual situation and relevant policies. Finally, the risk factors were identified as public security, living, and public health. Public security risk factors include public opinion and cyberbully; Living risk factors are the ones affecting the life of vulnerable groups; Public health risk factor is pandemic outbreak.

According to the results, this paper proposes the following prevention and control measures: 1. Strengthen the education and publicity of public security knowledge. The Chinese government has a relatively completed public security management system, so it should start with the education and publicity in the early stage to achieve the prevention of public opinion and cyberbully. 2. Establish service stations for vulnerable groups to ensure their normal life during the winter Olympics. 3. Create a real-name health monitoring mobile APP during the winter Olympics. Smart phones have already been popularized in China, and people can upload their personal health status anytime and anywhere through the APP, which can effectively assist the Chinese government on public health situation during the Beijing Olympic Winter Games.

[Keywords] Winter Olympic Games, Risk Control, Risk Prevention, Prevention Strategy, Systematic Reviews

1. Introduction

Social risks is a kind of possibility that leads to social conflicts and endangers social stability and social order. To be precisely, social risk means the possibility of social crisis[1]. When major

international events occur, it is easier to break the existing balance and increase the possibility of social risks. Although the hosting of the Beijing Olympic Winter Games has made contributions to the promotion of the Olympic spirit and international image and development of China's economy[2], it has also broken the existing balance to some extent and provided opportunities for the occurrence of social risks, especially under the unstable situation at home and abroad. In recent years, China's social transformation, increased interest differentiation and unbalanced development have accumulated certain social risks. It is easy to accelerate the accumulation of social risks when mega international events such as the Olympic Winter Games are held, even leading to the outbreak. Some Hong Kong independence activists have committed illegal incidents that disturb public security and cyber violence, which have had a negative impact on China's social stability and international image. It is still an unstable factor even it's tackled. In addition, the outbreak of Corona Virus Disease(COVID-19) not only affects the public order of countries around the world, hinders economic development, causes social conflicts and cyber violence, but also makes it unclear whether the Tokyo and Beijing Olympic Games can be successfully held. If the events is not held smoothly, it will lead to the loss of early preparation and investment, which will make economy worse and increase the possibility of social crisis. Although COVID-19 in China has been controlled, and the China's state council has issued the safety management protocols for large-scale mass activities to deal with emergencies[3]. It is still imperative to conduct prevention and control research on social risks during the Beijing Olympic Winter Games, considering the overall situation of the world and precautions.

Chinese academic circle has carried on the active discussion to this question, many scholars have carried on the research to this question or the related questions, and has obtained certain results. For example, Wang(2016) made a prospective study on the risk management of the Beijing 2022 Olympic Winter Games through the method of traditional literature, and believed that political social risks include terrorist activities, international conflicts, destruction of domestic reactionary organizations, and boycott by other countries[4]. Huo(2014) studied index weight of social risks of Beijing Olympic Winter Games by entropy weight method. It believed that Beijing Olympic Winter Games have a great impact on the three dimensions of economy, politics and public security, which is easy to cause social risks[5]. Song(2018) and other scholars' points out that Beijing Olympic Winter Games will face the huge pressure of politicization of the Olympic Games due to ideological and cultural differences, as well as the challenge of the lack of objective reports from the leading public opinion in the west from the perspective of public diplomacy challenges and value realization [6]. Mao & Huo(2019) summarized the previous literature and the views of the Internet in social risk identification of Beijing Olympic Winter Games[2]. There are many such studies, but there is little of comprehensive arrangement of viewpoints or no further analysis. Therefore, this paper summarizes the views of many scholars and analyzes them, aiming to find out the existing or still unresolved factors that may cause social risks during the Beijing Olympic Winter Games, hoping to play an early warning role for the prevention and control of social risks during the Beijing Olympic Winter Games, and to provide a theoretical basis for further research on this issue.

2. Methods

Many scholars have analyzed directly and indirectly the factors that may cause social risks for the Beijing Olympic Winter Games from different perspectives and methods. This study employs 'Systematic Review' to synthesize these viewpoints comprehensively and objectively. Systematic reviews are a type of literature review that uses systematic methods to collect secondary data, critically appraise research studies, and synthesize findings qualitatively or quantitatively[7]. Compared with traditional literature review methods, systematic reviews is more scientific and objective method to ensure accurate results. It can be subdivided into qualitative and quantitative reviews. The former is qualitative evaluation and summary of results and conclusions of the original literature. The latter is a process to use of statistical methods to combine the results, also called 'Meta-analysis'[8]. In some research fields which are difficult to combine analysis via statistical methods, qualitative review method is more suitable. Therefore, this paper adopts qualitative research method to carry out descriptive statistics on the existing textual conclusions.

2.1. Research questions

Systematic review aims to provide a complete, exhaustive summary of current literatures relevant to a research question. The first step in conducting a systematic review is to create a structured question to guide the review[8]. For interpreting the research topic more comprehensively, this paper first discusses the types of social risks, the specific manifestations of social risks, the harms of social risks, the influencing factors of social risks, the assessment indicators of social risks and the prevention of social risks. After comprehensive consideration of the research theme, this paper finally excluded the harm and the evaluation index of social risks, and determined the research question as: what are the types of influencing factors of social risks in the Beijing Olympic Winter Games? And what are the specific risk factors for that?

2.2. Literature inclusion criteria

Documentation standard is an important part of systematic review and it plays a decisive role in the end result[9]. In order to ensure the accuracy and rigor of the research results, this paper mainly sets the following standards to ensure the quality of the retrieved literature:

(1)Limit database. In this paper, CNKI(China National Knowledge Infrastructure) China Academic Journal Network Publishing Database was used as the sample source of literature. With the internationally leading 'CNKI digital library' and CNKI Grid Resource Sharing Platform, CNKI is China's largest monopolized website integrating all kinds of full-text academic information, which is able to guarantee the comprehensiveness and reliability of data[10].

(2)Limit retrieval keywords. According to the research problem, after several screenings, this paper took social risk, social risk of Beijing Olympic Winter Games and other keywords as key words to conduct multiple retrieval in CNKI.

(3)Limit retrieval time. Beijing was chosen as the candidate cities of Olympic Winter Games by IOC in 2014. Therefore, 2014 was set for the starting time for document retrieval. In 2008, Beijing held Olympic summer Games for the first time, and achieved a great success, accumulated the experience and practice of solving problems in all aspects, and therefore, 2008 was set as the beginning time of document retrieval.

(4)Limit types of retrieved documents. The literature retrieved this time only include article, other publishing forms are excluded. Articles mainly include CSSCI and core database in CNKI.

(5)Limit the contents of retrieved literature. In view of the theme of this study, the literature that regards the social risks of the Beijing Olympic Winter Games as a dependent variable was input, and the literature regarding the social risks of the Beijing Olympic Winter Games as an independent variable was excluded. However, the research methods of the literature are not set a limit standard.

2.3. Literature search and extraction

Searching literature is the second step of Systematic review, mainly to search the relevant literature thoroughly[8]. It is mainly divided into three stages. The first stage is to use the advanced retrieval function of CNKI to conduct literature retrieval from the start of the 2014 to

March 1st, 2020. Firstly, 'social risks', 'winter Olympics', and' Beijing' were used as keywords for the initial search, and a total of 131 articles were obtained. The first selection of literature was conducted in second stage according to the inclusion criteria. A preliminary selection was conducted by two researchers through the title and abstract of the articles, and then they were cross-checked to ensure the validity of outcomes and it was reduced to 41 articles. The articles remaining were initially reviewed by carefully reading the full text based on the inclusion criteria in the last stage. It was narrowed down to 41 articles after two rounds of selection. The articles remaining were extracted and analyzed in this stage. The final articles were sorted and summarized according to the publication time. Total of 24 articles were remained after two rounds. Then, the final remained documents were sorted and summarized according to the publication time. Finally, the further extraction was conducted to the articles and the main contents were extracted and classified according to the research questions <Table 1>.

