# Kinesiology

## Vol. 6 No. 4

#### <Index>

1. Study on Judgment Recognition of Figure Skating COACHES.

#### / Sunghee Koh

2. The Effects of Different SQUAT Loading on Lower Extremity Movement Pattern and Stability Index during Squat Exercise Between Trained versus Un-Trained Individuals.

#### / Sangho Park, Changyoung Kim

3. A Study on the Brand Equity of Title Sponsorship, Customer's Attitude, Loyalty, and Intention of Use: With a Focus on the Chinese E-SPORTS Clubs.

#### / Jie Ren, Sukkyung Lee

4. The Effects of Saturated and Unsaturated Fat Intake on the Skeletal Muscle's LPL mRNA Expression in Rats.

#### / Wookwang Cheon, Jusik Park

5. The Citespace Approach on the Changes of Trends and Hotspots to Consume SPORT Products of Chinese Collegiate Students.

/ Xuefeng Bai, Hongbum Shin

6. The Effect of Body Image Recognition of Manipulative Therapy Based on KINESIOLOGY of Customers on the Appearance Management Behaviors.

/ Youngbook Kim, Eunjoo Choi

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## Study on Judgment Recognition of Figure Skating COACHES

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#### Abstract

**Purpose:** This study is to analyze the judgment perception of the figure skating instructor, to secure trust between the judge and the director, and to provide basic data for the development plan of the figure skating event. The subject was a survey of 45 professional figure skating instructors registered as directors in the Korea Skating Federation.

**Method:** This analysis of the perception of figure skating instructors' judgments based on gender was conducted using t-test. One-way ANOVA was carried out to identify the judge's perception according to the director's age, coaching period, coaching experience, and director level.

**Results:** First, regarding gender, male directors were found to be more positively perceived than female directors, but the difference was not statistically significant.

Second, regarding age, the scores of directors over 50 was the lowest.

Third, regarding the guidance period, it was found that directors with more than 10 years of guidance received the most negative perception.

Fourth, there was a statistically significant difference in the director's perception according to the coaching experience. There was a difference in the perception of fairness, reliability, and accuracy of the judge, which is a sub-factor, and the perception of judge decision was more negative for professional directors with experience in coaching national athletes than for directors with experience in coaching general sports.

*Fifth, there was a difference in the perception according to the level of the director. Especially the perception was the most negative for class 7-8 directors.* 

**Conclusion:** As a result, it is considered that studies are needed to increase the objectivity of the judges in scoring, which depends on their subjective evaluation.

#### [Keywords] Figure Skating, Coaches, Judgment Recognition, Subjective Evaluation, Scoring Sports

#### 1. Introduction

Sports events such as figure skating, rhythmic gymnastics, and aerobics that reflect the subjective score of the judges are ranked according to the judges' evaluation [1]. In these scoring matches, unlike the record-based matches, the result may be determined by the subjective viewpoint of the judges assigned to the match [2][3]. For this reason, in scoring games there are cases of dissatisfaction with the decision of the judges due to a misunderstanding [4] or a dispute over the decision [5][6].

In order to prevent the subjective judgment of judges, each sports federation has introduced a video reading system for objective and correct judgment[4][7][8][9]. In addition, judgment education in line with the ethics education of judges[10] is conducted every year, and efforts are being made to prevent misconduct and ethically problematic misconduct and evaluations.

In particular, the International Skating Federation introduced a system that gives disciplinary action to judges after a meeting of experts if there is any doubt regarding their decision after international figure skating events such as the Olympics and championships [11]. This management system imposes sanctions on judges activities by making the results standard and making the judge take responsibility for scores that are far out of the range.

Nevertheless, the cases of large and small misjudgments in sports events give more negative perception to the players and coaches and become a reason for distrusting the decision and disobeying the judge[6][12][13][14][15]. In addition, if the judge is related to a player or coach who participated in the game due to academic ties or delay, bias is suspected, and players and coaches distrust the judgment[16].

Athletes and coaches' perceptions of judges are considered important because they can affect the players' commitment, performance, and dropouts in preparation for the game[17][18][19]. In the midst of this, research for judges education and change of director perception by understanding the director's perception of judgment has been done in various sports, such as: 'Analysis of reliability and error sources of judges' rating in rhythmic gymnastics[20], The understanding of judge's decision factor and improvement way in Kumdo competition[7], The Recognition of the judge's Decision in Male Gymnastics and It's Improvement[12], Effects of Awareness of Umpire's Judgment in Hapkido Competition on Players' Performance and Psychological State[21], Investigation on the Recognition of judges on the Scoring Rules for TAEKWONDO Demonstration Competition[22]. Nevertheless, research on judgment recognition in figure skating events is insufficient.

Therefore, the purpose of this study is to analyze the judgment perception of figure skating instructors, to secure trust between the judges and the director, and to provide basic data for the development plan of the figure skating event.

#### 2. Research Method

#### 2.1. Study subjects

The subject of this study was the figure skating instructors who were registered as directors in the Korea Skating Federation, an organization affiliated with the Korea Sports Association. The directors selected 45 professional figure skating instructors who had completed the director's workshop conducted by the Korea Skating Federation as subjects of investigation. They instruct figure skating athletes and professional athletes in the field, and were affiliated with local ice rinks in Seoul, Gyeonggi, Incheon, Daegu, Busan, and Jeonbuk. The 45 directors consisted of 39 women and 6 men, with women being the majority. Directors were classified by gender, age, coaching experience, coaching experience, and player level. The coaching experience was classified according to the experience of coaching the national team players and the experience of coaching the national team candidates, dream tree players, and general players, by classifying the number of players, the coach's career was divided into no class, class-2, class 3-4, class 5-6, and class 7-8 <Table 1>.

Classification	Contents	Personnel	Percentage	Percentage(excluding missing)	
Condor	Male	6	13.0	13.3	
Gender	Female	39	84.8	86.7	
	20's	9	19.6	20.0	
4.50	30's	20	43.5	44.4	
Age	40's	9	19.6	20.0	
	50's	7	15.2	15.6	
Guidance period	1 to 3 years	3	6.5	6.7	

Table 1. General characteristics of directors.
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	4 to 6 years	7	15.2	15.6
	7 to 9 years		17.4	17.8
	10 years or more	27	58.7	60.0
	Life sports player	17	37.0	37.8
Leadership	Dream player	8	17.4	17.8
experience	National team candidate player	5	10.9	11.1
	National team player	15	32.6	33.3
	No class-Class 1	3	6.5	6.7
Figure disting	Class 3-4	7	15.2	15.6
Figure skaling	Class 5-6	8	17.4	17.8
	Class 7-8	27	58.7	60.0
Total		45	97.8	100.0

#### 2.2. Judgment measuring tool

The questionnaire used by Park Dae-seong[23] and Huh Dong-jin[5] was used to measure the perception of the judges' decision, and the questions were modified and supplemented to fit the figure skating competition. The questionnaire consisted of 11 items of fairness, 6 items of consistency, 5 items of reliability, and 4 items of accuracy.

All items were classified as 'Not at all(1 point), No(2 points), Average(3 points), Yes(4 points), Very much(5 points)' on a 5-point Likert scale. The reorganization of the question was reinterpreted to preserve the original author's intention as much as possible, and was revised and supplemented through the inspection of three research-related experts(one professor at the Graduate School of Education, one international figure skating judge, and one figure skating director).

As a result of the factor analysis, 26 items consisted of 5 factors(shared value >1.0) and showed 79.27% of explanatory power. However, the cumulative variance included in one factor(57.00%) was concentrated. This means that most of the first questions were asked about one factor, and 22.27% of the other questions were about the remaining four factors. <Table 2> shows the eigenvalues of factor analysis(N-Factor=5, principal component analysis) for the 26 selected items.

Ingradiant	Initial eigen values								
ingredient	All	Dispersion %	Total %						
1	14.820	57.001	57.001						
2	2.055	7.905	64.906						
3	1.436	5.522	70.428						
4	1.234	4.746	75.174						
5	1.065	4.096	79.270						

 Table 2. Principal component analysis items.

There were a total of 46 questionnaires, and 45 were used for analysis except for one invalid questionnaire in <Table 3>.

Table 3. Case handling summary.

		Ν	%	
	Available	45	97.8	
Case	Excluded	1	2.2	
	All	46	100.0	

For structural validity of item setting, factor analysis(N-factor=5, verimax) was performed and 26 items were determined. The internal fidelity of the factors(Cronbach- $\alpha$ ) was .939, indicating that the reliability of the questions examining the judge's perception was high <Table 4>.

Table 4. Reliability statistics.

Cronbach's Alpha	Number of items		
.939	26		

#### 2.3. Data analysis

This analysis of the perception of figure skating instructors' judgments based on gender was conducted using t-test. One-way ANOVA was carried out to identify the judge's perception according to the director's age, coaching period, coaching experience, and director level.

#### 3. Result

Therefore, this study conducted an analysis to find out the differences in the judgment recognition of figure skating instructors.

As a result of conducting the t-test to find out the difference in the perception of judges according to the gender of the director, as shown in the table, the male directors' score was  $4.01\pm.61$  and the female  $3.40\pm.55$ , showing high scores. Also, there was no statistically significant difference between groups with a significance probability of .757(p<.05). Consistency, a sub-factor according to gender, showed a significant difference between men and women with an F value of 4.951 and a significance probability of .031(p<.05) <Table 5>.

	Gender	N	Average	Standard deviation	Standard error mean	F	Significance probability
Judge recognition	Male	6	4.0192	.61286	.25020	007	.757
total average	Female	39	3.4043	.55847	.08943	.097	
Fairness	Male	6	4.1212	.77708	.31724	004	.953
	Female	39	3.4685	.69377	.11109	.004	
Consistency	Male	6	3.9167	.67289	.27471	4.051	021
	Female	39	3.2009	.42609	.06823	4.951.	.031

 Table 5. Results of analysis of differences in the perception of judges by gender.

Reliability	Male	6	4.0667	.43205	.17638	2.661	.062
	Female	39	3.7077	.77166	.12357	3.001.	
Accuracy	Male	6	3.8333	.64550	.26352	002	066
	Female	39	3.1538	.55788	.08933	.002	.966

As a result of one-way analysis of variance to find out the perception of judgment according to the age of the director, the F value was 3.262 and the probability of significance was .031(p<.05), indicating that there is a statistically significant difference in the perception of judgment according to age. According to age, the average judge's judgment recognition was highest in their 30s at 3.7404, and those in their 50s and over showed the lowest at 3.1264. As for the sub-factor, in fairness, those in their 30s had the highest score of 3.7404, and those in their 50s and over had the lowest score of 3.1264. In addition, the F value was 4.226 and the significance probability was .011, indicating that there was a significant difference in the perception of fairness according to age <Table 6>.

		N	Average	Standard deviation	Standardization error	F	Significance rate
	20's	9	3.5043	.50568	.16856		
Judge	30's	20	3.7404	.52200	.11672		
recognition	40's	9	3.1838	.66054	.22018	3.262	.031
total average	Over 50	7	3.1264	.57122	.21590		
	All	45	3.4863	.59726	.08903		
	20's	9	3.6566	.53740	.17913		
	30's	20	3.8727	.62665	.14012		
Fairness	40's	9	3.1919	.79050	.26350	4.226	.011
	Over 50	7	2.9870	.72997	.27590		
	All	45	3.5556	.73119	.10900		
	20's	9	3.3704	.59964	.19988		
	30's	20	3.4000	.51696	.11560		.387
Consistency	40's	9	3.0556	.42492	.14164	1.036	
	Over 50	7	3.2143	.51563	.19489		
	All	45	3.2963	.51846	.07729		
	20's	9	3.6444	.66916	.22305		
	30's	20	4.0500	.65494	.14645		
Reliability	40's	9	3.4000	.96954	.32318	2.223	.100
	Over 50	7	3.5143	.51455	.19448		
	All	45	3.7556	.74210	.11063		
	20's	9	3.1111	.48591	.16197		
	30's	20	3.5000	.60153	.13451		
Accuracy	40's	9	3.0833	.48412	.16137	2.550	.069
	Over 50	7	2.8929	.71962	.27199		
	All	45	3.2444	.60886	.09076		

Table 6. Results of analysis of differences in the perception of judges according to age.

As a result of ana As for the average of judgment recognition, directors with 1 to 3 years of guidance showed 3.9359, and those with more than 10 years showed 3.3148. The F values of the sub-factors were fairness 2.031, consistency 1.832, reliability 1.240, and accuracy 2.004, and the significance probabilities were fairness.125, consistency.156, reliability.307, and accuracy.128, with no significant difference <Table 7>.

		Ν	Average	Standard deviation	Standardization error	F	Significance probability
	1 to 3 years	3	3.9359	.38717	.22353		
Judge	4 to 6 years	7	3.6538	.42191	.15947		
recognition total	7 to 9 years	8	3.7500	.68955	.24379	2.173	.106
average	10 years or more	27	3.3148	.58330	.11226		
	All	45	3.4863	.59726	.08903		
	1 to 3 years	3	4.0909	.27273	.15746		
	4 to 6 years	7	3.7273	.49237	.18610		
Fairness	7 to 9 years	8	3.8864	.65149	.23034	2.031	.125
	10 years or more	27	3.3535	.78217	.15053		
	All	45	3.5556	.73119	.10900		
	1 to 3 years	3	3.8333	.72648	.41944		.156
	4 to 6 years	7	3.4048	.28637	.10824		
Con- sistency	7 to 9 years	8	3.3958	.72887	.25769	1.832	
Sisteriey	10 years or more	27	3.1790	.44560	.08576		
	All	45	3.2963	.51846	.07729		
	1 to 3 years	3	4.1333	.41633	.24037		
	4 to 6 years	7	3.9714	.75214	.28428		
Reliability	7 to 9 years	8	4.0000	.88802	.31396	1.240	.307
	10 years or more	27	3.5852	.70586	.13584		
	All	45	3.7556	.74210	.11063		
	1 to 3 years	3	3.4167	.72169	.41667		
	4 to 6 years	7	3.4286	.49401	.18672		
Accuracy	7 to 9 years	8	3.5938	.81216	.28714	2.004	.128
	10 years or more	27	3.0741	.52264	.10058	]	
	All	45	3.2444	.60886	.09076		

Table 7. Results of analysis of differences in the perception of judges according to the instruction period.

As a result of the analysis to find out the perception of judgment according to the coach's leadership experience, the F value was 5.249, and the significance probability was .004, showing a significant difference. The F value of sub-factor fairness was 5.305, the significance probability was .003, the F value of the reliability was 5.779, the significance probability was .002, the F value of the accuracy was 2.912, and the significance probability was .046, indicating a significant difference in all configurations except consistency. The average of judgment recognition according to coaching experience was 3.8179 for daily sports players and 3.1041 for national team coaching experience, indicating that coaches with national team coaching experience had more negative judgment perception <Table 8>.