Authors	Year	Topics	Findings related to this research
Hou SC, Zhang SJ [11]	2014	The impact of holding mega sports events on social issues	Major social problems in the process of holding mega sports events in China include disturbing residents and waste of social resources
Zhang XC, Li CJ[12]	2015	Social problems and causes in the process of holding mega sports events	The main social problems are disturbing residents, running events luxuriously, and the waste of public resources
Zou YH, Jin ZX[13]	2015	The impact of hosting mega sports events on the ecological environment	The pursuit of economic benefits and social benefits of mega sports events lead to the unrestrained occupation of ecological resources
Liu LF[14]	2015	indexes of the impact of mega sports events on urban development	The negative factors of mega sports events on urban development mainly include financial deficit, culture shock, traffic control and deterioration of social security
Feng YN, Sun BL[15]	2017	Sustainable development of Beijing Olympic Winter Games	Beijing Olympic Winter Games should focus on disease control, traffic management, ecological protection and other issues
Wang SR [16]	2018	The risks Beijing Olympic Winter Games should pay more attention to	The risks Beijing Olympic Winter Games should pay more attention to focus on social security, social stability and other issues
Jia HW[17]	2018	Risk avoidance of big events	The risks of big events focus on terrorism, social instability and Cyberbully
Wang D, Feng WG[18]	2019	How does mega sports events to tackle emergency	The emergency that affects the smooth running of mega sports events mainly refers to sabotage of terrorist organizations
Wang YY[19]	2019	Risk factors of Beijing Olympic Winter Games safety	The biggest risk to the Beijing Olympic Winter Games is personnel risk
Huo DL, Liu LF et al. [5]	2019	Early warning indexes of Beijing Olympic Winter Games social risks	Beijing Olympic Winter Games has a great impact on the economy, politics and public security, which is easy to cause social risks
Teng YH, Peng ZD[20]	2019	Security system of Beijing Olympic Winter Games	Economy, policy and other issues are the cores of the security guarantee of Beijing Olympic Winter Games
Yang YH [21]	2018	Security system characteristics of Beijing Olympic Winter Games	The security of the Beijing Olympic Winter Games will face challenges such as terrorist threat, security risk and political sensitivity
Zhang M [22]	2019	Suggestions to security system of Beijing Olympic Winter Games	The security of Beijing Olympic Winter Games needs to pay attention to terrorist activities, public opinion, public security and other issues
Zhong BS, Jin YY[23]	2019	Beijing urban management and Beijing Olympic Winter Games	Beijing should pay more attention to environmental governance, financial management and cultural exchanges during the winter Olympics

Table 1. Summary of the data collected.

Li ZL, Dong F[24]	2019	Public relations crisis of Beijing Olympic Winter Games	According to the past experience, Beijing Olympic Winter Games should pay attention to emergencies and avoid international public opinion and negative international image
Dong J, Liu XL[25]	2020	Expenditure risks management of Beijing Olympic Winter Games	Beijing Olympic Winter Games should pay attention to excessive expenditure and waste of public resources

3. Results

7

Through the further analysis of literature, this paper organized and summarized the risk factors that may cause public problems for Beijing Olympic Winter Games. According to the characteristics of risk factors and types of social problems by systematic reviewed from the data, they were divided into social security risks, living risks, economic risks, the ecological environment risks, political risks, cultural risk and public health risk. Risk factors were categorized into each types of risks <Table 2>.

Number	Types of risks	Risk factors
1	Public security risks	 Terrorist threat Vandalism of Hong Kong independence and unscrupulous people Conflicts caused by religious and cultural differences assembly Public opinion and cyberbully
2	Livings risks	 Disturbing residents Disturb the order of life Affecting the lives of vulnerable group Increasing cost of living
3	Economic risks	 Excessive spending Excessive occupation of social resources Waste of social resources The valley effect The matthew effect
4	Ecological environment risks	 Pollution Break the local ecological balance
5	Political risks	 Sports corruption International public opinion Exaggerated and untrue reports by foreign media
6	Cultural risk	Cultural invasion

 Table 2. Summary of results from the data.

Public health risk

After summarizing all the risk factors, it finds that due to the large retrieval time span, some risk factors have been managed or can be prevented and controlled. Although the possibility of occurrence still exists, it has been under control. Therefore, according to relevant laws and regulations, policies, management regulations, etc., this study screens the summarized factors, and removes the risk factors that are less difficult to prevent, control and deal with. It does not deny the accuracy and validity of these risk factors but ensure the pertinency of further results. Therefore the risk factors are screened and specific contents are as follows:

• Outbreak of pandemic

(1)Public security risks: Law of the People's Republic of China on emergency response issued by the Chinese government is the management protocol to monitor, warn in advance and deal with social risks, safeguard the security of the state, protect citizen life, property safety and public security[26]. Therefore, this paper removes vandalism of Hong Kong independence and unscrupulous people from this type. Terrorist is also removed according to Anti-terrorism Law of the People's Republic of China. It has demonstrated how to tackle terrorists[27]. Although there are rules and regulations about public opinion and cyberbully, they are still remained in account of high occurrence possibility, fast spread and large influence.

(2)Living risks: Referring to the successful experience of the 2008 Beijing Olympic Summer Games, this paper holds that the risk factors affecting life problems are mainly reflected in vulnerable group, so vulnerable group is the only factor remained.

(3)Economic, ecological and political risk: According to the Olympic 2020 Agenda(2014) and Beijing Olympic Winter Games took sustainable development as main idea, Green, Sharing, open and incorruptible Olympic as the concepts[28][29]. Hence sports corruption is removed. In addition, world's information can be shared in this internet era. Exclusive reports by traditional media has passed, bad public opinion hardly achieves complete and long-term effects. So public opinion in political risks is also removed.

(4)Cultural risk: Cultural invasion and conflicts can be reasonably solved, based on the successful experience of the 2008 Beijing Olympic Summer Games. Although there are still some risks, but it is still under control.

(5)Public health risk: Although the Chinese government has issued protocols on the public health emergencies, the outbreak of pandemic was still remained as an important risk factor for the importance of Olympic Winter Games for its short period, long duration and huge danger of pandemic, especially the outbreak of Corona Virus Disease 2019(COVID-19).

In summary, the main risk factors that may cause social problems are finally classified as public security, living and public health. Public security risk factors include public opinion and cyberbully; living risk factors are the one affecting the life of vulnerable groups. Public health risk factor refers to pandemic outbreak.

4. Suggestions

The ultimate purpose of risk prevention and control is to propose targeted solutions or suggestions to achieve the control or avoidance[30]. According to the principle of risk avoidance, this paper proposes the following suggestions for the main risk factors remained.

4.1. strengthen the education and publicity of public security knowledge

Public opinion and cyberbully are difficult to be eradicated completely. So only targeted measures can be taken to reduce or control the emergence. The best preventive measures are carried on from the root of the control. This paper believes that the publicity of public security knowledge should be conducted intensively in different places at the early stage of Olympics, such as schools, public places, etc. In addition, Chinese residents take the community as the living unit, they can be organized to study public security knowledge by community. The public will know harms of public opinion and cyberbully as much as possible, and then achieve controlling.

4.2. Establish a service station for vulnerable group during the winter olympics

Vulnerable groups mainly refer to the disabled and the elderly. Compared with other groups, their survival or living ability is relatively low, and their daily life is more easily affected, especially in the case of floating population and the increase of traffic pressure. Therefore, it is sug-

gested to set up service stations for vulnerable groups in different regions to ensure their normal life during the Winter Olympics. Although it will cost more manpower and financial resources, it could be great benefit to the stability of the society and the guarantee of the quality of life for vulnerable groups.

4.3. Create a real-name health monitoring mobile APP during the winter olympics

Although the Chinese government has made clear the importance of preventing pandemic, emergency measures and a sound warning system, sudden outbreaks of pandemic can still affect Beijing Olympic Winter Games or cause social panic. In addition, Beijing has a large population and a large inflow of population, so it is difficult to monitor the health status of all people at all times. Therefore, it is recommended to create a mobile app that can upload the health status of people in real time during the Winter Olympics. Mobile phone APP was appropriate due to the popularity of smartphone. It is convenient and effective for anyone to upload their own health. Even vulnerable groups can also complete with the help of the family or nursing assistant. It not only can effectively monitor the pandemic during the Olympics, also can promote the quality of public health.

5. Conclusion

The prevention and control of social risk during the Beijing Olympic Winter Games is an important part of security work, and also an effective means to ensure social stability in Beijing and the smooth holding of the Olympic Winter Games. Systematic review is employed to comprehensively summarize the risk factors that may cause social problems during the Olympics, accurately screen out more major risk factors according to the actual situation and relevant policies, and then propose reasonable risk prevention and control strategies. However, due to the descriptive statistics of the existing textual conclusions and the lack of quantitative analysis, there are still some limitations. It is hoped that it can be made up in the following research and the results of this study can provide some theoretical basis for the further researches.

6. References

6.1. Journal articles

- Xie QJ & Xie JS & Liang ZR. A Review of Chinese Social Risk Study. *Journal of Changzhou University*, 15(3), 15-20 (2014).
- [2] Mao XY & Huo DL. Social Risk Identification of Beijing Winter Olympic Games. *Journal of Sport and Science*, 40(4), 106-113 (2019).
- [5] Huo DL & Liu LF & Yuan Y. Weight of Social Risk Early Warning Index of Beijing Winter Olympics Based on Entropy Weight Method. *Journal of Shenyang Sport University*, 38(5), 47-55 (2019).
- [6] Song JM & Sun YM. The Public Diplomacy Challenge and Value Realization of Beijing Winter Olympics. *Journal of Hebei Sport University*, 5, 53-59 (2018).
- [7] Armstrong R & Hall BJ & Doyle J. Cochrane Update: Scoping the Scope' of a Cochrane Review. *Journal of Public Health*, 33(1), 147-50 (2011).
- [8] Wang Q. Interdisciplinary Research on E-commerce Entrepreneurship: A Systematic Review. *Journal of Tianjin College of Commerce*, 5, 26-32 (2019).
- [9] Shang TT & Miu XM & Lu D. Lessons from Influencing Factors of Disruptive Innovation Studies at Abroad- A Systematic Review of the Literature from 1997-2017. *Science & Technology Progress* and Policy, 36(19), 153-160 (2019).
- [10] Zhao YY & Qiu JB. Study on the Development of CNKI. *Information Science*, 4, 626-634 (2005).

- [11] Hou SC & Zhang SJ. Social Problems of Mega Sports Events in China. *Journal of Shenyang Sport University*, 33(2), 12-16 (2014).
- [12] Zhang XC & Li CJ. Study on the Social Problems Caused by Large-scale Sports Games Held in China, and Its Reasons or Countermeasures. *Journal of Capital University of Physical Education and Sports*, 27(4), 364-366 (2015).
- [13] Zou YH & Jin ZX. Research on the Ecological Environment Alienation of Major Sports Events. Journal of Shandong Institute of Physical Education and Sports, 5, 9-13 (2015).
- [14] Liu LF. Research on the Ecological Environment Alienation of Major Sports Events. *Sports Culture Guide*, 9, 25-29 (2015).
- [15] Feng YN & Sun BL. Sustainable Development of Olympic Winter Games and the Enlightening for Beijing 2022 Olympic Winter Games. *Journal of Shenyang Sport University*, 36(5), 1-8 (2017).
- [16] Wang SR. Which Risk Factors should be Paid more Attention to during Beijing Olympic Winter Games. *People's Tribune*, 21, 72-73 (2018).
- [17] Jia HX. Research on Risk Avoidance and Government of Major Sports Events. *Journal of Shandong Police College*, 3, 115-123 (2018).
- [18] Wang D & Geng WG. Based on Emergencies: Intelligence Needs Analysis and Risk Prevention and Control in Large-scale Sport Events. *Journal of Intelligence*, 38(8), 56-62 (2019).
- [19] Wang YY. An Analysis of the Security Risk Factors for the Beijing Winter Olympic Games. *Journal of Beijing Police College*, 1, 35-41 (2019).
- [20] Teng YH & Peng ZD & Nie P. Research on Security System of Beijing Olympic Winter Games. *Journal of Beijing Police College*, 1, 42-45 (2019).
- [21] Yang YH. Research on Basic Essence of Security System during Beijing Olympic Winter Games. *Journal of Beijing Police College*, 4, 37-40 (2018).
- [22] Zhang M. The Suggestions and Ideas of Beijing Olympic Winter Games Security under the Cooperation of Police Service in Beijing, Tianjin and Hebei. *Management Insights*, 4, 178-179 (2019).
- [23] Zhong BS & Jin YY & Wang HB. Research on 2022 Winter Olympics and Beijing Urban Management from the Perspective of Coupling Theory. *Journal of Beijing Police College*, 31(4), 292-297 (2019).
- [24] Li ZL & Dong X. Study on the Public Relations Strategy of Beijing Winter Olympic Crisis: Taking on Societies of Sochi and Pyeongchang Winter Olympic as an Example. *China Winter Sport*, 41(5), 1-4 (2019).
- [25] Dong J & Liu LX. The Risks and Risk Management Expenditures for the Beijing 2022 Olympic Winter Games. *Journal of Sports and Science*, 41(1), 16-27 (2020).

6.2. Thesis degree

[4] Wang MQ. Prospective Study on the Risk Management of Beijing 2022 Winter Olympic Games. Beijing Sport University, Master's Thesis (2016).

6.3. Additional references

- [3] http://www.gov.cn/ (2007).
- [26] http://www.gov.cn/ (2016).
- [27] http://www.gov.cn/ (2007).
- [28] http://www.olympic.org/ (2014).
- [29] http://www.wenming.cn/ (2016).

6.4. Books

[30] Wang X. Risk Management. Shanghai University of Finance and Economics (2003).

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	Initial name	Contribution
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Lood		-Getting results 🔽
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		-Make a significant contribution to
		collection \square
		-Final approval of the paper 🛛
Corresponding	CLID	-Corresponding 🗹
Author*	эпр	-Play a decisive role in modification \square
		-Significant contributions to concepts, de- signs, practices, analysis and interpreta- tion of data 🔽
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International Journal of Protection, Security & Investigation

Publication state: Japan ISSN: 2423-8368

Publisher: J-INSTITUTE Website: http://www.j-institute.jp

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http://dx.doi.org/10.22471/protective .2020.5.1.42

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An Investigation on Developing the Shelter and Safety Facilities of FOREST KINDERGARTENS

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Abstract

This dissertation aims at investigating the geographical conditions, facilities, programs and status of the shelter and safety facilities of nine selected forest kindergartens in Gyeongsangbuk-do Province in Korea. Based on the surveys of instructors and participating teachers of forest kindergartens, this study provides several suggestions for improving the shelter and safety facilities of forest kindergartens.