**Table 8.** Results of analysis of differences in the perception of judges according to their coaching experience.

			Average	Standard deviation	Standardization error	F	Significance probability
ludgo	Life sports player	15	3.8179	.29164	.07530		
recogni-	Dream player	5	3.5308	.57397	.25669		
tion	National team candidate player	8	3.6490	.70903	.25068	5.249	.004
total	National team player	17	3.1041	.57624	.13976		
average	All	45	3.4863	.59726	.08903		
	Life sports player	15	3.9758	.41012	.10589		
	Dream player	5	3.5273	.60780	.27182		
Fairness	National team candidate player	8	3.7614	.76515	.27052	5.305	.003
-	National team player	17	3.0963	.75067	.18206		
	All	45	3.5556	.73119	.10900		
	Life sports player	15	3.4333	.40237	.10389		

Con-	Dream player	5	3.3667	.69121	.30912		
sistency	National team candidate player	8	3.4167	.67259	.23780	1.388	.260
	National team player	17	3.0980	.46045	.11167		
	All	45	3.2963	.51846	.07729		
	Life sports player	15	4.2000	.53984	.13939		
	Dream player	5	3.8000	.73485	.32863		
Reliabil-	National team candidate player	8	3.9250	.82765	.29262	5.779	.002
icy	National team player	17	3.2706	.61213	.14846		
	All	45	3.7556	.74210	.11063		
	Life sports player	15	3.4833	.47684	.12312		
	Dream player	5	3.4500	.54199	.24238		
Accu- racy	National team candidate player	8	3.3438	.77848	.27523	2.912	.046
	National team player	17	2.9265	.55032	.13347		
	All	45	3.2444	.60886	.09076		

The judgment recognition according to the director's level was 7.602 F, and the significance probability was .000, indicating that there was a significant difference between the groups. Directors level 7-8 were 3.1288 and directors level 5-6 were 4.2115, and directors level 7-8 were less aware of the judgment <Table 9>.

		N	Average	Standard deviation	Standardization error	F	Significance probability
	No level-level 2	11	3.6259	.47453	.14307		
Judge	Lever 3-4	10	3.7577	.36173	.11439		
recognition total	Level 5-6	4	4.2115	.59460	.29730	7.602	.000
average	Level 7-8	20	3.1288	.54268	.12135		
	All	45	3.4863	.59726	.08903		
	No level-level 2	11	3.7686	.53685	.16187		
	Lever 3-4	10	3.8727	.53902	.17045		
Fairness	Level 5-6	4	4.4773	.65713	.32856	8.680	.000
	Level 7-8	20	3.0955	.63223	.14137		
	All	45	3.5556	.73119	.10900		
	No level-level 2	11	3.3030	.36376	.10968		
	Lever 3-4	10	3.3667	.42164	.13333		
Consistency	Level 5-6	4	4.0417	.67185	.33593	4.601	.007
	Level 7-8	20	3.1083	.49048	.10967		
	All	45	3.2963	.51846	.07729		
	No level-level 2	11	3.9091	.78671	.23720		
	Lever 3-4	10	4.2000	.57349	.18135		
Reliability	Level 5-6	4	4.2500	.34157	.17078	5.012	.005
	Level 7-8	20	3.3500	.65815	.14717		
	All	45	3.7556	.74210	.11063		
	No level-level 2	11	3.3636	.55186	.16639		
	Lever 3-4	10	3.4750	.34258	.10833		
Accuracy	Level 5-6	4	3.6875	1.02825	.51412	2.986	.042
	Level 7-8	20	2.9750	.56720	.12683		
	All	45	3.2444	.60886	.09076		

 Table 9. Results of analysis of differences in the perception of judges according to the level of directors.

7

#### 4. Discussion

As a result of analyzing the difference in the director's perception of judgment according to gender, in the figure skating event, male directors showed more positive perception of judgment according to gender than female directors, but the difference was not statistically significant. This result is different from speculative events such as Aikido[21], which shows that the male director's perception was more positive in the figure skating event with a lot of female directors, unlike the sports with a lot of male directors due to the characteristics of the event. Such differences showed a greater difference in consistency. Relatively, female coaches had more negative thoughts about judges making decisions based on the same criteria, and this result is consistent with the argument in events that depend on judge decisions in scoring games[24].

Regarding the perception of judge judgment according to the age of the director, the score of the director over 50 was the lowest. Most of the directors in their 50s and older had more than 10 years of experience and had a lot of coaching experience and coaching experience, but their perception of judgment was rather negative. In particular, this result came out more clearly in terms of fairness. Specially, figure skating directors in their 50s and older thought that judges had different standards of judgment depending on academic achievement and delay, and this result is consistent with the results of the directors of gymnastics, a scoring event[16].

As a result of the survey to find out the perception of judgment according to the period of guidance of the director, it was found that the director with more than 10 years of guidance had the most negative perception of judgment. This can be seen as the result that the directors with long leadership experience had high leadership belief[25] and professionalism[26], and the director doubted the judge's inaccurate judgment and did not trust the professionalism[24][27].

There was a statistically significant difference in the director's perception of judgment according to the coaching experience. There was a statistically significant difference in the perception of the judges' fairness, reliability, and accuracy, which are sub-factors. Coaching careers were classified according to the experience of coaching life sports players, dream tree players, national team candidates, and national team players. The perception of judge judgment was more negative for professional coaches with experience in coaching national athletes than coaches with experience in coaching life sports players. Directors who participated in large-scale competitions such as important national team selections, national sports competitions, and Olympic selections thought that judges were not judged fairly if they were related to academic achievement or delay[16]. In particular, it can be seen that the judge directors were more interested in subjective judge's decision in a situation where the match result had to depend on the judge's decision in a big game[24]. In addition, if the coach has a high career, the player's game is evaluated and compared with the judge's decision, and in this process, the judge's decision cannot be trusted[28].

According to the level of the director, the perception of judgment differed according to the level. Especially the perception was the most negative for class 7-8 directors. Levels 7-8 belong to the highest level among Korean figure skating athletes and have the qualifications to participate in national qualification competitions, the Olympics and various championships. In the case of a director level 7-8, there are many directors from the national team, national team candidates, or experienced athletes who have participated in the world championships, Olympics, Asian championships, and various international competitions among the directors who achieved the highest level during their athlete's day. Directors with more professional knowledge were more sensitive to judge decisions and did not trust the judges' professionalism[28][29]. I also thought I wasn't judging the game properly.

As a result, it is considered that studies are needed to increase the objectivity of the judge in scoring matches that will depend on the subjective evaluation of the judge in the future[6][30][31][32][33][34][35].

#### **5.** Conclusion

The purpose of this study was to provide basic data to secure trust between the judge and the director by analyzing the perception of judgment of the director of figure skating. The conclusion is as follows.

As for the judge's perception of the founder of figure skating, the older the judge and the longer the coaching period, the more negative the perception. In addition, it was found that the level of leadership was high and the perception of the judgment of the judge who had the experience of coaching professional players was more negative. This was consistent with the results of the argument that the perception of the judge was more negative in the scoring event, which was highly dependent on the judge's decision. For this reason, it is necessary to conduct various studies to secure the trust of directors and judges through follow-up studies.

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#### 7. Appendix

#### 7.1. Authors contribution

	Initial name	Contribution
		-Set of concepts 🔽
		-Design 🗹
		-Getting results 🔽
		-Analysis 🗹
		-Make a significant contribution to collection 🛛
Author	SK	-Final approval of the paper $ abla$
Addior	51	-Corresponding 🔽
		-Play a decisive role in modification $\ igsqcare{}$
		-Significant contributions to concepts, designs,
		practices, analysis and interpretation of data $\ oxtimes$
		-Participants in Drafting and Revising Papers 🔽
		-Someone who can explain all aspects of the paper $ abla$

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#### The Effects of Different SQUAT Loading on Lower Extremity Movement Pattern and Stability Index during Squat Exercise Between Trained versus Un-Trained Individuals

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#### Abstract

**Purpose:** Weight training is a training method that can effectively increase muscle strength and anaerobic exercise capacity. The muscles of the lower extremities, which have been trained through lower body exercises, are a particularly important group of muscles for daily physical and sporting activities. The purpose of this study was to investigate the difference squat loading of the lower extremity joints movement pattern between trained versus un-trained individuals.

**Method:** A total of 20 physically healthy individuals 10 trained subjects(age: 28.71±2.41 yrs, height: 178.92± 4.25 cm, weight: 81.72±4.98 kg) and 10 un-trained subjects(age: 29.42±3.67 yrs, height: 176.62±3.8 cm, weight: 80.2±5.11 kg) participated in this study. The un-trained subjects who had not performed regular resistance exercise for at least the past 1 year, and had no experience performing squat movements were selected. The trained group was selected as subjects who had regularly performed resistance strength training for at least 3 years. The three-dimensional motion analysis system, force plate and an wireless electromyography system were synchronized and used for measurement.

**Results:** The results of this study showed that there was difference between the trained group and the untrained group and the trained group showed the pattern of knee varus and un-trained group showed the valgus angle(Knee valgus) displacement. Also, Statistically significant differences appeared in knee forward movement and the trained group(5cm) showed less than the un-trained group(11cm). In the case of MLSI(Medial-Lateral Stability Index), the untrained group showed a higher stability index than the trained group. It was found that the stability index of the trained and untrained groups increased as the body weight increased.

**Conclusion:** The purpose of this study was to investigate the effect of various squat loads on lower extremity movement patterns and stability index during squat exercise between trained and untrained individuals. The subjects of the study were 10 trainees who regularly squat for 3 years and 10 non-trainers who practiced squats irregularly throughout their lives. As a result of the experiment, it was confirmed that the untrained group had greater knee forward movement and a smaller hip flexion angle than the trained group. In the stability index, it was confirmed that the untrained group showed a higher stability index than the trained group. In future studies, it is considered necessary to study the improvement of squat motion in untrained individuals. It is important to check for changes in movement patterns after training.

[Keywords] Squat, Stability Index, Joint Movement, Knee Valgus, External Load

#### 1. Introduction

According to a survey on the participation of people in physical activity in 2020, walking 41.9%, mountaineering 17.6%, and bodybuilding(weight training) 13.3% were found to be the most popular sports[1]. Weight training is a resistance exercise against an external load and has been widely distributed to the general public including athletes[2]. Weight training is a training method that can effectively increase muscle strength and anaerobic exercise capacity, and the lower extremity muscles trained through lower body exercise are particularly important muscle

groups for daily physical and sports activities[3][4]. There are various exercises in the weight training method for developing lower extremity muscles.

One of the most popular exercises is the back squat[5], which trains the muscles of the rectus femoris, vastus lateralis, vastus medialis and vastus intermedius and calf muscles[6]. These muscles are known to play an important role in improving athletic performance and performance in running and jumping and preventing injuries[7]. Squat exercise is a complicated exercise and it is an exercise method that is performed while supporting a heavy weight, it is known that the probability of injury is high if instability occurs during incorrect posture or movement pattern[8]. The squat is an exercise that activate various lower extremity muscles, and it is a movement that requires proper coordination between the muscles. Also, it is very important to perform the squat correctly, and the squat movement with the wrong posture is highly likely to cause back and knee injuries. Therefore, it is important to maintain proper upper and lower extremity posture during the squat exercise[9][10].

The spine is known to have the highest rate of injury related to squats[11], and the squat exercise is an effective exercise method for increasing dynamic stability[12], promoting muscle mobilization patterns in the lower extremities due to exercise in weight bearing, and increasing the ability to maintain posture against the external environment by stimulating proprioceptive sensations[13]. The instability of the spine exists due to its structural characteristics[14], and it maintains the stiffness and stability of the spine by compensating for the instability of the spine through passive tissues such as ligaments and dynamic muscle activation[15]. It was reported that the stability of the spine can be increased by preventing excessive motion by increasing the stiffness of the vertebral segments through co-activation of trunk muscles and intra-abdominal pressure[16].

The point to be aware of in the progress of the back squat exercise is to control the movement of the upper extremity during exercise, and the forward tilt of the upper body causes the weight to be transferred to the spine instead of to the lower extremity[5]. In particular, un-trained individuals are in a more dangerous state due to the uneducated of the agonist muscle and synergist muscles required for squatting, and the movement and instability of the center of gravity in the forward and backward directions during squat exercise[5]. Maintaining a correct posture in squat exercise can be seen as very important, and it can be seen that there is a close relationship in preventing injury and improving exercise performance. There are previous studies on the effect of squat movement on the knee and back and the increase in the incidence of squat-related back injuries, which means that the posture and movement of the squat are important[17][18].

Therefore, the purpose of this study was to investigate the difference in movement patterns of lower extremity joints due to incorrect posture and weight during squat operation between trained and un-trained individuals.

#### 2. Method

#### 2.1. Participants

A total of 20 subjects and trained group(N=10) (age: 28.71±2.41 yrs, height: 178.92± 4.25 cm, weight: 81.72±4.98 kg) and un-trained group(N=10) (age: 29.42±3.67 yrs, height: 176.62±3.8 cm, weight: 80.2±5.11 kg) participated in this study. The un-trained group was selected as healthy male adults without musculoskeletal injuries or diseases for 1 year from the date of the experiment. Subjects who had not performed regular resistance exercise for at least the past 1 year, and had not experience performing squat movements were selected. The trained group was selected as subjects who had regularly performed resistance strength training for at least 3 years. The experimental motive and procedures was communicated verbally and written informed consent below was also taken prior to the experiment.

#### 2.2. Measurements

The experiments in this study consisted of three-dimensional motion analysis equipment(Vicon MX-F20, Oxford Metric Ltd, Oxford, UK), a force plate(ORG-6, AMTI Watertown, MA, USA), and an wireless electromyography system(Delsys Trigno Wireless, USA). Were synchronized and used for measurement. The trained and un-trained groups performed squats on the force plate. Anthropometric information was measured prior to the experimental test and participants performed for 5 minutes to warm up. All participants wore the same running shoes provided (model 60001; Adidas) and spandex shorts to reduce variability due to different absorbent properties of the shoes or marker movements. Warm-up was performed by small jogging in place and stretching, and the speed of performing squat movement was performed by setting the metronome to a speed of 40 beats/min. Three criteria were set for squat movement failure. First, if the foot detaches from the ground reaction force during the squat, Second, if your foot falls off the ground reaction force during the squat, Finally, it was defined as a case of deviating from the metronome speed. Successful squat motions were collected 5 times in each condition(subject body weight(100%), 110%, 120%, and 150% barbell weight). To analyze the motion of the squat motion, a motion analysis system consisting of 8 infrared cameras was used, and the squat motion was recorded after setting it to 200Hz, and the picture was taken using the Plug-In Gait Full-body model. 34 spherical reflective markers of 14 mm were attached to the anatomical boundary points, and the ground reaction force data were collected at 2000 Hz <Figure 1>. In order to confirm the degree of forward movement of the knee during squat movement, motion analysis was performed by attaching markers to both Patella and Second metatarsal.

Figure 1. Plugin- gait marker set.



#### 2.3. Data processing

In this study, three-dimensional motion analysis was performed on the squat motion between trained group and un-trained group, and the movements of lower extremity joints(hip, knee, ankle) were compared between trained and un-trained individuals. The stability index(anterior-posterior stability index: APSI, medial-lateral stability index: MLSI) was calculated through the movement of the center of pressure generated by the ground reaction force. A low stability index means higher stability, and a higher value means lower stability.

Figure 2. Squat movement.



#### 2.4. Statistical analysis

All data were analyzed via SPSS for Windows statistical program(IBM Corp., Armonk, NY, USA). A two-factor ANOVA with repeated measurement factor(group) and within-subjects factor(weight loading differences) was used to compare the effects of different squat loading on lower extremity movement pattern and stability index during squat exercise. The significance level for all analyses was set a priori at  $p \le 0.05$ .

#### 3. Results

The angles of the hip, knee, and ankle joints were observed in the sagittal and frontal planes between trained and un-trained individuals during the squat movement. Motion analysis was set from the initial point of the movement to the time point at which the maximum knee flexion occurred point <Figure 2>.

#### 3.1. Result of sagittal plane angle between subjects

There are no significant interactions between group and weight difference on a joint angle during squat movement(p>0.05). However, the trained group showed a higher hip joint flexion angle than the un-trained group, but as the weight of the barbell increased, there was no difference between the trained group and the un-trained group. Similar to the hip joint kinematics, there are no significant interactions between group and weight difference on a knee joint angle during squat movement(p>0.05). Also, there was no difference between trained and un-trained individuals in knee joint movement pattern. In the case of the ankle joint, the trained group showed a smaller dorsi flexion than the un-trained individuals, which was the result of the trained group despite the increase in weight <Table 1>.

 Table 1.
 Results of lower extremity(hip, knee, ankle) sagittal plane angle at maximum knee flexion.

(unit: degree)

	_	0%	10%	20%	50%		p
Joints	Group	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)		
Hip	Trained	97.47(3.64)	98.01(3.07)	97.02(5.26)	95.85(5.17)	group	.156
(+: flexion)	Untrained	88.04(15.23)	89.43(14.79)	90.46(14.02)	88.81(14.62)	weight	.776
Knee	Trained	95.43(8.40)	96.59(9.95)	96.75(10.07)	96.98(10.76)	group	.646
(+: flexion)	Untrained 96.19(7.64) 97.77(10.10) 99.84(8.48) 9	99.12(6.81)	weight	.197			
Ankle	Trained	28.7(2.40)	27.92(2.99)	27.92(2.03)	28.38(3.30)	group	.013*
(+: Dorsi flexion)	Untrained	35.37(5.59)	34.6(6.79)	34.91(6.74)	33.93(6.27)	weight	.403

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

#### 3.2. Result of frontal plane angle between subjects

In the frontal plane, there are no significant interactions between group and weight difference on a joint angle during squat movement(p>0.05). Also, there was no difference between the trained group and the un-trained group in hip joint. However, in the case of the knee joint, there was difference between the trained group and the un-trained group and the trained group showed the pattern of knee varus and un-trained group showed the valgus angle(Knee valgus) displacement <Table 2>.

 Table 2. Results of lower extremity(hip, knee, ankle) frontal plane angle at maximum knee flexion.
 (unit: degree)

loints	Group	0%	10%	20%	50%		р
Joints	Group	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)		
Нір	Trained	-18.26(3.79)	-18.25(3.44)	-18.19(4.5)	-18.66(3.92)	group	.134
(-: adduction)	Untrained	-15.48(3.79)	-14.84(5.19)	-15.85(4.87)	-17.06(6.45)	weight	.203
Knee	Trained	4.77(4.43)	4.17(4.07)	4.25(4.99)	4.75(5.46)	group	.041*
(-: valgus)	Untrained	-2.95(8.49)	-2.69(8.79)	-3.67(8.67)	-3.72(8.8)	weight	.562

Ankle	Trained	2.81(2.41)	2.26(1.99)	2.13(2.13)	2.16(2.22)	group	.259
(+: eversion)	Untrained	4.00(1.87)	3.93(1.87)	4.07(2.06)	3.86(2.14)	weight	.282

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

#### 3.3. Result of knee location at maximum knee flexion between subjects

In the case of knee forward movement between trained and un-trained individuals during squat movement, the trained group showed less forward movement than the un-trained group, and there was a statistically significant difference <Table 3>.

 Table 3. Results of lower extremity(hip, knee, ankle) frontal plane angle at maximum knee flexion.
 (unit: degree)

lointo	Crown	0%	10%	20%	50%		р
JOINTS	Group	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)		
Hip	Trained	5.04(1.50)	5.10(1.55)	5.71(2.68)	6.41(3.35)	group	.020*
(-: adduction)	Untrained	10.99(3.55)	10.08(4.43)	10.24(4.59)	9.41(4.20)	weight	.837

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

#### 3.4. Result of center of pressure between subjects

In the case of medial-lateral stability index(MLSI), it was found that the un-trained group had a higher stability index than the trained group. It was found that the stability index of the trained group and the un-trained group increased as the weight increased. The right foot showed a significant difference according to the weight and the left foot showed a significant difference in both group and weight <Table 4>.

 Table 4. Results of medial-lateral stability index between subject.

(unit: cm)

Cide	Crown	0%	10%	20%	50%		Р
Side	Group	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)		
Pight	Trained	.055(.005)	.077(.016)	.056(.007)	.055(.005)	group	.067
Kight	Untrained	.061(.012)	.065(.013)	.070(.015)	.088(.024)	weight	.039*
Left	Trained	.055(.005)	.077(.016)	.055(.005)	.055(.005)	group	.044*
Leit	Untrained	.061(.012)	.066(.014)	.071(.015)	.092(.025)	weight	.016*

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

#### 4. Discussion

The purpose of this study was to determine the effects of different squat loading on lower extremity movement pattern and stability index during squat exercise between trained versus un-trained individuals.

First, it was confirmed that the forward movement of the knee during the squat movement was less in the case of the trained group(5 cm) compared to the un-trained group(11 cm). The results were similar to the results of the knee forward movement between the trained and untrained group mentioned in previous studies [19]. In the un-trained group, it was confirmed that the forward movement of the knee increased as the weight increased. This is thought to be a pattern that appears due to the inability to properly perform the movement using the movement of the hip joint in performing the squat movement according to the increase in weight, and it is considered to be a result showing that there is a difference in movement pattern depending on the skill level of the squat movement. The decrease in knee anterior movement in the unskilled group means a decrease in knee angle, which is a meaningful result in relation to the anterior cruciate ligament injury of the knee. Reduced knee flexion may be important given its effect on ACL loading. Less knee flexion results in a greater patellar tendon-tibial axis angle, resulting in greater anterior tibial shear force during quadriceps contraction[20][21]. Also, Reduction of knee joint flexion decreases the ability of the hamstrings to increase anterior tibial shear and reduce ACL load[21]. An increase in the forward movement of the knee is a posture that can give a large load to the knee joint, which in turn is closely related to the possibility of injury occurrence. It is thought that the squat proper form of the movement plays a very important role in performing the squat movement.

Second, In the case of the ankle, less dorsi flexion angle was observed in the trained group, but the hip flexion angle was larger in the expert group. This is thought to be due to the difference between the two groups in the change in the angle of the ankle because the knee forward movement was small through the expert using the hip joint more during the squat movement. This observation is in agreement with the results of individuals with limited ankle dorsi flexion during the weight-bearing movement demonstrated altered knee and ankle joint kinematics. Specifically, those with limited ankle dorsi flexion during the weight-bearing movement displayed less knee-flexion and ankle-DF displacement during the squatting tasks[22].

Third, In the knee joint, trained group showed a meaningful knee valgus displacement during the squat movement. In contrast, un-trained group showed a knee varus displacement during the squat movement. It was confirmed that there was a difference between the two groups in distinguishing between the trained group and un-trained group. Excessive knee valgus is a movement that has a risk in occurrence of knee injuries, so it is important to perform the movement through the correct posture when performing the squat movement. Increased knee valgus motion and load are also associated with a higher risk of ACL injury and are observed during ACL injury mechanisms[23][24][25]. These results suggest that changes in sagittal or frontal displacement(decreased knee flexion, increased knee valgus, and decreased dorsiflexion) are associated with injury in people performing weight-bearing movements such as squat movement[26].

#### **5.** Conclusion

The purpose of this study was to investigate the effects of different squat loading on lower extremity movement pattern and stability index during squat exercise between trained versus un-trained individuals. The subjects of the study were 10 persons in the trained group who regularly performed squat exercise for 3 years and 10 persons in the un-trained group who performed squat exercise irregularly for a life time. As a result of the experiment, it was confirmed that the untrained group showed greater knee forward movement and less hip flexion angle than the trained group. In the stability index, it was confirmed that the un-trained group showed

a higher stability index than the trained group. In future studies, it is considered necessary to study the improvement of the squat motion of un-trained individuals. It is an important to confirm the change in movement pattern after training.

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#### 7. Appendix

#### 7.1. Authors contribution

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

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#### A Study on the Brand Equity of Title Sponsorship, Customer's Attitude, Loyalty, and Intention of Use: With a Focus on the Chinese E-SPORTS Clubs

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#### Abstract

**Purpose:** By examining the causal relationship of the e-sports club title sponsorship's brand asset on the customer's attitude, loyalty, and intention of use, this study seeks to provide the basic data for the revitalization between corporate sponsors and the e-sports industry and their corporate marketing strategies.

**Method:** In this study, SPSS 26.0, frequency analysis, exploratory factor analysis, reliability analysis, correlation analysis, and multiple regression analysis were performed with a focus on a total of 481 copies of questionnaires.

**Results:** First, it turned out the generations M through Z enjoy e-sports according to demographic characteristics, and as the female population is growing, a strategy to enhance the brand image of the companies targeting those in their 20s and 30s is necessary. Second, as a result of examining the effect on brand asset and customer's attitude, it has had a significant effect in the sequence of brand awareness and brand image. Third, as a result of examining the effect on brand assets and customer loyalty, it turned out in the sequence of brand image and brand awareness. Fourth, as a result of examining the effects on brand asset and the consumer's intention of use, it turned out that brand image and brand awareness have had a significant effect in their sequence. Fifth, the company's customer's attitude turned out to have a significant effect on customer's intention of use.

**Conclusion:** Examining such results, the title sponsorship of e-sports club made by a company is a very effective cooperative activity since it can enhance all of the company's brand assets, customer's attitude, customer's loyalty, and consumer's intention of use. It is hoped that there will be more such cooperative activities in the future to help promote the development of both the companies and e-sports of China.

#### [Keywords] E-Sports Club, Title Sponsorship, Brand Asset, Customer's Loyalty, Intention of Use

#### **1. Introduction**

'e-sports' has evolved from the modern day electronic games, and is an individual or intergroup tactical game activity which uses electronic games as a medium, electronic equipment as an exercise equipment, and is conducted in a fair manner with the same game rules as the virtual environment created by the modern day information technology[1]. Last year, the COVID-19 situation took a toll on the development of the traditional sports industry. By comparison, however, the e-sports industry was not largely affected given its online characteristics, and the e-sports competition related market underwent perhaps the most active period with the highest broadcast ratings and sponsors of the tournament. On December 21, 2020, the BLG's e-sports club executed a title sponsorship with Ping An Bank, a well reputed Chinese bank, and changed the name of the club to 'BLG Ping An Bank E-sports Club.' As such, Ping An Bank, which seeks to expand its business into the global banking market, sponsored the BLG's e-sports club for the most influential LPL competition in the Chinese e-sports market, and sought to enhance the brand asset value of Ping An Bank and further expand its business into a global company. In particular, the synergies between the company and the LPL's e-sports club given the potential of the online e-sports market caused by COVID-19 would be created by the marketing activities which naturally increase the brand asset value by inducing the interest in the company's image, recognition, and the company's products.

The title sponsorship for competition refers to a form of sponsorship made through which the most or a large portion of the operating expenses are paid in the anticipation of the company's commercial returns and brand image's promotion by attaching a company or a brand name. Traditionally, title sponsorship is the largest source of income for sports clubs, and is also a method of sponsorship which grows together with the e-sports industry. Recently, in the case of the Chinese Men's Basketball Professional League(CBA), since 2010, each team's title sponsorship has gradually increased and reached 10 million yuan(approximately 1.7 billion won), and Shinjang Men's Basketball Team changed the title sponsorship from CASS to China Grand Auto for the 2018-2019 season, posting an annual title income of 30 million yuan(approximately 5 billion won)[2]. Meanwhile, in the League of Legends League(LCK), which is an e-sports competition, most sports clubs have their title sponsors, and the value of title sponsors for the e-sports is a blue ocean. Furthermore, given the fact that the title sponsor of the DWG Club is Kia, an automobile company, the title sponsor of the T1 Club is SK, a telecommunications company, and the title sponsor of the HLE club is Hanwha Life, an insurance company, translates into the high feasibility of title sponsorship regardless of being an esports game or an e-sports team, expansion of the club's revenue source, and the achievement of the sponsor's sponsorship strategy and goals [3]. As such, in the e-sports, sponsorship is a time when a marketing strategy is required from a business perspective to highlight the brand asset value of a company and further expand the company's diversified business and brand equity.

As such, brand equity, which represents the value of a company, is defined as the desired marketing effect generated since a product or service has a brand, which creates the effect of high brand loyalty, market share, or profit[4], and it is said that brand asset influences the brand attitudes and consumer behavioral intentions as high brand awareness, and that such strong and favorable brand associations are formed[1]. Such sub-factors of brand equity are classified into brand awareness, brand image, and perceived quality factors[5]. Brand awareness is an important component of the brand assets, and is also a criterion for evaluating the consumers' perception and understanding of brand connotations and values[5], while it refers to the characteristics of a brand, and embodies the evaluation and perception of the brand by the public, especially consumers[4]. That is, the existence of the corporate image favorably increases the loyalty for the product evaluation and brand awareness' formation, and the brand asset value of the business forms the superiority of the company in terms of its business management, thereby having such an intimate relationship with their attitude and intention of use[6][7].

A company's brand equity value can directly or indirectly reflect the consumers' deeper desires and closely related values, and the consumers might generate positive attitudes, emotions, and willingness to make purchases or cause acts of purchase in connection with the relevant memories of brand information in a specific situation. In addition, the customer's loyalty is a factor which influences the final purchase related decisions among all of the factors which determine the customers' intention for consumption[8][9]. It is was suggested that the consumers should consider their own desire for satisfaction and profit maximization when choosing products and services, as well as being influenced by the brand attitude. Hence, the brand attitude has a direct effect on the consumers' intention for purchase to some extent[7][10][11][12][13][14][15]. As such, a practical study which examines the relationship between a company's brand asset value, which is the main source of income for the e-sports title sponsorship, which is the link between the market's competitiveness and capital strength, as an emerging e-sports industry, on the customers who actually participates in the e-sports industry means the expansion of the e-sports industry. Hence, the purpose of this study is to examine the relationship between the brand selection's attributes of the e-sports viewers and the brand asset, customer's attitude, loyalty, and the intention of use of the sponsor, and a marketing strategy for the partnership of corporate brand asset value with the development of the e-sports industry, and provide the basic data towards that end. A company's acting as the title sponsorship of esports can significantly increase the company's brand asset, customer's attitude, loyalty, and intention of use. An e-sports sponsorship may be a good investment to expand the influence over young people <Figure 1>.





#### 2. Research Method

#### 2.1. Research subject

 Table 1. General characteristics of the research subjects.

	Classification	Percent	Valid percent(%)	Cumulative percent(%)	Cumulative percent(%)
Candar	М	263	52.8	52.8	52.8
Gender	F	235	47.2	47.2	100
	10-19	53	1.6	1.6	1.6
Conception	20-29	228	45.8	45.8	56.4
Generation	30-39	130	26.1	26.1	82.5
	More than 40	87	17.5	17.5	100
	Less than 3 years	152	3.5	3.5	3.5
Duration of	3-5 years	187	37.6	37.6	68.1
Participation	5-7 years	96	19.3	19.3	87.3
	More than 7 years	63	12.7	12.7	100
	Large cities	137	27.5	27.5	27.5
Diago of residence	Small & medium-sized cities	169	33.9	33.9	61.4
Place of residence	Township area	114	22.9	22.9	84.3
	Countryside	78	15.7	15.7	100

This study seeks to examine and articulate the structural relationship between the brand assets of e-sports club title sponsorship, customer's attitude, customer's loyalty, and the consumers' intention of use, focusing on the LPL participants. Focus on the individuals who viewed and participated in the LPL competition from.

August 25, 2021, through August 31, 2021, the Convenience Sampling was used and prepared questionnaires were prepared via Google programs, and a total of 516 copies of the questionnaires were collected, of which a total of 498 copies(96.5 %) of the questionnaires were used for the research results. The demographic characteristics of the specific research subjects are as illustrated in <Table 1>.