The surveyed forest kindergartens had an average of 2.5 forest kindergarten instructors, while the number of participating children in the programs were gradually increasing. In 2017, an average of 9,621.5 children participated in the programs. In some forest kindergartens, the number of participants increased more than two times, three times in 2017 compared to 2016.

As a result, this study suggests following three improvements for the shelter and safety facilities in forest kindergartens. First, the scope of use of the shelters need to be expanded. Emergency kit should be kept in the shelters and the shelters should be constructed as fire-and-quake proof buildings. The shelters need to have air-conditioning and heating so that children can take a rest or enjoy more activities in the shelters. Second, safety facilities need to be improved to have more secure escape routes, more CCTVs and the safety facilities monitoring should be strengthened. Sign board for the children should also be improved to provide more details of the surrounding risks with pictures. Third, safety management should also be improved. Instructors and participating teachers of forest kindergartens need to have more training opportunities to learn how to utilize the shelter and safety facilities and they need to be more responsible and capable in securing safety in the daily activities in forest kindergartens.

[Keywords] Investigation, Developing, Shelter, Safety Facilities, Forest Kindergartens

1. Introduction

Forest kindergartens began in the 1950s with the aim of creating educational effects through outdoor activities in Scandinavian peninsular countries such as Denmark, Sweden, and Norway. Early scholars such as Froevel and Pestalozzi emphasized the importance of play in the infant development process[1], and the forest kindergarten model became popular because infants of various ages can get both physical and mental as well as educational effects by playing in clean nature through forest kindergartens. The Scandinavian model of forest kindergartens has spread around the whole of Europe, including Britain, Germany, and the United States, Canada, and Australia, as alternatives to the situation where urbanization along with industrialization made it difficult for infants and children to enjoy clean air, free space, and healthy diet in their daily lives[2]. Recently, concrete research has shown that forest activities can help infants develop self-esteem and independence and have a positive impact on creativity, emotional

* This Paper Summarizes Jeon Mi-ja's Daegu Haany University Master's Thesis.

stability, and social development, as well as on the promotion of learning ability. The demand for forest kindergartens as ecological alternative education is also growing[2].

Against this backdrop, Korea has also been spreading across the country since the first infant forest experience center was established in 2008. Korea's infant forest experience center refers to a facility that guides and educates infants to cultivate their emotions and achieve wellrounded growth by experiencing various functions of forests[3], which is established and operated by the Korea Forest Service, not by the education office. It is widely used as an "infant forest experience center" instead of a forest kindergarten because it is not a regular kindergarten[4]. The first infant forest experience center was launched in 2008 when the Northern Forest Service first provided forest kindergarten programs led by "forest commentators" to general kindergartens and daycare centers. Since then, infant forest experience centers have spread under the leadership of public institutions, with the Songpa-gu Office in Seoul running forest kindergartens on a trial basis in 2010[5]. Recently, the number of children's forest experience centers has gradually increased as children's interest in forest experience activities has increased. The number of forest experience centers currently operating nationwide increased to more than 77 as of 2016[6].

As such, the popularity of infant forest experience centers is increasing in Korea, but there is not much interest in the safety of infants participating in the program. What is particularly important about safety in infant forest experience centers is the shelter and safety facilities that help ensure safety[7]. However, there is no previous research on the shelter and safety facilities of infant forest experience centers. Therefore, this study investigated the facilities and use status of the infant forest experience center established by the Gyeongsangbuk-do Forest Service and local governments, investigated the actual conditions of evacuation and safety facilities, and proposed measures to improve the evacuation and safety facilities of infant forest experience centers based on the survey of relevant "forest teachers."

2. Research Method

2.1. Research subjects

The research team has surveyed a total of 68 teachers of infant forest experience centers, daycare centers, and kindergartens to investigate the awareness and practical requirements of the evacuation and safety facilities related to infant forest experience centers. The survey was conducted between September and October 2017.

Overall, for gender, 62 women(91.2 percent) and 6 men(8.8 percent) participated, and for age group, 15 people in their 20s(22.1 percent), 19 in their 30s(27.9 percent), 21 in their 40s(16.2 percent), and 13 in their 50s and older(19.1 percent) participated. For occupation, 27 teachers from infant forest experience centers(39.7 percent), 20 teachers from daycare centers(29.4 percent), and 16 teachers from kindergartens(23.5 percent) participated. In addition, for work period, 5 people with less than 1 year(7.4%), 18 with 1-2 years(26.5%), 26 in 3-5 years(38.2%), and 19 with 6 years or longer(27.9%) participated. As for the educational qualifications, 36 people had a certificate for forest education expert(52.9 percent), followed by 15 with the second-degree kindergarten teacher(22.1 percent), 11 with the first-degree child care teacher(16.2 percent), 6 with the second-degree child care teacher(8.8 percent), and 3 with vice-director of kindergarten(4.4 percent) <Table 1>.

	Description	Frequency (N)	Percentage (%)
Condor	Male	6	8.8
Gender	Female	62	91.2
	20s	15	22.1
A.c.o	30s	19	27.9
Age	40s	21	30.9
	50s or older	13	19.1
	Daycare center teacher	20	29.4
Occupation	Kindergarten teacher	16	23.5
Occupation	Infant forest experience center teacher	27	39.7
	Other	5	7.4
	Less than 1 year	5	7.4
Markpariad	1-2 years	18	26.5
work period	3-5 years	26	38.2
	6 years or longer	19	27.9
	Director of kindergarten	7	10.3
	Vice-director of kindergarten	3	4.4
Qualifications	Kindergarten teacher(1st degree)	7	10.3
(multiple re-	Kindergarten teacher(2nd degree)	15	22.1
sponses)	Childcare teacher(1st degree)	11	16.2
	Childcare teacher(2nd degree)	6	8.8
	Forest education expert	36	52.9
	Total	68	100.0

 Table 1. General characteristics of the research subjects.

2.2. Measurement tools and data processing

The survey consists of a total of 10 questions, including 2 questions on awareness of the evacuation and safety facility system of infant forest experience centers, 1 question on utilization, 5 questions on utilization methods, and 2 questions on problems and improvements. The data collected from the survey were analyzed using the SPSS 21.0 Version. The analysis details are as follows. First, frequency analysis and multi-response analysis were conducted to identify the general characteristics of those surveyed. Second, cross-analysis was conducted to find out the current status and requirements of infant forest experience centers and to see if there are any differences depending on the general characteristics of the people surveyed.

3. Results and Discussions

3.1. Consciousness on use of evacuation and safety facilities in infant forest experience centers

3.1.1. Number of times to use evacuation and safety facilities during infant forest experience programs

The results of the analysis of the number of times of use of evacuation and safety facilities during infant forest experience programs are as shown in <Table 2>. Overall, 34 people(50.0%) said "never," followed by 17 people(25.0%) with "1-3 times," 11 people(16.2%) with "4-9 times," and 6 people(8.8%) with "10 times or more," which indicates that the utilization of evacuation and safety facilities is generally very low. There were no statistically significant differences depending on the general characteristics of the subjects surveyed(p>.05).

Description		Never	1-3 times	4-9 times	10 times or more	χ² (p)
Condor	Male	3(50.0)	2(33.3)	0(.0)	1(16.7)	1.706
Gender	Female	31(50.0)	15(24.2)	11(17.7)	5(8.1)	(.636)
	20s	10(66.7)	4(26.7)	1(6.7)	0(.0)	
100	30s	8(42.1)	6(31.6)	4(21.1)	1(5.3)	7.811
Age	40s	9(42.9)	5(23.8)	3(14.3)	4(19.0)	(.553)
	50s or older	7(53.8)	2(15.4)	3(23.1)	1(7.7)	
	Daycare center teacher	11(55.0)	6(30.0)	2(10.0)	1(5.0)	
Occupa-	Kindergarten teacher	9(56.3)	5(31.3)	1(6.3)	1(6.3)	8.337
tion	Infant forest experi- ence center teacher	11(40.7)	5(18.5)	8(29.6)	3(11.1)	(.501)
	Other	3(60.0)	1(20.0)	0(.0)	1(20.0)	
	Less than 1 year	4(80.0)	1(20.0)	0(.0)	0(.0)	
Work pe-	1-2 years	9(50.0)	5(27.8)	3(16.7)	1(5.6)	3.398
riod	3-5 years	11(42.3)	7(26.9)	5(19.2)	3(11.5)	(.946)
	6 years or longer	10(52.6)	4(21.1)	3(15.8)	2(10.5)	
Total		34(50.0)	17(25.0)	11(16.2)	6(8.8)	

Table 2. Number of times to use evacuation and safety facilities during infant forest experience programs.

3.1.2. Usage of evacuation and safety facilities during infant forest experience programs

The results of the analysis of the usage of 34 people who have experience in using evacuation and safety facilities during infant forest experience programs are as shown in <Table 3>. The total number of responses was 83, with 33(39.8%) for "rain," followed by 14(16.9%) for "heat wave" and "first aid," respectively, 11(13.3%) for "unpredictable behavior of infants," 6(7.2%) for "cold," and 1(1.2%) for "fire," "natural disasters," and "crime prevention" respectively. In general, this shows that the facilities have been used relatively much in rainy weather conditions. Other respondents(2) said that the facilities were used for "break time."

Desci	ription	Unpredictable behavior	Rain	Heat wave	Cold	Fire	First aid	Natural disasters	Crime pre- ven- tion	Other (break)	Total
Candan	Male	1(16.7)	3(50.0)	1(16.7)	0(.0)	0(.0)	1(16.7)	0(.0)	0(.0)	0(.0)	6(100.0)
Gender	Female	10(13.0)	30(39.0)	13(16.9)	6(7.8)	1(1.3)	13(16.9)	1(1.3)	1(1.3)	2(2.6)	77(100.0)
	20s	2(20.0)	5(50.0)	0(.0)	1(10)	0(.0)	2(20.0)	0(.0)	0(.0)	0(.0)	10(100.0)
	30s	3(13.6)	10(45.5)	4(18.2)	1(4.5)	0(.0)	3(13.6)	0(.0)	0(.0)	1(4.5)	22(100.0)
Age	40s	4(10.5)	12(31.6)	8(21.1)	3(7.9)	1(2.6)	7(18.4)	1(2.6)	1(2.6)	1(2.6)	38(100.0)
	50s or older	2(15.4)	6(46.2)	2(15.4)	1(7.7)	0(.0)	2(15.4)	0(.0)	0(.0)	0(.0)	13(100.0)
	Daycare center teacher	5(20.8)	9(37.5)	3(12.5)	1(4.2)	1(4.2)	3(12.5)	1(4.2)	1(4.2)	0(.0)	24(100.0)
0	Kinder- garten teacher	2(12.5)	6(37.5)	2(12.5)	1(6.3)	0(.0)	4(25.0)	0(.0)	0(.0)	1(6.3)	16(100.0)
tion	Infant forest experi- ence center teacher	4(10.5)	16(42.1)	8(21.1)	3(7.9)	0(.0)	7(18.4)	0(.0)	0(.0)	0(.0)	38(100.0)
	Other	0(.0)	2(40.0)	1(20.0)	1(20.0)	0(.0)	0(.0)	0(.0)	0(.0)	1(20.0)	5(100.0)
Work period	Less than 1 vear	0(.0)	1(100.0)	0(.0)	0(.0)	0(.0)	0(.0)	0(.0)	0(.0)	0(.0)	1(100.0)

Table 3. Usage of evacuation and safety facilities during infant forest experience programs(multiple responses).

1-2 years	2(11.8)	9(52.9)	2(11.8)	1(5.9)	0(.0)	2(11.8)	0(.0)	0(.0)	1(5.9)	17(100.0)
3-5 years	5(13.5)	15(40.5)	7(18.9)	3(8.1)	0(.0)	7(18.9)	0(.0)	0(.0)	0(.0)	37(100.0)
6 years or longer	4(14.3)	8(28.6)	5(17.9)	2(7.1)	1(3.6)	5(17.9)	1(3.6)	1(3.6)	1(3.6)	28(100.0)
Total	11(13.3)	33(39.8)	14(16.9)	6(7.2)	1(1.2)	14(16.9)	1(1.2)	1(1.2)	2(2.4)	83(100.0)

3.1.3. Demand for the utilization of shelters and safety facilities during infant forest experience programs

The results of the analysis of the demand for utilization of shelters and safety facilities during infant forest experience programs are as shown in <Table 4>. There were 286 responses in total, with the highest with 47(16.4%) for "first aid," followed by 39(13.6%) for "rain," 38(13.3%) for "natural disasters," 36(12.6%) for "fire," 35(12.2%) for "unexpected emergencies," 31(10.8%) for "crime prevention," 28(9.8%) for "heat wave," and 27(9.4%) for "cold." The overall distribution of responses in each situation indicated the need for teachers to make various uses of shelters and safety facilities[8]. Other opinions(2 people) included "space for sick children to rest" and "space as an earthquake evacuation facility in line with future environmental changes."

Table 4. Demand for the utilization of shelters and safety facilities during infant forest experience programs(multiple responses).

Descr	iption	Unex- pected emer- gencies	Rain	Heat wave	Cold	Fire	First aid	Natural disasters	Crime preven- tion	Other (break)	Total
	Male	5(17.2)	4(13.8)	2(6.9)	3(10.3)	3(10.3)	6(20.7)	3(10.3)	3(10.3)	0(.0)	29(100.0)
Gender	Female	30(11.7)	35(13.6)	26(10.1)	24(9.3)	33(12.8)	41(16.0)	35(13.6)	28(10.9)	5(1.9)	257 (100.0)
	20s	10(16.1)	10(16.1)	6(9.7)	3(4.8)	6(9.7)	11(17.7)	7(11.3)	8(12.9)	1(1.6)	62(100.0)
A = -	30s	12(14.6)	8(9.8)	6(7.3)	8(9.8)	11(13.4)	14(17.1)	13(15.9)	8(9.8)	2(2.4)	82(100.0)
Age	40s	7(7.1)	13(13.1)	12(12.1)	12(12.1)	14(14.1)	16(16.2)	13(13.1)	12(12.1)	0(.0)	99(100.0)
	50s or older	6(14.0)	8(18.6)	4(9.3)	4(9.3)	5(11.6)	6(14.0)	5(11.6)	3(7.0)	2(4.7)	43(100.0)
	Daycare center teacher	13(13.7)	13(13.7)	10(10.5)	8(8.4)	11(11.6)	14(14.7)	13(13.7)	11(11.6)	2(2.1)	95(100.0)
Oremetice	Kindergar- ten teacher	8(12.5)	7(10.9)	6(9.4)	6(9.4)	7(10.9)	11(17.2)	8(12.5)	10(15.6)	1(1.6)	64(100.0)
Occupation	Infant forest experience center teacher	11(10.6)	16(15.4)	11(10.6)	10(9.6)	15(14.4)	17(16.3)	14(13.5)	8(7.7)	2(1.9)	104 (100.0)
	Other	3(13.0)	3(13.0)	1(4.3)	3(13.0)	3(13.0)	5(21.7)	3(13.0)	2(8.7)	0(.0)	23(100.0)
	Less than 1 year	4(15.4)	2(7.7)	2(7.7)	3(11.5)	4(15.4)	3(11.5)	4(15.4)	4(15.4)	0(.0)	26(100.0)
Mort pariod	1-2 years	10(12.3)	13(16.0)	10(12.3)	10(12.3)	8(9.9)	13(16.0)	8(9.9)	7(8.6)	2(2.5)	81(100.0)
work period	3-5 years	10(10.2)	15(15.3)	8(8.2)	5(5.1)	15(15.3)	17(17.3)	16(16.3)	10(10.2)	2(2.0)	98(100.0)
	6 years or longer	11(13.6)	9(11.1)	8(9.9)	9(11.1)	9(11.1)	14(17.3)	10(12.3)	10(12.3)	1(1.2)	81(100.0)
То	tal	35(12.2)	39(13.6)	28(9.8)	27(9.4)	36(12.6)	47(16.4)	38(13.3)	31(10.8)	5(1.7)	286 (100.0)