In terms of gender, there were 263 males(52.8%) and 235 females(47.2%), and in terms of age, 53 teens(1.6%), 228 people in their 20s(45.8%), and 130 people in their 30s(26.1%), and 87 people in their 40s or older(17.5%) were found, and it turned out that the young people in their 20s and 30s of the generations M through Z enjoyed e-sports. In terms of the e-sports viewing / participation hours, for 3-5 years, there were 187 people(37.6%), for 5-7 years, there were 96 people(19.3%), for 7 years or more, there were 63 people(12.7%), and for less than 3 years, there were 152 people(3.5%), with most of the age groups for 3-5 years demonstrating the highest rate of distribution. In terms of region, it turned out that 169 people(33.9%) were from small to medium sized cities, 137 people(27.5%) from large cities, 114 people(22.9%) from country areas, and 78 people(15.7%) from rural areas, making it apparent that the small to medium sized cities are most active in the e-sports. Based on such results, the women's interest in e-sports sports and games is increasing, and it is the time that sports marketing is needed, targeting the relatively young generations(M through Z).

#### 2.2. Research tools

As for the brand awareness of the Chinese e-sports club title sponsorship, the questions of the study by Keller(1993), Aaker(1996), and Dongwoo Ko(2002) were used, and as for the brand image, the questions of Aaker(1996), Martinez and de Chernatony(2008) and Byeongcheon Kim(2018) were used in construction in line with the characteristics of e-sports. As for the customer's attitude, those of the study by MacKenzie and Lutz(1989), and Agun Koo(2021) were used, and as for the customer's loyalty, those of the study by Jacoby and Olson(1970), and Stum and Thiry(1991) were used, and as for the consumer's intention of use, those used for the study of Dodds and Grew-al(1991), and Gookjin Kim(2020) were used, which all underwent the validation and contents of the sports management professors and e-sports expert group. Furthermore, in accordance with the purpose of this study, a draft of the questionnaires was prepared and the validity and reliability of the questionnaire contents related to sponsors were secured through the preliminary survey, following which, this study was conducted. The questionnaires were used as a measurement tool to determine the causal relationship, and all questions were constructed and conducted based on the previous studies and theories to be consistent with the purpose of the study. Finally, it is consisted of 23 questions for the brand image, 5 questions for the brand awareness, 5 questions for the customer's attitude, 5 questions for the customer's loyalty, 3 questions for the consumer's intention of use, while all questions except for the 4 questions for the demographic characteristics were consisted of a 5-point Likert scale.

As for the brand awareness factor, an eigen value of 4.270 and an explanatory power of 18.564% were yielded. The brand image factor demonstrated an eigen value of 4.277 and an explanatory power of 18.594%. The customer's attitude factor demonstrated an eigen value of 4.254 and an explanatory power of 18.498%, while the brand loyalty factor demonstrated an eigen value of 4.067 and an explanatory power 42.301%. The intention of use factor demonstrated an eigen value of 1.708 and an explanatory power of 7.425%. The total cumulative explanatory power turned out to be as high as 80.765%, indicating that the questionnaire's questions were adequately measured. Furthermore, the Cronbach's  $\alpha$  value turned out to be relatively high at .890-.947, indicating that the internal consistency was secured.

#### 3. Data Processing Method

As for the data processing method of this study, the frequency analysis, factor analysis, reliability analysis, correlation relative analysis, and the multiple regression analysis were performed by using the SPSS 26.0 Version, and the significance level was set to P<.05.

Questions	B/A	B/I	C/A	C/L	U/I	h²
I have heard of the brand Ping An Bank.	.855	.189	.159	.110	.118	.817
The LOGO and symbols of Ping An Bank can be clearly distinguished from other brands of the same type.	.881	.187	.126	.123	.151	.850
You can often see Ping An Bank's advertisements.	.817	.228	.152	.157	.194	.805
The advertisement of Ping An Bank is impressive.	.852	.237	.150	.163	.142	.852
Ping An Bank is a well-known brand.	.846	.183	.192	.150	.153	.813
Ping An Bank's services are professional.	.189	.820	.151	.180	.110	.775
The business of Ping An Bank has great growth potential in the future.	.201	.828	.108	.179	.147	.792
Ping An Bank pays attention to customer needs.	.179	.797	.146	.174	.113	.732
Ping An Bank is good at advertising and publicity.	.198	.832	.106	.173	.121	.787
Ping An Bank can provide quality services.	.233	.814	.119	.202	.105	.782
I like the service of Ping An Bank.	.120	.106	.870	.139	.116	.816
The service of Ping An Bank is positive.	.182	.161	.855	.160	.118	.795
The service of Ping An Bank is in line with my preference.	.163	.140	.852	.150	.126	.816
Generally speaking, I have a good impression of Ping An Bank.	.144	.134	.846	.160	.108	.834
Ping An Bank has a use-value.	.140	.130	.817	.164	.114	.818
I will continue to pay attention to Ping An Bank.	.159	.121	.119	.858	.101	.800
Compared with other banks, I believe Ping An Bank's services are better.	.160	.181	.178	.840	.124	.805
I will give priority to using Ping An Bank.	.172	.208	.148	.831	.166	.812
even if the price is more expensive than other companies, I will give priority to using Ping An Bank.	.125	.177	.157	.832	.190	.800
I am satisfied with Ping An Bank's services and products.	.119	.229	.145	.824	.153	.790
I am willing to use the services of Ping An Bank.	.229	.224	.210	.320	.764	.833
I would like to recommend Ping An Bank to the people around me.	.298	.295	.289	.355	.772	.837

 Table 2. The result of EFA on brand equity, customer attitude, loyalty, use intention.

If I am currently using Ping An Bank's products , I have the willingness to continue using them.			.346	.310	.399	.792	.815
Cronbach's -α			.926	.943	.936	.890	
eigen va	4.270	4.277	4.254	4.067	1.708		
Dispersion value(%)			18.594	18.498	17.684	7.425	
Accumulati	ive(%)	18.564	37.158	55.656	73.340	80.765	
	KMO(Kaiser-Meyer-Olkin) = .949						
Bartlett's test of sphericity = 10314.113 DF = 253 Sig = .000							

#### 4. Research Results and Discussion

#### 4.1. Correlation analysis

As a result of the analysis performed, it turned out that there was no variable demonstrating a high correlation of .8 or greater in the range of the correlation coefficient value of .367 to .654, thereby securing independence for the overall correlation. Hence, it was confirmed that there is a discriminant validity between the concepts.

Factor	B/A	B/I	C/A	C/L	U/I
B/A	1				
B/I	.499**	1			
C/A	.367**	.346**	1		
C/L	.404**	.468**	.380**	1	
U/I	.571**	.592**	.526**	.654**	1

Table 3. Correlation between factors.

Note: \*\*p<.01.

## 4.2. The effect of the Chinese e-sports club title sponsorship's brand asset on the customer's attitude

<Table 4> illustrates the results of the regression analysis performed to examine the effect of the sponsor's brand asset on the customer's attitude for those who participated in LPL. Among the brand assets, brand awareness( $\beta$ =.258, t=5.471) and brand image( $\beta$ =.217, t=4.601) demonstrated a statistically significant effect on the customer's attitude in their or-der(p<.001).

Factor	В	SE	β	t	sig	Tolerance	VIF
(Constant)	1.937	.197		9.833	.000***		
B/A	.250	.046	.258	5.471	.000***	.751	1.331
B/I	.244	.053	.217	4.601	.000***	.751	1.331
Deper	ndent variable	: customer attit	ude		R <sup>2</sup> =.167, F	=50.708***	•

 Table 4. The effect of brand equity on customer attitude.

Note: \*\*\*p<.001.

Such results, as in the study of Doohee Lee & Seoyoung Kim(1995), brought about the result that the brand awareness has a positive effect on the attitude towards the brand [16], while

Youngseok Son(2002) ckained that the attitude towards the brand asset, as with the pure cognitive reaction, holds an important diagnostic meaning, and that such brand assets have an effect on the brand attitude[17].

It is understandable as to how brand awareness in a company demonstrates to what extent consumers know about the company. In marketing, depending on the perspective of consumer psychology, brand awareness is the consumer experience of how to make the consumers feel differentiated from the other brands and emotions towards the brand. That is, the title sponsor of the e-sports club has a great influence on the level of interest and the amount of interest in the brand, and brings changes to the customer's cognitive viewpoint and attitude, and hence, it is a very important concept for the company or the brand operation.

Petty & Cacioppo(1996) claimed that the brand image has the potential to operate and act as a cue of persuasion when the attitude related formation or change occurs through the peripheral path, and proposed a relationship between the brand image and attitude [18], while Jaryong Koo & Jeonghoon Lee (2008) also claimed that, in a study on the brand assets of cities, the brand image has a positive(+) effect on the brand attitude [19]. As such, e-sports is a young sport, and the majority of the audiences are young people, whether directly participating or watching the games. The sponsor's sponsorship activities in the field of e-sports can develop a younger brand image, and rely on the strong brand exposure of e-sports to instill the brand image in the people's minds and change the consumers' attitudes towards the brand. Young people of all generations are the engine behind the future consumption, and the sponsored advertising investments targeting such group of people will bring about unexpectedly tremendous returns. The collaboration by and between LPL and Mercedes-Benz is a good example. Mercedes-Benz has invested 500 million yuan(approximately 90 billion won) in the title sponsorship of the LPL from 2017 to date. Mercedes-Benz's small sized SUVs grew over 40% year on year for the 4<sup>th</sup> consecutive year. Furthermore, Mercedes-Benz, which is the brand's youngul image, is deeply rooted in the people's minds, and the attitude of young people towards Mercedes-Benz has also changed significantly. It became the first car brand for the lives of young people from the previous luxury car brand. This is an example which illustrates how the sponsorship of e-sports is exerting a great force in changing the brand image and the customer's attitude.

## 4.3. The effect of the Chinese e-sports club title sponsorship's brand assets on the customer's loyalty

<Table 5> illustrates the results of the regression analysis performed to examine the relationship between the sponsor's brand assets and the customer's loyalty among those who participated in LPL. As a result of the analysis performed, among the brand assets, the brand image( $\beta$ =.354, t=7.923) and the brand awareness( $\beta$ =.228, t=5.101) have had a statistically significant effect on the customer's loyalty(p<.001) in their order.

Factor	В	SE	β	t	sig	Tolerance	VIF
(Constant)	1.618	.176		9.198	.000***		
B/A	.208	.041	.228	5.101	.000***	.751	1.331
B/I	.375	.047	.354	7.923	.000***	.751	1.331
Dependent variable: Customer loyalty				R <sup>2</sup> =.255, F	=85.922***		

Table 5. The effect of brand equity on customer loyalty.

#### Note: \*\*\*p<.001.

In an empirical study, Zeithaml, Berry & Parasuraman(1996) provided a conceptual framework for the effect of brand awareness on the specific behaviors, and such behaviors demonstrated as to whether the customer maintains a relationship with the company or betrays the company, and it also turned out that the brand awareness and the customer's loyalty have a positive correlation[20]. Lau & Lee(1998) believe that a high consumer awareness of a company can help maintain the customer's loyalty. Brand awareness can be used as a mark of a product or service to create a difference from the same product or service[21]. Given the network's natural attributes of e-sports events, such a tremendous exposure can make the sponsor's brand more visible to more people, which also represents the rudimentary formation of the brand loyalty. If the consumers have never heard of a brand before, only very few people will choose to pay to experience the brand's services or products. A good brand awareness provides the foundation for increasing the brand loyalty.

Gul et al.(2012) demonstrated that, as a result of conducting an empirical analysis for the Taiwanese industry related tourists in a study on brand asset through industrial tourism, the brand image has an effect on the brand association, and the brand association can have a significant positive relationship with the brand loyalty[22]. Abou-Shouk & Soliman(2021) studied the factors of influence of the intention for the gamification adoption for the brand image and brand loyalty in terms of tourism, and consequently, claimed that the brand image had a significant positive effect on the brand loyalty[23]. The brand image can truly form the customer's loyalty only when it satisfies the needs of the consumer's generality or characteristics, such as the consumer's psychological or social needs, including the external asset linkage and packaging of the product or service.

## 4.4. The effect of the Chinese e-sports club title sponsorship's brand asset on the intention of use

Factor	В	SE	β	t	sig	Tolerance	VIF
(Constant)	1.619	.140		8.337	.000***		
B/A	.310	.032	.367	9.550	.000***	.751	1.331
B/I	.403	.038	.409	10.666	.000***	.751	1.331
Dep	oendent varia	ble: use intentio	n		R <sup>2</sup> =.450, F	=204.018***	

Table 6. The effect of brand equity on use intention.

Note: \*\*\*p<.001.

<Table 6> illustrates the results of the regression analysis performed to examine the relationship between the sponsor's brand assets and the intention of use for those who participated in LPL. As a result of the analysis performed, among the brand assets, the brand image( $\beta$ =.409, t=10.666) and the brand awareness( $\beta$ =.367, t=9.550) have had a statistically significant effect on the intention of use(p<.001). Brand awareness can directly or indirectly reflect the consumers' deeper desires and closely related values, and the consumers generate positive attitudes, emotions, and intention of making purchase in connection with the relevant memories of the brand information in certain situations, and also cause to make purchases[8]. Increasing the brand awareness enhances the consumer's experience. Furthermore, the consumer's awareness can be enhanced by showing the best brand image to the consumers through the brand promotion and communication activities. Increasing brand awareness enhances the consumer experience. In addition, brand awareness can reduce any risk perceived by the consumers and also increase the value of a product or service in the mind of the consumer. The enhancement of brand awareness creates more active and favorable associations with the brand image of consumers, thereby causing the consumers' intention of making purchases. When purchasing a product, one will include such a product within the scope of consideration. In an environment of brand competition, a good brand awareness strengthens the consumers' willingness to use and reuse products. Wu, Yeh & Hsiao(2011) claimed that the consumers are influenced by a brand's own image when choosing a brand [24]. Sengupta and Fitzismon(2000) claimed that the consumers ought to consider their desire for satisfaction and profit maximization when choosing products and services, and may also be influenced by the brand image[13]. Brand image is the consumer's overall perception and perspective on the brand as a result of the consumer's perception of various elements of the brand and the related marketing activities. When the information acquired by the brand and the consumers is asymmetric, the brand image becomes an important clue for the consumers to determine and evaluate the brand equity and quality, etc., and has a very important influence on the intention of making purchases. The sponsor's investments in the e-sports club is intended to build a specific and active brand image, and for building the brand image, the use and the intention of making purchases for a specific class becomes stronger.

## 4.5. The effect of the Chinese e-sports club title sponsorship on the customer's attitude and the intention of use

Factor	В	SE	β	t	sig	Tolerance	VIF
(Constant)	2.130	.133		15.956	.000***		
C/A	.461	.033	.526	13.777	.000***	1.000	1.000
Dependent variable: Use Intention			R <sup>2</sup> =.275, F=189.796***				

Table 7. The effect of customer attitude on use intention.

Note: \*\*\*p<.001.

The customer's attitude( $\beta$ =.526, t=13.777) has had a statistically significant effect on the intention of use(p<.001). According to the study of Abzari, Ghassemi & Vosta(2014), it was claimed that, such results indicate that, the intention of making purchases for a brand is a result of the evaluation of a specific brand, and after evaluating the brand, the consumers desire to purchase the brand as a means to achieve the highest level of satisfaction [25]. Furthermore, a study by Jeongjoon Kim & Kyeonghwan Yim(2016) validated the relationship of effect between the influence of the brand assets of the Gimje Jipyeongseon Festival on the brand loyalty, and also confirmed the mediating effect of brand attitude in this connection [26]. It was determined that an intensive study on the brand attitude was necessary to build the customers with a high brand loyalty, and it was also revealed that significant results were yielded through the mediating effects in the relationship of effect between the brand asset and the brand loyalty. Customer attitude is a kind of a relatively stable internal psychological state which the consumers have for a certain product or service. In general, the more active the attitude of the consumer is, the higher the likelihood of using the product or service. The poorer the consumers' attitude towards a product or service, the more likely they are to stop using the product or service. The customer's attitude refers to the persistence of a particular product, and this tendency represents a person's personal standards for taste and hobbies, etc.