3.1.4. Adequacy of utilization of shelters and safety facilities during infant forest experience programs

The results of the analysis of the adequacy of the utilization of shelters and safety facilities during infant forest experience programs are as shown in <Table 5>. The analysis shows, 1

person(1.5%) with "very good," 2(2.9%) with "good," 31(45.6%) with "fair," 27(39.7%) with "poor," and 7(10.3%) with "very poor," indicating that 50.0% of the respondents believe that shelters and safety facilities are not properly utilized during infant forest experience programs [10]. According to the general characteristics of the subjects surveyed, there were statistically significant differences depending on the gender(p<.01); men, relative to women, tended to think that shelters and safety facilities were used properly during infant forest experience programs.

De	escription	Very poor	Poor	Fair	Good	Very good	χ² (p)
Candar	Male	0(.0)	4(66.7)	1(16.7)	0(.0)	1(16.7)	13.616**
Gender	Female	7(11.3)	23(37.1)	30(48.4)	2(3.2)	0(.0)	(.009)
	20s	1(6.7)	7(46.7)	7(46.7)	0(.0)	0(.0)	
1.50	30s	2(10.5)	6(31.6)	11(57.9)	0(.0)	0(.0)	10.834
Age	40s	2(9.5)	9(42.9)	8(38.1)	2(9.5)	0(.0)	(.543)
	50s or older	2(15.4)	5(38.5)	5(38.5)	0(.0)	1(7.7)	
	Daycare center teacher	2(10.0)	7(35.0)	10(50.0)	1(5.0)	0(.0)	
Occupation	Kindergarten teacher	0(.0)	7(43.8)	9(56.3)	0(.0)	0(.0)	14.042
Occupation	Infant forest experience center teacher	5(18.5)	10(37.0)	11(40.7)	0(.0)	1(3.7)	(.298)
	Other	0(.0)	3(60.0)	1(20.0)	1(20.0)	0(.0)	
	Less than 1 year	0(.0)	2(40.0)	3(60.0)	0(.0)	0(.0)	
Mortenariad	1-2 years	4(22.2)	8(44.4)	4(22.2)	1(5.6)	1(5.6)	15.310
work period	3-5 years	3(11.5)	7(26.9)	16(61.5)	0(.0)	0(.0)	(.225)
	6 years or longer	0(.0)	10(52.6)	8(42.1)	1(5.3)	0(.0)	
Total		7(10.3)	27(39.7)	31(45.6)	2(2.9)	1(1.5)	

Table 5. Adequacy of utilization of shelters and safety facilities during infant forest experience programs.

Note: **p<.01.

3.1.5. Time spent guiding shelters and safety facilities during infant forest experience programs

The results of the analysis of time spent on guidance for shelters and safety facilities during infant forest experience programs are as shown in <Table 6>. According to the analysis results, "0-3 minutes" was the highest with 38 people(55.9%), followed by 15(22.1%) for "no guidance," 6(8.8%) for "3-5 minutes," and 3(4.4%) for "5 minutes or more," indicating time spent on the guidance is generally less than 2 minutes[9]. There were no statistically significant differences depending on the general characteristics of the subjects surveyed(p>.05).

Table 6. Time spent guiding shelters and safety facilities during infant forest experience programs.

De	scription	No guidance	0~3 min.	3~5 min.	5 min. or more	Other	χ² (p)
Condor	Male	3(50.0)	2(33.3)	0(.0)	1(16.7)	0(.0)	6.329
Gender	Female	12(19.4)	36(58.1)	6(9.7)	2(3.2)	6(9.7)	(.176)
	20s	6(40.0)	4(26.7)	2(13.3)	1(6.7)	2(13.3)	
4	30s	5(26.3)	12(63.2)	1(5.3)	0(.0)	1(5.3)	17.928
Age	40s	4(19.0)	13(61.9)	3(14.3)	0(.0)	1(4.8)	(.118)
	50s or older	0(.0)	9(69.2)	0(.0)	2(15.4)	2(15.4)	
Occupation	Daycare center teacher	5(25.0)	7(35.0)	3(15.0)	2(10.0)	3(15.0)	10.826
occupation	Kindergarten	5(31.3)	9(56.3)	1(6.3)	0(.0)	1(6.3)	(.544)

	teacher						
	Infant forest experience center teacher	3(11.1)	19(70.4)	2(7.4)	1(3.7)	2(7.4)	
	Other	2(40.0)	3(60.0)	0(.0)	0(.0)	0(.0)	
	Less than 1 year	3(60.0)	0(.0)	0(.0)	1(20.0)	1(20.0)	
Work pe-	1-2 years	4(22.2)	10(55.6)	1(5.6)	1(5.6)	2(11.1)	12.869
riod	3-5 years	5(19.2)	16(61.5)	3(11.5)	0(.0)	2(7.7)	(.379)
	6 years or longer	3(15.8)	12(63.2)	2(10.5)	1(5.3)	1(5.3)	
	Total	15(22.1)	38(55.9)	6(8.8)	3(4.4)	6(8.8)	

3.1.6. Guidance details for shelter and safety facilities during infant forest experience programs

The results of the analysis of guidance details for shelter and safety facilities during infant forest experience programs are as shown in <Table 7>. The total number of responses was 83, with 32 people(38.6%) with "location and use of evacuation/safety facilities," followed by 24 (28.9%) with "how to use evacuation/safety facilities," and 15(18.1%) with "no guidance" at all, indicating the location and use of safety facilities were guided[11]. There were no statistically significant differences depending on the general characteristics of the subjects surveyed(p>.05).

	Description	No guidance at all	Location and use of evacuation/safety facilities	How to use evacuation/safety facilities	Other	Total
Condor	Male	3(42.9)	2(28.6)	2(28.6)	0(.0)	7(100.0)
Gender	Female	12(15.8)	30(39.5)	22(28.9)	12(15.8)	76(100.0)
	20s	6(35.3)	6(35.3)	2(11.8)	3(17.6)	17(100.0)
	30s	5(23.8)	8(38.1)	5(23.8)	3(14.3)	21(100.0)
Age	40s	4(14.3)	13(46.4)	8(28.6)	3(10.7)	28(100.0)
	50s or older	0(.0)	5(29.4)	9(52.9)	3(17.6)	17(100.0)
	Daycare center teacher	5(20.0)	8(32.0)	6(24.0)	6(24)	25(100.0)
Occupa-	Kindergarten teacher	5(27.8)	7(38.9)	4(22.2)	2(11.1)	18(100.0)
tion	Infant forest experi- ence center teacher	3(8.8)	15(44.1)	13(38.2)	3(8.8)	34(100.0)
	Other	2(33.3)	2(33.3)	1(16.7)	1(16.7)	6(100.0)
	Less than 1 year	3(60.0)	1(20.0)	0(.0)	1(20.0)	5(100.0)
Work	1-2 years	4(18.2)	10(45.5)	7(31.8)	1(4.5)	22(100.0)
period	3-5 years	5(15.6)	10(31.3)	10(31.3)	7(21.9)	32(100.0)
	6 years or longer	3(12.5)	11(45.8)	7(29.2)	3(12.5)	24(100.0)
	Total	15(18.1)	32(38.6)	24(28.9)	12(14.5)	83(100.0)

Table 7. Guidance details for shelter and safety facilities during infant forest experience programs(multiple responses).

3.2. Awareness of problems and improvements in evacuation and safety facilities of infant forest experience centers

3.2.1. Problems in evacuation and safety facilities of infant forest experience centers

The results of analyzing the problems of shelters and safety facilities in infant forest experience centers are as shown in <Table 8>. The total number of responses was 195; 33(16.9%)

with "lack of knowledge or interest in using the evacuation and safety facilities," followed by 31(15.9%) with "poor facility conditions," 30(15.4%) with "limited use," 23(11.8%) with "lack of the number of persons to be accommodated and size," 22(11.3%) with "lack of budget to secure and maintain evacuation and safety facilities," 21(10.8%) with "lack of standards and guidelines," 17(8.7%) with "lack of cooperation with government facilities," and 12(6.2%) with "lack of personnel," indicating that the biggest problem is the lack of knowledge or interest in using the evacuation and safety facilities[12].

Desc	ription	Lack of standards and guidelines	Lack of the number of persons to be accom- modated and size	Limited use	Lack of knowledg e or interest in using the evacua- tion and safety facilities	Poor facility condi- tions	Lack of coopera- tion with govern- ment facilities	Lack of budget to secure and main- tain evacua- tion and safety facilities	Lack of person- nel	Other	Total
Gender	Male	4(17.4)	2(8.7)	3(13.0)	4(17.4)	2(8.7)	4(17.4)	3(13.0)	1(4.3)	0(.0)	23 (100.0)
echael.	Female	17(9.9)	21(12.2)	27(15.7)	29(16.9)	29(16.9)	13(7.6)	19(11.0)	11(6.4)	6(3.5)	172 (100.0)
	20s	4(9.3)	7(16.3)	8(18.6)	8(18.6)	4(9.3)	3(7.0)	4(9.3)	3(7.0)	2(4.7)	43 (100.0)
Δσρ	30s	7(12.3)	10(17.5)	10(17.5)	9(15.8)	8(14.0)	3(5.3)	6(10.5)	3(5.3)	1(1.8)	57 (100.0)
1.80	40s	8(13.3)	5(8.3)	7(11.7)	9(15.0)	11(18.3)	6(10.0)	9(15.0)	4(6.7)	1(1.7)	60 (100.0)
	50s or older	2(5.7)	1(2.9)	5(14.3)	7(20.0)	8(22.9)	5(14.3)	3(8.6)	2(5.7)	2(5.7)	35 (100.0)
	Daycare center teacher	5(8.8)	7(12.3)	8(14.0)	11(19.3)	8(14.0)	5(8.8)	8(14.0)	3(5.3)	2(3.5)	57 (100.0)
	Kindergar- ten teacher	5(11.4)	7(15.9)	8(18.2)	7(15.9)	6(13.6)	4(9.1)	3(6.8)	3(6.8)	1(2.3)	44 (100.0)
Occupa- tion	Infant forest experience center teacher	7(8.8)	8(10.0)	12(15.0)	13(16.3)	16(20.0)	7(8.8)	9(11.3)	6(7.5)	2(2.5)	80 (100.0)
	Other	4(28.6)	1(7.1)	2(14.3)	2(14.3)	1(7.1)	1(7.1)	2(14.3)	0(.0)	1(7.1)	14 (100.0)
	Less than 1 year	2(13.3)	2(13.3)	2(13.3)	4(26.7)	1(6.7)	1(6.7)	1(6.7)	1(6.7)	1(6.7)	15 (100.0)
Work	1-2 years	7(13.0)	4(7.4)	6(11.1)	8(14.8)	9(16.7)	7(13.0)	9(16.7)	2(3.7)	2(3.7)	54 (100.0)
period	3-5 years	6(8.0)	10(13.3)	17(22.7)	14(18.7)	13(17.3)	3(4.0)	7(9.3)	4(5.3)	1(1.3)	75 (100.0)
	6 years or longer	6(11.8)	7(13.7)	5(9.8)	7(13.7)	8(15.7)	6(11.8)	5(9.8)	5(9.8)	2(3.9)	51 (100.0)
То	otal	21(10.8)	23(11.8)	30(15.4)	33(16.9)	31(15.9)	17(8.7)	22(11.3)	12(6.2)	6(3.1)	195 (100.0)

Table 8. Problems in evacuation and safety facilities of infant forest experience centers(multiple responses).

3.2.2. Improvements to shelters and safety facilities at infant forest experience centers

The results of the analysis on the improvements to shelters and safety facilities at infant forest experience centers are as shown in <Table 9>. The total number of responses was 259. 42 responses(16.2%) were "expansion of the use scope(e.g. fire, earthquake, etc.) and "expansion of the budget for securing and maintaining shelters and safety facilities," respectively, followed

by 37(14.3%) for "reinforcing existing facilities," 35(13.5%) for "conducting training for teachers related to using evacuation and safety facilities," 32(12.4%) for "enhancement of related standards or guidelines," 30(11.6%) for "expansion of the number of persons to be accommodated and size," 20(7.7%) for "cooperation with related government agencies," and 17(6.6%) for "recruiting related staff," indicating that the expansion of the use scope, facilities, and budget is most needed[13].

Des	cription	Enhance- ment of related standards or guidelines	Expansion of the number of persons to be accom- modated and size	Expansion of the use scope(e.g. fire, earth- quake, etc.)	Conducting training for teachers related to using evacuation and safety facilities	Rein- forcing existing facilities	Cooper- ation with related govern- ment agencies	Expan- sion of the budget for securing and main- taining shelters and safety facilities	Recruit- ing related staff	Other	Total
Gen-	Male	4(15.4)	4(15.4)	4(15.4)	4(15.4)	2(7.7)	4(15.4)	4(15.4)	0(0)	0(0)	26(100.0)
der	Female	28(12)	26(11.2)	38(16.3)	31(13.3)	35(15)	16(6.9)	38(16.3)	17(7.3)	4(1.7)	233(100.0)
	20s	6(10.5)	8(14)	11(19.3)	8(14)	8(14)	3(5.3)	9(15.8)	3(5.3)	1(1.8)	57(100.0)
	30s	8(11.3)	10(14.1)	11(15.5)	10(14.1)	12(16.9)	4(5.6)	10(14.1)	5(7)	1(1.4)	71(100.0)
Age	40s	12(14.6)	6(7.3)	14(17.1)	11(13.4)	9(11)	8(9.8)	15(18.3)	7(8.5)	0(0)	82(100.0)
	50s or older	6(12.2)	6(12.2)	6(12.2)	6(12.2)	8(16.3)	5(10.2)	8(16.3)	2(4.1)	2(4.1)	49(100.0)
	Daycare center teacher	10(12.7)	10(12.7)	11(13.9)	14(17.7)	10(12.7)	6(7.6)	11(13.9)	6(7.6)	1(1.3)	79(100.0)
0	Kinder- garten teacher	6(10.3)	8(13.8)	11(19)	5(8.6)	12(20.7)	4(6.9)	8(13.8)	3(5.2)	1(1.7)	58(100.0)
pation	Infant forest experi- ence center teacher	13(13.1)	9(9.1)	17(17.2)	12(12.1)	13(13.1)	7(7.1)	20(20.2)	6(6.1)	2(2)	99(100.0)
	Other	3(13)	3(13)	3(13)	4(17.4)	2(8.7)	3(13)	3(13)	2(8.7)	0(0)	23(100.0)
	Less than 1 year	4(20)	2(10)	4(20)	3(15)	2(10)	2(10)	2(10)	0(0)	1(5)	20(100.0)
Work	1-2 years	9(14.3)	5(7.9)	6(9.5)	8(12.7)	10(15.9)	6(9.5)	13(20.6)	4(6.3)	2(3.2)	63(100.0)
period	3-5 years	11(10.4)	15(14.2)	20(18.9)	16(15.1)	15(14.2)	5(4.7)	16(15.1)	8(7.5)	0(0)	106(100.0)
	6 years or longer	8(11.4)	8(11.4)	12(17.1)	8(11.4)	10(14.3)	7(10)	11(15.7)	5(7.1)	1(1.4)	70(100.0)
Т	otal	32(12.4)	30(11.6)	42(16.2)	35(13.5)	37(14.3)	20(7.7)	42(16.2)	17(6.6)	4(1.5)	259(100.0)