## 4.6. The effect of the Chinese e-sports club title sponsorship on the customer's loyalty and the intention of use

Factor	В	SE	β	t	sig	Tolerance	VIF
(Constant)	1.550	.126		12.267	.000***		
C/I	.607	.032	.654	19.252	.000***	1.000	1.000
Dependent variable: Use Intention				R <sup>2</sup> =.427, F	=370.638***		

 Table 8.
 The effect of customer loyalty on use intention.

Note: \*\*\*\*p<.001.

Customer's loyalty( $\beta$ =.654, t=19.252) has had a statistically significant effect on the con-

sumer's intention of use(p<.001). Such results demonstrated that a positive loyalty towards a brand which an individual has a sense of identity influencing on the intention of making recommendations, in a study by Giwan Bae and Yoonshil Huh(2016)[27]. Laksama-na(2018) claimed that the brand association, brand image, and the brand loyalty have a positive effect on the brand attitude and purchase intention[28][29][30]. Customer's loyalty refers to a phenomenon where some consumers repeatedly choose one or a few brands within a certain period of time or even for a long period of time in terms of conducting a realistic purchasing activity, while other brands are rarely mentioned. Such overlapping purchase making tendency expresses the customers' emotions for the brand, and provides for an important competitive advantage of the company and also an important source of brand equity. All highly loyal customers are positive consumers. They repeatedly purchase products or services from companies, but do not consciously seek discounts on their prices. Furthermore, they lead and influence the people around them to cause and carry out the same purchase behaviors, thereby ensuring that the sales volume of the company constantly grows, and that the company has a stable source.

#### 5. Conclusion and Recommendation

#### 5.1. Conclusion

This study has examined the causal relationship between the e-sports club title sponsorship's brand assets, customer's attitude, customer's loyalty, and the consumer's intention of use, with a focus placed on the participants of LPL, and derived the following results with a view to develop a sponsorship activation strategy and a strategic plan to expand its business towards and across the e-sports industry.

First, according to the demographic characteristics, it turned out the generations M through Z enjoy e-sports, and as the female population is growing, a strategy to enhance the brand image of the companies targeting those in their 20s and 30s is needed. Second, as a result of examining the effect on the brand asset and the customer's attitude, it has had a significant effect on the brand awareness and brand image. Third, as result of examining the effect on the brand assets and customer loyalty, brand image and brand awareness were found in their order. Fourth, as a result of examining the effect on the brand asset and consumer's intention of use, it turned out that the effect was significant on the brand image and brand awareness. Fifth, the company's customer's attitude turned out to have a significant effect on the customer's intention of use. Sixth, the company's customer's loyalty turned out to have a significant effect on the customer's intention of use. Examining such results, in order to improve the brand image and the recognition of a company, it is necessary to devise an aggressive corporate marketing strategy through the title sponsorship activities for the e-sports club, and in particular, if the corporate image and sponsorship activities are actively promoted with a focus on the young generations of M through Z, the corporate sponsorship in the e-sports industry could coexist with each other in terms of business management, and the mutual cooperation would lead to an active promotion of the e-sports development in China together with corporate expansion towards into the global market.

#### 5.2. Recommendation

This study is a meaningful study which focuses on the e-sports and which has approached the title sponsorship from the business management aspect of the actual company's brand asset. Since the study subjects were limited to the mania who participated or watched the competition, it would be difficult to generalize the subjects who enjoy e-sports in its entirety. However, if the scalability and demand of the global companies online are considered, it would be a more meaningful study if a study is conducted on the relationship between the overseas e-sports sponsoring companies and the domestic e-sports sponsoring companies.

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#### 7. Appendix

#### 7.1. Authors contribution

	Initial name	Contribution
		-Set of concepts 🔽
		-Design 🗹
Lead Author	ID	-Getting results 🔽
	л	-Analysis 🔽
		-Make a significant contribution to collection $ ar {igsid} $
		-Final approval of the paper $\ ar{ u}$
		-Corresponding 🗹
		-Play a decisive role in modification $\ \!$
Corresponding	CI	-Significant contributions to concepts, designs,
Author*	3L	practices, analysis and interpretation of data $\ igside S$
		-Participants in Drafting and Revising Papers 🛛
		-Someone who can explain all aspects of the paper $\ igsqcup$

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#### The Effects of Saturated and Unsaturated Fat Intake on the Skeletal Muscle's LPL mRNA Expression in Rats

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#### Abstract

**Purpose:** The purpose of this study is to provide the basic data for the fatty acid metabolism research by analyzing the expressions of body weight, blood components(TG, FFA, Glucose) and rat skeletal muscle's LPL mRNA after 5 weeks of the saturated and unsaturated fatty acids intake.

**Method:** For this experiment, 30 rats were divided into the control group(CON), saturated fat intake group(BT) and the unsaturated fat intake group(SF) with 10 rats allocated each, and 2 rats each received a different diet inside the breeding cage. Their body weight was measured before meals and at the interval of 1 week, and after ingestion of each group's diet for 5 weeks, anesthetic was injected and slaughtered, and blood sampling was performed to analyze the blood components. Soleus muscles were extracted and were stored frozen, then analyzed using the Real Time PCR in order to analyze the expressions of the skeletal muscles LPL mRNA. For the statistical processing of the study, the mean and standard deviation of all items were calculated using the SPSS 18.00 Package, and the one-way repeated ANOVA was performed to examine and understand the changes in the blood components and LPL mRNA according to each group. The statistical significance level was set to p<.05.

**Results:** After 5 weeks of the dietary intake, all groups demonstrated increases in their weight as the dietary intake period have elapsed. The differences in the TG concentration according to the dietary intake in blood components turned out to be significantly lower for the BT group(p<0.05) and the SF group(p<0.001) than for the CON group, and also for SF group compared to the BT group in terms of the TG concentration being significantly higher. There turned out to be no significant difference for the FFA concentration, and the difference in the glucose concentration turned out to be significantly higher for the SF group than for the BT group. As for the LPL mRNA expressions, there turned out to be no significant difference between the groups in terms of the difference in GAPDH mRNA expression according to the dietary intake, and the difference in the LPL mRNA expressions for the SF group(p<0.01), the LPL mRNA expression turned out to be significantly higher.

**Conclusion:** As a result of gathering the study results, the unsaturated fat intake rather than the saturated fat intake brought about the effective improvement of the triglyceride concentration and the increases in the LPL mRNA expression when structuring the dietary intake for the prevention of adult diseases related to obesity and arteriosclerosis, it is thought that the lipolysis is facilitated.

[Keywords] Saturated Fat, Unsaturated Fat, High Fat Diet, Skeletal Muscle, Lipoprotein Lipase

#### **1. Introduction**

In the modern society, following the development of science and technology, the quality of life has improved and the economic level has increased, while the diet has also been influenced and transformed into a convenient meal. In the case of Korea, the standard of eating and living ranging from children to adults has westernized due to the economic development and urbanization from the traditional slow food, making the convenient fast food rather more preferred [1].

The western diet increases the intake of the saturated fat and decreases the intake of the unsaturated fat, and such type of diet further causes irregular nutrition in the modern people, and among them, the excessive fat intake causes obesity and increases the prevalence of the obesity related metabolic syndrome and geriatric diseases[2][3].

Examining the previous studies, in order to prevent the adult diseases caused by obesity, the intake of saturated fatty acid was restricted while the intake of unsaturated fatty acid was suggested for the intake of fat, and as a result of such studies, it was reported that the group which consumed high fat and n-3 polyunsaturated fatty acid together reduced the insulin resistance and facilitated glucose transport than the group which consumed high fat only [4]. Therefore, it is recommended to restrict the intake of cholesterol and reduce the intake of the saturated fatt and the trans fat[5].

The human body causes various complications due to the abnormal physiological changes, and when the exercise therapy, diet, and the daily habits are carried out in combination to improve them, obesity treatment can bring about a large effect [6][7]. As for Korea, the prevalence of obesity among the population aged 30 years and older increased from 31.8% in 2001 to 42.3% in 2016 for men, and decreased from 27.4% in 2001 to 26.4% in 2016 for women, and hence, for over 15 years, the prevalence of obesity in men has increased by over 10%. Furthermore, hypercholesterolemia increased by 12% in 2016 compared to 2005 for both men and women, and the prevalence of metabolic syndrome among the adults has consistently increased since 1998, and over 30% of adults aged 30 or older have demonstrated the symptoms of metabolic syndrome [8][9]. Therefore, in order to reduce the incidence of obesity, hypercholesterolemia, and metabolic syndrome, it is recommended to restrict the intake of the saturated fat and trans fat[10].

The studies related to the etiology of brain function and neuropathological conditions according to the dietary intake are actively in progress, and there is a need to further examine the mechanisms and changes of the lipid related genes related to the dietary intake in order to improve obesity[11].

The Lipoprotein Lipase(LPL), which is closely related to obesity and adult diseases, is an enzyme which is produced by many tissues and hydrolyzes lipoprotein, which is a combination of triglycerides and proteins, and is also an important factor for preventing arteriosclerosis in connection with high triglycerides[12]. Lipoproteins are classified into chylomicron VLDL, IDL, LDL, and HDL according to the structure and density of triglycerides, apoproteins(Apo E, B, C) and cholesterol. First, the chylomicron hydrolyzed by LPL is stored in the adipose tissue, peripheral tissue, and the muscle tissue with fatty acids and glycerol, and the remnants of chylomicron are reabsorbed into the liver[13]. Furthermore, the VLDL is hydrolyzed by LPL again by the synthesis of triglycerides and cholesterol in the liver, and after its conversion into IDL, it moves to the liver and is then converted back into the LDL by the hepatic triacylglycerol to transport the cholesterol[14]. The HDL delivers Apo E and Apo C-II depending on the density of the lipoprotein for the other lipoproteins to be hydrolyzed to the LPL. The HDL receives Apo A from the remnants again, and such cycle is repeated[15].

Fatty acids are largely classified into the saturated fatty acid(SFA) and the unsaturated fatty acid(USFA), and are also named differently depending on the types of animal fat and vegetable fat[16][17]. Examining the papers of the previous studies related to the diet in the forms of the saturated and unsaturated fatty acids, and according to the results of the studies which examined the fat intake by generation, the unsaturated fatty acids were reported to be consumed higher among and by the parents and the saturated fatty acids consumed higher by the students, and such studies reported that the dietary changes were caused by the westernized meals and snacks[18][19]. Furthermore, as a result of investigating the intake of the saturated and unsaturated fatty acids by region, it was reported that the fishery villagers had a higher intake of omega-3 unsaturated fatty acids(EPA, DHA) and lower levels of plasma cholesterol, VLDL, LDL, and TG[20][21]. Hence, the studies on the saturated and unsaturated intake and the LPL are inadequate, and in particular, the studies which examine the changes in the LPL mRNA among

the skeletal muscles of experimental animals in connection with the fatty acid components are inadequate at best.

The purpose of this study is to provide the basic data for the fatty acid metabolism research by analyzing the expressions of the body weight, blood components(TG, FFA, Glucose) and the skeletal muscles' LPL mRNA after the ingestion of the saturated and unsaturated fatty acids.

#### 2. Research Method

#### 2.1. Test subject and the breeding method

#### 2.1.1. Test subject

In this experiment, 30 male Sprague Dawley rats aged 5 weeks were purchased(Orient Bio INC), and the stress was reduced via the environmental adaptation for 1 week and preliminarily bred. Thirty rats were classified into 3 groups, and 10 rats were randomly assigned to the control group(Control, CON), 10 rats to the saturated fat intake group(Beef tallow, BT), and 10 rats to the unsaturated fat intake group(Safflower oil, SF). Among the rats of the control group, two rats with the highest body weight and the lowest body weight were excluded from the standards, and the experiment was terminated with a total of 28 rats.

#### 2.1.2. Breeding method

Two rats of the same group were bred by laying a sterile tree bark(chips) in the plastic cages for the rats. For one week of the preliminary breeding for one week of environmental adaptation, the free diet method was applied, which provided the sufficient commercial rat feed(5L79, Orient, Korea) and water. After one week of the preliminary breeding, the control group was fed the AIN-76 Basic Diet feed, and the saturated fat group was fed the AIN-76 Basic Diet, which contained 40% beef tallow by weight. A prepared high-fat feed(Dyets, USA) was supplied, and furthermore, the unsaturated fat intake group was supplied with a high-fat feed(Dyets, USA) prepared to contain 40% of safflower oil(safflower seed) by weight based on the AIN-76 Basic Diet. All groups were applied with the free diet method, which provided the sufficient sterilized water and feed every day during the breeding period for 5 weeks. The dietary intake and body weight were measured using an electronic scale(IB-6100 balance, Innotem, Japan) at a fixed time from 08:30 to 09:30 in the morning. The writing period was set to 08:00-20:00 and the memorization period was set to 20:00-08:00 with 12 hours each, and the indoor temperature was maintained at  $23\pm2^{\circ}$ C and the relative humidity at 50%, respectively. The cage was replaced with the chips (sawdust) once a week for cleanliness. The dietary structure for the rats is as illustrated in <Table 1>.

Increations		Amount(g/kg)	
Ingredient	CON	BT	SF
Casein	200	200	200
DL-methionine	3	3	3
Cornstarch	150	150	50
Sucrose	500	150	50
Cellulose	50	50	50
Mineral mix	35	35	35
Vitamin mix	10	10	10
Choline bitartrate	2	2	2
Maltose dextrin	-	-	200
Corn oil	50	-	-
Beef tallow	-	400	-

Table 1. Composition and energy content of the experimental diets.

Suffer oil	-		400
grams/kg	1000.0	1000.0	1000.0
Kcal/g	3.79	5.54	5.52

#### 2.2. Experimental design

For this experiment, 30 rats were divided into the control group(CON), a saturated fat intake group(BT), and the unsaturated fat intake group(SF) with 10 rats each, and 2 rats each received a different diet inside the breeding cage. Their body weight was measured before meals and at the interval of 1 week. After the ingestion of each group's diet for 5 weeks, anesthetic was injected and slaughtered, blood sampling was performed to analyze blood components, and the skeletal muscle's LPL mRNA expressions were analyzed, while the soleus muscle of the skeletal muscle was extracted, stored frozen, and analyzed using the Real Time PCR.

#### 2.3. Skeletal muscle extraction and the total RNA extraction

#### 2.3.1. Muscle sampling

On the last day of the 5 weeks of experimental breeding, and after maintaining a fasting state for 3 hours, intraperitoneal Zoletyl(40mg/kg) and Lumpen(5mg/kg) were injected to complete the anesthesia. Then after laparotomy, 10 ml of blood was collected via the abdominal vena cava using a tube containing EDTA and anticoagulant. As for the extraction of the skeletal muscle, the soleus muscle of the rats was collected and their weight was measured using a scale(TYPE-CBL 220H balance, CAS, Korea).