Table 9. Guidance details for shelter and safety facilities during infant forest experience programs(multiple responses).

4. Conclusion and Suggestion

Infant forest experience centers have so far been successfully established in Korea as part of pre-school ecological education centers[14], but since it is a place for infants and children to enjoy nature and that requires a lot of activity, safety issues for participating children are always accompanied[15]. Therefore, how to secure their safety is an important topic. In this study, the awareness survey was conducted on teachers related to forest experience centers to find more effective ways to improve evacuation and safety facilities. According to the survey on the awareness of using the evacuation and safety facilities at infant forest experience centers, the utilization level of evacuation and safety facilities was low, and there was a demand for utilization in more diverse ways. It also confirmed the limitations of evacuation and safety facilities and the demands for improvement measures.

This paper tried to investigate the current status of the infant forest experience centers operated by the local governments, the Forest Service, and the Forest Welfare Promotion Agency in Gyeongsangbuk-do and propose measures to improve the evacuation and safety facilities of infant forest experience centers based on the results of the survey conducted on teachers related to the centers. The limitations of this study and suggestions for further research that emerged in the course of the study are as follows.

First, this study was conducted only on the infant forest experience centers operated by local governments, the Forest Service, and the Forest Welfare Promotion Agency of Gyeongsangbukdo, so the other privately operated infant forest experience centers were not covered. In the case of the privately operated centers, it was difficult to identify and check official status data, so it was not selected for this research. In the future, it will be necessary to understand the current status of privately operated infant forest experience centers and conduct research on the evacuation and safety facilities of these centers.

Second, there is a spatial limitation of the research target in that not all the infant forest experience centers in other regions established nationwide were selected for the research. Since there are infant forest experience centers run by various operators nationwide, but due to time and spatial limitations, future research is expected to expand the scope to study various problems and improvement measures.

Finally, it is necessary to study the system and status of evacuation and safety facilities at overseas forest kindergartens and discuss ways to benchmark them in Korea. In the course of the research, the research team could think of ways to develop Korea's infant forest experience centers by benchmarking the case of overseas forest schools, but there was a limit because overseas field research was practically impossible. Provided that the team has the chance, it would like to study more to learn from overseas field trips.

5. References

5.1. Journal articles

- [3] Kim DG & Kim HJ. The Effect of Forest Experience Activities on the Emotional Intelligence of Infants. *Ecological Early Childhood Education Research*, 5(1), 57-78 (2006).
- [4] Kim SH & Park HJ & Kim SY. Effects of Forest Play Activities on Children's Emotional Control Ability and Problem Behavior. *Korean Infants and Toddlers*, 90(1), 1-21 (2015).
- [5] Jang HJ. A Study on the Forest Kindergarten, an Ecological Alternative Education in Europe, and a Plan to Develop a Forest Kindergarten in Korea. *Ecological Early Childhood Education Research*, 11(3), 95-119 (2012).
- [6] Shin JY & Lee SY & Jeong MJ & Lee SY. A Basic Study for the Development of a Korean Forest Kindergarten Curriculum Model. *Journal of Early Childhood Education*, 20(4), 549-582 (2016).
- [7] Choi IH & Jeong YE & Heo SA & Cha DS. Preschool Forest Experience Education Operation and Improvement Plan. Journal of the Korean Society of Photography Geography, 24(3), 57-65 (2014).
- [8] Han YM. Forest Kindergarten's Overseas Trends and Domestic Introduction Tasks. Korean Infants and Toddlers, 60(1), 1-18 (2010).
- [10] Hwang YS & Kim KA & Son MS. Meta-analysis on Research Method Trend Analysis and Development Effect of Forest Kindergarten Related Research. *Open Early Childhood Education Research*, 21(1), 193-207 (2016).
- [11] Kang YS & Kim GS. The Effect of Infants' Peer-to-peer Experience on Interaction and Leadership. *Open Early Childhood Education Research*, 22(3), 127-143 (2017).

- [12] Kang HM & Song JE. Comparison of Multi-intelligence of Infants according to Forest Experience Activities in Early Childhood Educational Institutions. *Ecological Early Childhood Education Research*, 13(1), 155-174 (2014).
- [13] Ma JS. The Effect of Forest Experience Activities on Children's Scientific Attitude and Scientific Inquiry Ability. *Journal of the Korean Society for Infant Physical Education*, 9(1), 85-101 (2008).
- [14] Jeong YH. The Effect of Play-oriented Forest Experience Activities on Infants' Basic Fitness and Growth Factors. *Subject Education Research*, 36(1), 50-72 (2015).
- [15] Jang HJ. A Study on the Forest Kindergarten, an Ecological Alternative Education in Europe, and a Plan to Develop a Forest Kindergarten in Korea. *Ecological Early Childhood Education Research*, 11(3), 95-119 (2012).

5.2. Thesis degree

[9] Ham MR. A Study on the Safety of Forest Experience Centers for Children Experienced by Early Childhood Teachers: Focusing on Seoul City. Sookmyung Women's University, Master's Thesis (2016).

5.3. Additional references

- [1] Knight S. Forest Schools & Outdoor Learning in the Early Years. Sage (2009).
- [2] Jang HJ. Forest Kindergarten: From Establishment to Program. Homi (2010).

6. Contribution

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	Initial name	Contribution
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Lood		-Getting results 🔽
Author	JMJ	-Analysis 🔽
		-Make a significant contribution to
		collection \checkmark
		-Final approval of the paper 🛛
Corresponding		-Corresponding 🗹
Author*	LVVH	-Play a decisive role in modification \square
		-Significant contributions to concepts, de- signs, practices, analysis and interpreta- tion of data 🔽
Co-Author	PJS	-Participants in Drafting and Revising Pa-
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- The Effects of AMPK Activation Induced by Endurance Exercise on Glucose Uptake Via AKT/AS160, Korean Journal of Sport Studies, 57(6) (2018).
- An Estimation Model for Anaerobic Power of Taekwondo Athletes Based on Field Tests, Journal of Martial Arts Anthropology, 19(1) (2019).
- The Analysis of Research Trends on Psychological Factors in Taekwondo Demonstration: Systematic Review, Korea Sport Society, 17(2) (2019).

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