#### 2.3.2. Total RNA extraction(TRI)

To extract the total RNA, 1 ml of TRI reagent(Sigma-Aldrch, Inc., U.S.A) was added to 50-100 mg of the skeletal muscle tissue, and then crushed on top of the ice for 2 minutes using the Homohenizer(PRO Scientific Inc, U.S.A). After transferring to a new 1.5ml tube(e-tube), it was left at a room temperature(RT) for 5 minutes, then centrifuge(centrifuge 5415 R, eppendorf, Germany) was used to centrifugate it at 13,000rpm for 10 minutes at 4 °C, then the supernatant (Supernant) was again transferred to a 1.5ml tube and left at a room temperature for 5-10 minutes. Thereafter, 200 µl of Chloroform was added, voltexed and maintained at a room temperature for 15 minutes, and then centrifugated at 13,000 rpm at 4°C. for 15 minutes using a centrifuge, and the supernatant(RNA layer) was transferred to a new 1.5 ml tube. After adding 500 µl of isopropanal to the separated supernatant, invert mix, and maintained for 5-10 minutes at room temperature, it was centrifugated at 13.000 rpm 4°C. for 10 minutes at 13.000 rpm at 4°C for 8 minutes for washing. After removing the supernatant and air drying it for 5 minutes, 50 µl of the DEPC(diethylpyrocarbonate) treated tertiary distilled water was added and dissolved in a 55-60 °C water bath for 15 minutes, and finally, 50 µl of the total RNA was measured and used for the Real Time PCR analysis.

#### 2.3.3. Spectrophotometer and electrophoresis

The total RNA concentration extracted was obtained by measuring absorbance at 260 and 280 nm, respectively, with 96  $\mu$ l of DEPC and 4  $\mu$ l of total RNA using a UV spectrophotometer(UV-mini1240, Shimazu Co., Japan). The OD value was calculated to examine the pure content of the measured RNA, and 2  $\mu$ l of total RNA was electrophoresed on 1% agarose gel for 30 minutes, followed by the fluorescence staining with EtBr(Etidium bromide) for 20 minutes, rRNA 18S and rRNA 28S were confirmed for the rRNA band, then it was used for the experiment.

Figure 1. Electrophoresis of RNA agarose gel.



#### 2.4. Blood analysis

The blood collected was centrifugated at 3000 rpm at 4°C for 10 minutes to separate the plasma, and was immediately stored frozen at -80°C and used for the analysis. The plasma triacylglyceride(TG) concentration was measured with a spectrophotometer(Spectrophotometer, ADVIA, USA) after extraction using the TG reagents(SIMENS, USA) kit. The plasma glucose concentration was measured by using the Glucose Hexokinase(SIEMENS, USA) kit, and the plasma free fatty acids(FFA) concentration was determined with the NEFA HR. || .(Wako, Japan) kit. After completing the extraction using the kit, measurements were taken by using a spectrophotometer(HITACHI, Japan).

#### 2.5. Analysis of the mRNA expression using the real time PCR

In the past, Northern Blotting was often used to analyze the mRNA expressions of the total RNA, yet recently, a convenient and accurate Real-time PCR method was used to quantify and analyze the amount of the total RNA on a real time basis. Primer was prepared by using primer3 version 0.4(Web software provided by Steve Rozen and Whitehead Institute for Biomedical Research), and Sense and Anti-Sense Primer was prepared in the URF(upstream open reading frame) area of the gene sequence <Table 2>.

In order to investigate the mRNA expressions according to the dietary intake of the quantified RNA saturated and unsaturated fatty acids, the iQ5 Multicolor Real-Time PCR Detection System(Bio-Rad Laboratiries, Inc, USA) was used. The concentration of RNA was used for  $30ng/2\mu$ l, and the reagent was One Step SYBR RT-PCR kit(TaKaRa, JAPAN). The composition of the reagent is presented in <Table 3>, and as for the protocol of the Real-time PCR <Table 4>, the reaction enzyme reagent and total RNA were synthesized at 42°C for 15 minutes in the phase 1, and the Taq polymerase activity was increased by raising the temperature to 95°C, while the reverse transcription was induced by holding for 2 minutes. In the phase 2, the PCR reaction was continued while repeating a cycle of 40 times at 95°C for 10 seconds and at 60°C for 45 seconds to repeat the denaturation and unwinding and expansion of the DNA strands. In the last phase 3, after maintaining at 60°C for 1 minute, the temperature was increased by 0.5°C every 15 seconds at 65°C, increasing to 95°C in 46 repetitions and amplifying to the maximum. When the phase 3 was completed after the phase 2, a melting curve was generated at a rate of 0.5°C/15s/cycle and the continuous polarization was measured. In order to compare and examine the mRNA expressions of LPL for each group, the GAPDH was set to the default value.

Gene		Primer sequence	
LPL	Sense	5'-TCACCAGCATCCCCATTATT-3'	
	Anti-sense	5'-ATAGCCACAACAGCGTTTCC-3'	

Table 2. Primer sequence.

#### GAPDH

Sense

Anti-sense

5'-GGGTGCAGCGAACTTTATTG-3'

Table 3. Components of kit.

Reagent	Concentration/reaction
2xone step SYBR RT-PCR buffer	$10\mu\ell$
Prime script PLUS RTase mix	<b>0.4</b> µℓ
TaKaRa Ex Taq HS mix	<b>1.2</b> µℓ
PCR sense primer	$1\mu\ell$
PCR Anti-sense primer	$1\mu\ell$
Total RNA	$2\mu\ell$
RNase free dH2O	<b>4.4</b> µl
Total	<b>20</b> µℓ

#### Table 4. Protocol of the real time PCR.

	Step	Reps	Temperature( $^{\circ}$ C)	Time(s)
Cuela 1	Reverse transcription	1	42	900
Cycle 1	Pre-denaturation	1	95	120
	PCR reaction	10	95	10
Cycle 2	(denature->annealing-> extension)	40	60	45
Cycle 3	Final-denaturation	1	95	15
Cycle 4	Final elongation	1	60	60
Cycle 5	Melting curve		65	<b>15(+temp0.5℃&gt;95℃)</b>

#### 2.6. Data processing

As for the statistical processing of the study, the average and standard deviation of all items were calculated by using the SPSS 18.00 Package, and the changes in the body weight according to each group(3) and × measurement period(5) after 5 weeks of dietary intake were observed via the 2-way repeated ANOVA for analysis, and if a primary effect manifested, an ex post test was performed. Furthermore, the one-way repeated ANOVA was performed to examine and understand the changes in the blood components and LPL mRNA according to each group(3), and if the primary effect manifested, an ex post test was performed. The ex post test was valdiated by the Tukey method, and the statistical significance level was set to p<.05.

#### 3. Results

The results of the Real Time PCR to examine the weight, blood components and the skeletal muscle's LPL mRNA expressions of the rats after 5 weeks of the saturated and unsaturated fatty acids intake are as follows.

#### 3.1. Changes in weight

<Table 5> illustrates the results of the analysis of the changes in the body weight according to the dietary intake for 5 weeks for the saturated and unsaturated diet group.

	Owk	1wk	2wk	3wk	4wk	5wk
CON	172.85	226.63	288.11	345.26	395.20	430.91
	±8.33	±14.09	±16.71	±18.57	±24.78	±30.12
BT	172.58	224.02	286.99	348.62	409.29	448.94
	±7.47	±11.59	±17.03	±19.94	±20.98	±22.15
SF	171.93	232.75	298.25	359.30	408.31	453.38
	±5.31	±11.04	±18.23	±26.08	±33.44	±38.62

**Table 5.** Changes in the body weight according to the dietary intake for each group.

Values : Mean±SD \*\*\* p<0.001 relative to before the dietary intake.

The changes in the body weight according to group and measurement time are as illustrated in <Table 5>, yet there was no significant difference in the primary effect of the group, and the primary effect of the measurement time[F(5, 110)]=2707.952, p<.001] turned out to be significant. After 5 weeks of the dietary intake, all groups demonstrated an increase in their body weight according to the period. Furthermore, the interaction between the group and the measurement time[F(10, 110)]=2.315, p<.05] turned out to be significant. As a result of the ex post test performed on the interaction effect, there turned out to be no significant difference in the difference between groups by measurement time, yet a significant difference was manifested across all groups in terms of the difference in the measurement time for each group.

#### 3.2. Blood component

<Table 6> illustrates the results of the analysis of the changes in blood components according to the dietary intake for 5 weeks for the saturated and unsaturated diet group.

Group	TG	FFA	Glucose
CON	145.00±21.51	327.70±137.38	238.90±43.80
BT	115.25±28.65	357.33±110.44	203.44±34.37
SF	63.29±11.60	364.88 ±83.54	252.13±34.01

Table 6. Comparison of different blood components for each group.

Note: Values : Mean±SD \* p<0.05, \*\*\* p<0.001 relative to the CON group. # p<0.001 relative to the BT group.

The differences in the TG concentration according to dietary intake are as illustrated in <Table 6>, yet the primary effect turned out to be significant in terms of the differences between the groups[F(2, 21)]=27.116, p<.001]. As a result of the ex post test performed for the primary effect, the TG concentration turned out to be significantly lower for the BT group(p<0.05) and the SF group(p<0.001) than for the CON group, and furthermore, the TG concentration turned out to be significantly lower for the SF group than for the BT group. The differences for the FFA concentration according to dietary intake are as illustrated in <Table 6>, yet there turned out to be no difference between the groups. The differences in the glucose concentration according to the dietary intake are as illustrated in <Table 6>, yet the primary effect turned out to be significant in terms of the differences between the groups[F(2, 24)]=3.801, p<.05]. As a result of the ex post test performed for the primary effect, the TG concentration turned out to be significantly higher for the SF group than for the BT group.

#### 3.3. LPL mRNA's expressions

<Table 7> illustrates the results of analyzing the changes in the LPL mRNA according to the dietary intake for 5 weeks for the saturated and unsaturated diet group.

	GAPDH	LPL	LPL/GAPDH
CON	0.454±0.142	0.330±0.118	1.368±0.827
BT	0.414±0.159	0.755±.219	2.267±.883
SF	0.303±0.165	0.695±0.164	3.235±0.734

**Table 7.** Comparison of the expressions of GAPDH and LPL and LPL/GAPDH according to each group.

Note: Values : Mean±SD \*\* p<0.01, \*\*\* p<0.001 relative to the CON group.

The differences for the GAPDH mRNA expressions according to the dietary intake are as illustrated in <Table 7>, yet there turned out to be no significant differences for the primary effect. The differences in the LPL mRNA expressions according to the dietary intake are as illustrated in <Table 7>, and the primary effect turned out to be significant in terms of the differences between the groups[F(2, 19)]=16.058, p<.001]. As a result of the ex post test performed for the primary effect, the LPL mRNA expressions turned out to be significantly higher for the BT group(p<0.001) and the SF group(p<0.01) than for the CON group.

The differences for the LPL/GAPDH mRNA expression according to the dietary intake are as illustrated in <Table 7>, and the primary effect turned out to be significant in terms of the differences between the groups [F(2, 17)]=8.433, p<.001]. As a result of the ex post test performed for the primary effect, the LPL/GAPDH mRNA expressions of the SF group(p<0.01) turned out to be significantly higher than for the CON group.

#### 4. Discussion

#### 4.1. Body weight

After 5 weeks of the dietary intake, it turned out that the body weight increased with the proceeding of the dietary intake across all groups. However, when the total intake Kcal was the same, there turned out to be no significant difference for the body weight between the groups, demonstrating that there was no change in the body weight according to the dietary intake pattern.

Examining the previous studies, 120 rats were subjected to the general diet(Chow G: normal livestock feed), a high-carbohydrate and high-fat diet(HSHF(high sucrose, high-fat) G: Carbohydrate 41%, Fat 39%, Protein 20%), and as a result of studying them, both groups gained body weight after 4 weeks, and the HSHF group reported a significantly higher increase compared to the normal diet group. In particular, it was reported that the HSHF diet group turned out to be significantly higher for the white adipose tissue of the epididymis and retroperitoneum [22]. Among the obese rats induced by the high fat diet, anti-5-week-old rats of herbal acupuncture were divided into the 4 groups(CON, HF, HF+RAE 150mg, HF+RAE 300mg) with 8 rats each, and were fed for 30 days. Consequently, all 4 groups reported that their body weight increased significantly after 30 days compared to theirs before the intake, and that the HF group increased significantly compared to the CON group[23]. After 1 week of adaptation for the 4-week-old male C57BL/6J rats, the low-fat, low-carbohydrate diet group(LL: 3% fat, 5% sucrose) and the high fat diet group(HF: 45% fat) for 55 weeks and high carbohydrate diet group(HS: 50% sucrose) were divided and subjected to the dietary intake. As a result of the dietary intake, the HF group reported a significantly higher body weight than the LL and HS groups [24]. As a result of reviewing the previous studies, and across all studies, the high fat diet group reported on a significant

increase after their dietary intake, which is different from the results of this study. Therefore, as a result of analyzing the results of the body weight in this study, it was possible to discover a difference in the amount of food. Relative to the control group, the high fat diet group consumed 691.425 g of total food for 5 weeks, whereas the high fat diet group consumed 499.988 g. As a result of converting these into Kcal based on the dietary composition, the control group consumed 2621 Kcal, and the high fat diet group consumed 2770 Kcal. Therefore, while the ratio of dietary nutrients in the two groups was different, it is considered that there turned out to be no significant difference in terms of the body weight given the similar total calorie intake.

#### 4.2. Blood component

The difference in the TG concentration according to the dietary intake turned out to be significantly lower for the BT group(p<0.05) and the SF group(p<0.001) than for the CON group, and the TG concentration turned out to be significantly higher for the SF group than for the BT group. There turned out to be no significant difference in the FFA concentration, and the difference in terms of the glucose concentration turned out to be significantly higher for the SF group than for the BT group.

As a result of conducting the study by dividing the rats into the three groups of general diet, high carbohydrate diet, and high fat diet for 4 weeks, and after 24 hours of fasting, and they were slaughtered at each time zone, and the plasma triglyceride concentration was measured, and consequently, it was reported that the TG concentration turned out to be significantly higher for the fat diet group than for the general diet group [17]. Furthermore, as a result of the study of 5-week-old rats divided into the high fat diet group and the regular diet group for 30 days, the high fat diet group after 30 days turned out to be significantly higher than the general diet group [18], and as a result of conducting the study by dividing the 4-week-old, C57BL/6J rats into the high fat diet group, high carbohydrate diet group, and the low carbohydrate and low fat diet group, it was reported that the plasma triglyceride concentration turned out to be significantly higher for the high fat diet group than the general diet group, and the low carbohydrate and low fat diet group, it was reported that the plasma triglyceride concentration turned out to be significantly higher for the high fat diet group than the control group after 55 weeks [19].

Whereas, the five-week-old rats were consisted of the control group(Control; CON=43 rats, hydrated glucose 59.8%) and the high fat diet group(High Fat; HF=48 rats, Hydrogenated Vegatable Shortening 37%) by each group, and as a result of requiring their dietary intake, there turned out to be no difference in the concentration of triglycerides at 15 weeks, yet it was reported that the high fat diet group demonstrated a significantly lower level of triglyceride than the control group after 21 weeks [25]. Such results are consistent with the results which turned out to be significantly lower than the control group after 5 weeks of the high fat diet intake in this study. Furthermore, the dietary structure of the high fat diet group(High Fat; HF) for each group was ingested with Protein: 22.3%, Carbohydrate: 8.40%, and Fat: 62.67% for 2 weeks for the SD Rats. The high carbohydrate diet intake group (High-Sucrose; HS) was consisted of Protein: 9.95%, Carbohydrate: 81.39% (in 60% sucrose), and Fat: 4.80%, and as a result of requiring their intake, it was reported that it turned out to be significantly lower than that of the carbohydrate diet group[26]. Meanwhile, 43 healthy males were randomly assigned as the non-experimental animals to the high-fat diet group(38% carbohydrate, 46%-18% saturated fat, 12% unsaturated fat) and the low-fat diet group(60% carbohydrate, 24% Total fat-6% saturated fat, 4% unsaturated fat), and as a result of performing it for 6 weeks, it was reported that the concentration of triglycerides increased significantly for the low-fat diet group compared to the high-fat diet group[27]. In this study, the triglyceride concentration in the general diet group turned out to be significantly higher than that for the high fat diet group, which is consistent with the results of a study which reported that when the LPL's activation in the skeletal muscle occurred, the triglyceride decreased and the HDL-C increased [28]. It is interpreted to have been caused by the synthesis of triglycerides by the sugar metabolism other than the mechanism of absorption and the decomposition of fat. The Acetyl CoA used for the fatty acid synthesis is obtained from the carbohydrate metabolism, partially from the decomposition of the carbon skeleton of amino

acids, and from the oxidation of fatty acids, and in particular, when the carbohydrates are consumed excessively, the NAPDH increases and the fatty acid synthesis increases.

#### 4.3. LPL mRNA

The difference in the GAPDH mRNA expressions according to the dietary intake did not demonstrate a significant difference between the groups, and the difference in the LPL mRNA expressions turned out to be higher for the BT group(p<0.001) and the SF group(p<0.01) than for the CON group, and the LPL mRNA expressions turned out to be significantly higher. Furthermore, the difference in the LPL/GAPDH mRNA expressions turned out to be significantly higher for the SF group(p<0.01) than for the SF group(p<0.01) than for the CON group.

After pre-breeding the 5-week-old SD rats for a week, and as a result of performing the experiment by dividing them into the normal diet group and the high fat-cholesterol diet group for 4 weeks, it was reported that the LPL activity turned out to be higher for the epididymal adipocytes than for the visceral adipocytes [29]. Such research results turend out to be consistent with this study. Furthermore, as a result of analyzing the LPL activation for the skeletal muscle after the knockout of the skeletal muscle's LPL among the rats, it was reported that the activation turned out to be high in the order of heart, white adipose tissue, red muscle of skeletal muscle, and the white muscle of skeletal muscle<sup>[21]</sup>. In another study, as a result of requiring the high fat diet for the SD rats for 8 weeks, it was reported that the high fat diet group for the soleus muscle demonstrated a significantly higher LPL activation than the control group [30], and as a result of requiring the diet for 42 days for 24 Wister rats with each of P14C76L10(high carbohydrate, low fat, normal protein), P53C35L10(normal carbohydrate, low fat, high protein), and P55L45(Carbohydrate free, high fat, high protein), it was reported that the LPL activation turned out to be somewhat higher for the P55L45[31]. Furthermore, as a result of testing SD rats into the high-carbohydrate diet group and the high fat diet group for 2 weeks, the LPL activation turned out to be significantly higher for the high fat diet group [32]. Such results are determined such that the LPL activation takes place when the high fat diet is consumed, and in particular, it is interpreted that the fatty acid metabolism is activated. However, the activation of LPL may be interpreted differently depending on the type and amount of diet such as the saturated fatty acid, unsaturated fatty acid, carbohydrate, protein, and the tissues of skeletal muscle, heart, and testis. In addition, it is considered that the analysis of the variables related to the fatty acid metabolism in the follow-up studies will operate as important parts in articulating the mechanism of the fatty acid metabolism.

#### 5. Conclusion

As a result of conducting the real-time PCR to examine the body weight, blood components, and the skeletal muscle's LPL mRNA expressions of the rats after 5 weeks of the saturated and unsaturated fatty acid intake, the following conclusions were obtained.

As a result of gathering the research results, the unsaturated fat intake rather than the saturated fat intake in terms of the composition of dietary intake for the prevention of adult diseases related to obesity and arteriosclerosis brought about an effective improvement of the triglyceride concentration and the increased expression of LPL mRNA, and hence, it is believed that the lipolysis is activated.

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#### 7. Appendix

#### 7.1. Authors contribution

	Initial name	Contribution
Lead WC Author		-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑
		-Make a significant contribution to collection $\square$ -Final approval of the paper $\square$
Corresponding Author*	JP	<ul> <li>-Corresponding ⋈</li> <li>-Play a decisive role in modification √</li> <li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data √</li> <li>-Participants in Drafting and Revising Papers √</li> <li>-Someone who can explain all aspects of the paper √</li> </ul>

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#### The Citespace Approach on the Changes of Trends and Hotspots to Consume SPORT Products of Chinese Collegiate Students

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#### Abstract

**Purpose:** With the national emphasis on the high-quality development of sports industry and the cultivation of new cultural formats and consumption patterns, sports consumption of college student has become a hot topic of academic attention, and a lot of research has been carried out. In order to fully understand the research status of sports consumption of college student in China, this study conducted scientific econometric statistics on related researches in the past 20 years, aiming to analyze the hot spots and trend evolution of sports consumption of college students.

**Method:** In this paper, 487 valid samples were obtained by searching the literature related to college student sports consumption collected by CNKI from 2001 to 2021. CiteSpace was used to conduct visualized analysis, and through the collation of knowledge map, it revealed the hot spots and trend evolution of Chinese collegiate student sports consumption.

**Results:** The results of descriptive statistical analysis from literatures for this study showed that the time distribution characteristics of Chinese collegiate student who consume sport products could be divided into four stages: 1)steady growth stage from 2001 to 2005, 2)rapid development stage from 2006 to 2008, 3)ups and downs stage from 2009 to 2014, and 4)slow decline stage from 2015 to 2021. These literatures were mainly studied by colleges and universities, involving physical education, pedagogy, economics. The research hotspots analysis showed that the main keywords of Chinese collegiate student sports consumption were sports consumption, college students, current situation, influencing factors, sports consumption behavior, college student sports consumption, female college students, consumption consciousness, sports consumption structure and motivation. The results of emerging trend analysis showed that the research on sports consumption of collegiate student in China could be divided into four development stages: it mainly involved the definition and interpretation of sports consumption of college students, the investigation of the current situation in different regions, the analysis of influencing factors and the proposal of consumption countermeasures from 2001 to 2008. The research from 2009 to 2014 mainly included sports consumption consciousness and sports consumption behavior. From 2015 to 2019, sports and fitness consumption and sports consumption motivation were mainly discussed. After 2019, due to the short period of time and the gradual maturity of research in this field, the research mainly focused on the comprehensive discussion of sports consumption of collegiate students.

**Conclusions:** As the data used for this study were only collected from CNKI literature, there are limitations in obtaining data which were the previous literature. In addition, due to the strict limitation of keywords in the literature search process, it may lead to the omission of sport consumption contents of college student in other articles. Therefore, it is hoped that these problems can be properly solved in the future scientometrics researches.

#### [Keywords] Citespace, Scientometrics Research, Visual Analysis, Chinese Collegiate Students, Sports Consumption

#### 1. Introduction

Sport consumption belongs to the category of personal consumption expenditure, which is the process in which consumers purchase sport-related products or services based on their own sport needs and economic capacity[1]. According to the different consumption patterns, sport consumption can be divided into ornamental sport consumption, participation sport consumption, and physical sport consumption[2]. As an important part of modern service consumption and life service consumption, sport consumption not only reflects the national quality, education level, and civilization level of a country, but also plays an important role in accelerating the transformation of economic structure, promoting the development of sport industry, and endorsing the reform of sport field[3]. In recent years, China's sport industry has been developed rapidly, and the national sport consumption has also been significantly improved. By 2018, the total scale reached 2,657.9 billion yuan(US \$372.1 billion), accounting for 1.1% of GDP[4]. In order to further clarify the importance of sport consumption, the Chinese government issued the Action Plan for Further Promoting Sport Consumption in 2019, which made clear requirements for improving the overall scale of sport consumption and the per capita level of sport consumption. How to stimulate sport consumption has become a key research issue[5].

As China is in the process of economic transformation, there are differences in the demand for sport consumption among the citizens, which will be affected by many demographic factors such as age, gender, occupation, education background, and income, so the consumers at the present stage are diverse[6]. Among the numerous consumer groups, college student have always been regarded as an important part of sport consumption. Especially after China's sport industry has entered the digital era, live sport events and intelligent sport equipment have become new sport commodities [7]. As a young consumer group, the acceptance of such goods for college student is significantly higher than other consumer groups [8]. In addition, myopia, obesity, physical decline and other problems have a great negative impact on the physical and mental health of college students in China[9]. To address this problem, the Chinese government has issued 'the Healthy China 2030' program, which requires every youth to participate in physical activity at least for one hour every day and three times a week of moderate-intensity physical activity[10]. The issuance of this program not only alleviates the physical and mental health problems of college students, but also increases the frequency of college students' sport consumption to a certain extent[11]. At present, the number of college student in China exceeds 28.3 million, and the increase of sport consumption frequency is enough to bring significant benefits to the sport industry [12]. Therefore, the consumption of college student has been the focus of Chinese academics, and a lot of research has been conducted.

Overall, the existing research has carried on the investigation and analysis to the current situation of college students' sport consumption, sport consumption intention, sport consumption influence factors, sport consumption trend, sport consumption motivation, sport consumption level, sport consumption structure and sport consumption characteristics. However up to now, there has been no research summarized and concluded these achievements. In order to comprehensively understand the research status of sport consumption of college student in China, this study used CiteSpace to sort out the researches in the past 20 years. Scientific and rigorous combing can make numerous research results and differences between studies clearly recognized, and it can also serve as a reference for subsequent researches.

#### 2. Methods

#### 2.1. Data source

Data used in this study was collected from the China National Knowledge Infrastructure(CNKI). Since its establishment, CNKI has always been adhering to the purpose of serving to enhance

China's innovation ability and cultural soft power, committed to the development, utilization and dissemination of high-quality publishing knowledge resources at home and abroad, adhere to the innovation of knowledge production, dissemination and utilization mode under the condition of big data and Internet. It is committed to the integrated digital publishing, dissemination, content value-added services and related software technology development of cultural and educational literature resources such as periodicals, doctoral papers, newspapers, conference papers, books, yearbooks, statistical data, etc[13]. Now CNKI has the world's leading CNKI Digital Library and CNKI Grid resource sharing platform. CNKI is the largest monopolized website integrating all kinds of full-text academic information in China, which can ensure the comprehensiveness and reliability of data[14].

#### 2.2. Research tool

Bibliometrics is a science of quantitative analysis of literature information, which can more objectively analyze the impact of academic research. Literature metrology was first proposed by Alan Pritchard, a British information scientist, in 1969. It has been widely used in various fields such as publication statistics, impact evaluation of journals or research institutions, tracking of academic hotspots and future research directions[15]. In this paper, CiteSpace Visualization was used for quantitative analysis of the sample literature. Citespace is the literature analysis software designed and developed by Professor Chen Chaomei based on Java program. Through the recombination of literature authors, key words, research institutions, citation frequency and other characteristic information, new information is formed[16]. The program can realize cooperative network analysis of authors, institutions and countries, co-occurrence analysis of topics and keywords, co-citation analysis of literatures, authors and journals, and document coupling, etc.[17]. It can not only analyze the overall situation, but also analyze the specific content of research fields from multiple dimensions[18].

#### 2.3. Data processing

Research was conducted using Citespace mainly includes theme identification, data preparation, and visualization. The specific process was as shown in <Figure 1>.



Figure 1. Research process.

(1) Theme identification. Before the research officially began, this paper first made an extensive search. A preliminary search was conducted by using college students and sports goods,

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college students and sports consumption, college students and sports expenditure. According to the analysis of the search results, the key words of this study were set college students and sports consumption. In consideration of the principle that the retrieval results need to ensure the consistency of text, so after manual comparison, title was added in the retrieving item .

(2) Data preparation. According to the research theme, CNKI database was used to search literature from January 1, 2001 to October 1, 2021. The type and language of the literature were set as "Article" and "Chinese", and 487 pieces of data were obtained. After the search was complete, all retrieved data was exported to the empty folder named Data and save it in TXT format according to Citespace requirements.

(3) Visualization. The data was input into Citespace for visual analysis, and generated a static map that could show various aspects of information for each node. This map could be directly used for the expression of results, or content could be presented in the form of a table in the general structure. Since the CNKI was chosen as database and language was set as Chinese, the results were also shown in form in Chinese.

#### 3. Results

#### **3.1.** Descriptive statistical analysis

For a certain field, the index that can best measure the research hot spots and emerging trends in this field is the number of papers published in this field. The statistical chart of literature quantity can clearly reflect the development trend and research hot spots of this field[19]. The starting time of literature sample is in the early stage of China's market economy, in which sport consumption formed. The research on the connotation function and current situation of sport consumption is an important research topic at this time. It is clear and comprehensive to study this topic from this starting point.487 papers were obtained from CNKI database for this study. The number of periodicals published on the theme of college student sport consumption from 2001 to 2021 was counted, as shown in <Figure 2>.

According to the research on Chinese college students' sport consumption, it can be divided into four stages: steady growth stage from 2001 to 2005, with more than 10 papers published annually. In 2003, the published number was the most and 13 papers were published. Rapid development stage from 2006 to 2008 and e annual number of papers published more than 40. Perhaps due to the approach of 2008 Beijing Olympic Games, sport industry and sport consumption have been highly valued, so this period was the peak of the research on sport consumption of Chinese college student in the past 20 years. The period from 2009 to 2014 was a period of ups and downs, with more than 30 papers published annually. Among them, there was a sharp decline in 2009, with a decrease of nearly 50% in the past year. Although there was a slight rise in 2011, there was a sharp decline again in 2012, and the number of papers in 2014 was the lowest in nearly 10 years. The period from 2015 to 2021 is a slow decline stage, and the annual average number of papers is about 16. Although in 2019, the Chinese government paid attention to the development of sport consumption, and the number of papers published increased slightly, the number of papers published during this period still mainly showed a downward trend. The reason is mainly due to the decrease of the number of publications in some relevant journals during this period, and the development from monthly to bimonthly. In summary, the number of papers themed on Chinese college student sport consumption changes significantly in each stage.





#### 3.1.1. Analysis of research institution

The knowledge map analysis of scientific research institutions can intuitively show the distribution of major scientific research institutions in the research of sport consumption of college student in China, which can provide reference for follow-up research and academic cooperation[20]. Due to the large number of universities involved, in order to have a clearer understanding of the distribution of institutions, this paper selected the top 10 institutions according to the number of studies for statistics, However, due to the same number of papers issued by some universities, they are all elaborated in the paper, as shown in <Table 1>.

Grade	Institutions	Number of published papers
1	China University of Mining and Technology Xinxiang University Wuhan Sport University	7
2	Central China Normal University Henan Normal University Beijing Sport University Shenyang Normal University	6
3	Xidian University Mudanjiang Normal University	5
4	Zhengzhou University Zhongzhou University Jiangxi Normal University Nanjing Normal University Hebei University of Engineering Changchun Institution of Technology Yan'an University Hangzhou Vocational & Technical College Communication University of China, Nanjing	4

 Table 1. The research institutions of Chinese college student sport consumption.

Because of the same number of research institutions, this paper divides these institutions into four levels. In the first grade, China University of Mining and Technology, Wuhan Sport University and Xinxiang University published the most papers, with a total of 21 papers. Central China Normal University, Henan Normal University, Beijing Sport University and Shenyang Normal University ranked second grade, with a total of 24 research papers. Xi'an University and Mudanjiang Normal University, with a total of 10 papers, ranked third grade. The fourth grade consists of 10 universities, including Zhengzhou University and Zhongzhou University, with a total of 40 research papers. On the whole, there are many research institutions on sport consumption of college student in China at the present stage. Both ordinary universities and sport colleges and universities have discussed this issue. Better developments in this area will await if cooperation between institutions can be further strengthened.

#### 3.1.2. Analysis of related disciplines

The integration and cross-development of multi-disciplines is the main trend of current sport development, and cross-disciplinary cooperation is conducive to promoting the development of research fields[21]. Therefore, it is necessary to conduct statistics on disciplines involved in the research, as shown in <Table 2>. This research mainly involves physical education, pedagogy, economics, journalism and communication and psychology. Psychology and economics and journalism and communication are not included in the statistics due to their infrequency. Among them, Physical Education appeared the most frequently with 451 times. Pedagogy ranked second with 60 times. Economics appeared 30 times raking after Education and Pedagogy.

The frequency mentioned this time refers to times that different disciplines are involved in research. Because there are cross-disciplinary studies, the frequency of disciplines is higher than the actual number of studies. In addition, due to the limitation of research topics, physical education is the subject that conducts most research on this issue, followed by pedagogy and economics.

Discipline	Frequency	Percentage
Physical education	451	83.4%
Pedagogy	60	11.1%
Economics	30	5.5%

 Table 2. Related disciplines distribution of Chinese college student sport consumption.

#### 3.2. Analysis of the research hotspots of sport consumption of Chinese college students

Keywords are the summary of literature research topics and the concentration of core views. CiteSpace identifies hot topics in the research field through keywords with high frequency and high centrality[22]. In other words, the higher the frequency of a keyword in the literature of the research field, the higher the centrality of key words, which , indicates that keyword modification is a research hotspots in this field[23]. CiteSpace clearly displays the frequency and clustering relationship in the form of visualization on the basis of the co-occurrence frequency of keywords or key words, so as to analyze the research hotspots in a certain field[24]. In order to deeply analyze the hotspots in the research field of sport consumption of college student in China, this study analyzed 487 retrieved articles. Combined with the results of frequency and centrality of keywords, the top 10 keywords were summarized, As shown in <Table 3>.

It can be found from <Table 3> that the high frequency keywords of Chinese college student sport consumption in the past 20 years mainly include sport consumption, college students,

current situation, influencing factors, sport consumption behavior, college student sport consumption, female college students, consumption consciousness, sport consumption structure and motivation. Consumption status was the most popular keywords after eliminating the keywords consistent with the research topic. The main reason for this result is that Chinese scholars have carried out a conceptual analysis of sport consumption in the early stage of the research, and conducted a large number of investigations on sport consumption of college student in different areas at different times. However, sport consumption in different regions will be affected by local economy, environment, culture and other factors[25]. Therefore, influencing factors of sport consumption are the key words after consumption status. With the deepening of research and the change of national and social concerns, consumption behavior, consumption consciousness and consumption structure have become the research hotspots in different periods. It is worth mentioning that some Chinese scholars have conducted special studies on Chinese female college students. On the whole, the research hotspots of sport consumption of college student in China have changed according to the development of the research. From the initial status quo investigation and definition interpretation, the direction of change is mainly affected by national policies and social attention.

No	Keywords	Frequency	Centrality
1	Sport consumption	376	0.96
2	College student	348	0.84
3	Current situation	64	0.97
4	Influencing factor	45	0.29
5	Sport consumer behavior	28	0.5
6	College student Sport consumption	15	1.03
7	Female college students	14	0.36
8	Consumption consciousness	12	0.08
9	Sport consumption structure	12	0.93
10	Motivation	10	0.22

 Table 3. Research hotspots of sport consumption of Chinese college students.

#### 3.3. Research trend of Chinese college student sport consumption

Burst terms are keywords obtained through Burst Detection, which indicate that a variate has great changes in a specific period and has received great attention from researchers[26]. It can reflect the evolution of the research trend from the time dimension and show the research focus of a particular stage[27]. The longer the time dimension and the higher the intensity of the keywords, the more the discussions about this hot topic in this time period. Therefore, in order to intuitively understand the changes in the research trends of Chinese college student sport in different stages, this paper conducts keyword highlighting analysis on the basis of research hotspots. The higher ranking keywords were summarized. As shown in <Table 4>.

Keywords	Starting year	Finishing year	Strength
College student	2001	2004	1.5117
Sport consumption	2001	2005	2.4007
Current situation	2002	2007	2.5435
Influencing factor	2002	2007	1.8938
Instigation	2002	2008	1.6931
Suggestion	2003	2004	1.3189
Zhejiang province	2003	2008	1.96
Consumption level	2005	2007	1.36
Sport consumption structure	2005	2008	1.5469
Consciousness of sport consumption	2009	2010	1.4473
Sport consumer behavior	2009	2011	1.4663
Higher vocational college	2010	2014	1.343
Female college students	2015	2019	1.5046
Motivation	2015	2018	1.3398
Physical fitness	2015	2018	1.7918
College student sport consumption	2019	2021	1.9213

 Table 4. Research trend of Chinese college student sport consumption.

According to the research results in this paper, the research trend of Chinese college student sport consumption can be divided into four stages. The first stage is from 2001 to 2008. This stage is the beginning of the college student sport consumption research, so content mainly involves the definition of college student sport consumption, investigation of current situation in different regions, influencing factors and consumption suggestion. Due to the different among consumption current situation in different regions, so the corresponding influence factors and countermeasures exist a certain differences. But college student sport consumption mainly focus on sport object consumption, motor skill learning and practicing and recreational consumption three aspects, Hobbies, price and economy is considered to be the main factors affecting college student sport consumption [28]. Along with the research, many scholars have studied the sport consumption structure and consumption level based on the previous researches since 2015. It showed that the sport consumption of the college student in Northwest is consistent with their consumption capacity. It is relatively reasonable structure [29].In addition, the research of college student sport consumption in Zhejiang is more than it in other regions.

The second stage is from 2009 to 2014. The research trend in this stage gradually changed compared with before. The object of study covered more groups, students in higher vocational college were also studied as the object. The research content mainly included the sport consumption Consciousness and sport consumption behavior, sport consumption psychology has become the focus in this stage. It showed that the Chinese college student sport consumption behavior was in good condition. But there was obvious gender difference on the frequency of consumption and motivation. The frequency of the male students in sport consumption and desire was far higher than female [30].

The third stage is from 2015 to 2019. In 2014, the Chinese government issued several Opinions on Accelerating the Development of Sport Industry and Promoting Sport Consumption. In order to promote the development of sport industry and stimulate sport consumption, the research at this stage mainly tends to analyze the motivation of sport consumption. It showed that the motivation of college student sport consumption can be summarized into three aspects: physical object, development and fashion, among which physical object demand is the basic motivation of college student sport consumption[31]. From the research content, this stage of research is the continuation of sport consumption behavior research in the second stage, but the time line is independent, so it is regarded as a separate research stage. Besides, female college student become another group of college student to be discussed separately. In addition, with the proposal of Healthy China 2030 and other programs, the combination of college students' physical fitness and sport consumption has become a hot topic at that time. The research results also confirm that fitness demand is one of the reasons to promote college students' sport consumption[32].

The fourth stage is from 2019 to the present. In order to sustain the development of China's sport industry and continue to expand the scale of sport consumption, the Chinese government issued the Action Plan for Further Promoting Sport Consumption in 2019. The proposal of this plan once again ignited the enthusiasm of Chinese scholars to study sport consumption, college student sport consumption has therefore been focused on. However, due to the short period of time and the gradual maturation of research in this field, there has not been a major research trend. The research in the past two years mainly discussed the sport consumption of college student sport consumption and college physical education, it is found that college student physical education was the foothold of college student sport consumption, and college student sport consumption was an important way to realize the goal of college physical education [33].

#### 4. Conclusions

College student is the promoters of China's social economy and one of the important groups of sport consumption. Exploring college student sport consumption will not only help grasp the development direction of the future sport consumption market, but also form a good fitness concept and exercise behavior [34]. In this study, the knowledge map of Chinese college student sport consumption was made by CiteSpace and CNKI was selected as the data source. It systematically analyzed basic characteristics, research hotspots and evolution of trend. It can be seen from the results of this study that in the past 20 years, sport consumption of Chinese college student has always been the focus of university research, and related disciplines mainly involved sport science, pedagogy and economics. The keywords mainly include sport consumption, college students, current situation, influencing factors, sport consumption behavior, college student sport consumption, female college students, consumption consciousness, sport consumption structure and motivation. After four stages of development, the research on this topic has been enriched. With the advocacy and support of the Chinese government, college student sport consumption has once again become one of the important issues concerned at this stage, and the follow-up research will continue. It is hoped that the results of this scientometrics study can provide some reference for the subsequent research. However, as this study only searched CNKI, there are limitations in obtaining literature. In addition, due to the strict limitation of keywords in the literature search process, it may lead to the omission of sport consumption content of college student in other articles. Therefore, it is hoped that these problems can be properly solved in the future researches.

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#### 6. Appendix

#### 6.1. Authors contribution

	Initial name	Contribution
		-Set of concepts 🔽
		-Design 🔽
Lead	XB	-Getting results 🔽
Author		-Analysis 🔽
		-Make a significant contribution to collection $\ igside Q$
		-Final approval of the paper 🛛
		-Corresponding 🔽
		-Play a decisive role in modification <a>Image</a>
Corresponding Author*	нѕ	-Significant contributions to concepts, designs,
		practices, analysis and interpretation of data $ar{ u}$
		-Participants in Drafting and Revising Papers 🛛
		-Someone who can explain all aspects of the paper $ abla$

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#### The Effect of Body Image Recognition of Manipulative Therapy based on KINESIOLOGY of Customers on the Appearance Management Behaviors

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#### Abstract

**Purpose:** In this study, we intend to investigate the condition of the face and body that we want to improve for customers who use manipulative therapy based on kinesiology in the beauty shop. The purpose of this study is to analyze the effect of Body Image Recognition and its sub-factors on Appearance Management Behaviors in order to obtain basic data for vitalization of the beauty industry.

**Method:** The subjects of this study were customers who use manipulative therapy based on kinesiology in the beauty shop, and to validate the research issue, 219 copies of online. Empirical statistical analysis was performed using SPSS 25.0 program, and chi-squared test, one-way ANOVA, Pearson's correlation, simple regression analysis, and multiple regression analysis methods were used.

**Results:** The results of the analysis performed are as follows: First, the parts of the face that we want to improve by gender are as follows. Men wanted the wrinkles around the eyes to be improved, and women wanted the nasolabial folds to look younger( $\chi$ 2=28.121, p<.001). As for the parts of the body that they want to be improved, they hoped for changes in the abdomen and waist at all age groups, and those in their 20s and 40s wanted the lower body and calves to be improved, and those in their 50s and older wanted beautiful improvements in the clavicle and back neck line( $\chi$ 2 =22.033, p<.05). Second, women were perceived to be healthier than men(t=-2.961, p<.01), but their Self-body Image Recognition level was lower(t=3.247, p<.01). Third, Body Image Recognition was found to have a positive effect on Appearance Management Behavior( $\beta$ =.381, p<.001). Specifically, it was found that the higher the level of Health Awareness( $\beta$ =.207, p<.01) and Self-body Image Recognition( $\beta$ =.193, p<.01), the higher the Appearance Management Behavior.

**Conclusion:** Based on the results of this study, as each gender and age group have different desires to improve with manual therapy, it is necessary to develop a differentiated program. And these results suggest that there is a high possibility that it has a positive effect on the appearance of customers and that various levels of management behavior lead to consumption of beauty and health services.

[Keywords] Manipulative Therapy, Appearance Management Behaviors, Body Image Recognition, Health Awareness, Self-Body Image Recognition

#### **1. Introduction**

#### 1.1. Background of the study

In modern society, appearance is attracting attention as one of the most important capital. Appearance has an important influence not only on entertainers and service workers, but also on job seekers, interpersonal relationships, and social status change[1][2][3]. Sociologist Hakim [4] added the concept of attractive capital, arguing that it was insufficient to define individual assets only as economic, cultural, and social capital. The value of attractive capital, including consumption culture related to appearance, such as hair, is being studied[5].

As interest in income increase and improvement of health and quality of life increases[6], it

is expanding into the health care industry based on beauty[7], and natural remedies are being actively used[8].

In the Beauty Health Multi Shop, meridian massage and heat therapy are used as pain relief intervention programs[9]. Manipulative therapy is a general term for management forms using the hands and is one of the oldest therapeutic practices. In the past, it was handed down spontaneously, and from around the 17th century, it was systematized with the development of massage theory and medicine in Europe[10]. It was also developed and applied to alternative medicine, beauty, and health-related industries[11][12]. The characteristic of manipulative therapy is to induce a biological reaction by applying stimulation to the muscles, skin, and skeletal system with the hands to promote blood circulation, decrease muscle tone, promote metabolism, and stimulate nerves to promote the balance of each organ[13]. This has the effect of returning the balance of an unbalanced body type[14][15].

More and more customers are visiting beauty therapy centers to manage beauty through changes in body shape, rather than simply giving them a massage for relaxation or skincare. Consumers' desire to improve their body shape through manual management is growing. Modern people cause changes in body shape by living in an incorrect posture in daily life. These changes in body shape can cause imbalances in the musculoskeletal system or tension in joints and muscles, causing pain or reduced flexibility[16], an inclination of the cervical vertebrae, abnormal rotation of the scapula, and asymmetric deformation of the feet and knees[17].

Body image refers to one's feelings about one's appearance, body functions, health status, etc.[18], and body type recognition can be viewed as a concept similar to body image. It is said to be correlated with appearance management behavior[19]. How one recognizes one's body type affects not only cognitive aspects but also actual behaviors, leading to various appearance management behaviors[20]. Dieting behavior appears as the person is perceived as obese[21], while exercising and cosmetic behavior decrease[22][23][24]. Appearance satisfaction is one of the subordinate concepts of physical satisfaction[25]. Since dissatisfaction with appearance can be expected to have a function of stress healing through appearance management behavior[26] [27], body shape recognition can be seen as a variable influencing appearance satisfaction behavior. The purpose of this study is to investigate the condition of the face and body that they want to be improved for customers who use Manipulative therapy based on KINESIOLOGY in the beauty shop. Another purpose is to analyze the effect of Body Image Recognition and its subfactors on Appearance Management Behaviors. It is expected that this study will be able to secure basic data for vitalizing the beauty and health-related industries.

#### 2. Research Method

#### 2.1. Research subjects

The contents of the survey were modified and supplemented to suit the purpose of the study by referring to the results of previous studies. The sample collection was conducted with men and women in their 20s and older who had experience in using manual therapy based on kinesiology at beauty shops residing across the country. The samples were collected online from April 23 to May 10, 2021, and a total of 219 questionnaires were used as analysis data.

#### 2.2. Survey design and definition of variables

The questions consisted of a total of 31 questions and were measured on a 5-point Likert scale(23 questions) and Nominal scale(8 questions).

1) Body Image Recognition

Body Image Recognition does not judge one's own body shape by objective indicators, but subjectively evaluates one's own body shape according to social standards. It is a self-evaluation

of one's own health status through one's own senses, emotions, and perceptions, and it is a subjective, direct, and indirect evaluation rather than an objective indicator of clinical tests. Social Awareness refers to the state of being socially recognized about the body. Life-habit Awareness is a state of recognizing that lifestyles such as regular exercise, adequate sleep, and stress reduction are necessary for a healthy life. Self-body Image Recognition refers to one's subjective attitudes and emotions toward one's own body or appearance.

It consisted of 17 questions and 4 sub-factors: 6questions on social awareness, 4 questions on Health Awareness, 4questions on Life-habit Awareness, and 3questions on Self-body Image Recognition. Body Image Recognition is a 5-point Likert scale, with the higher score indicating the more positive of recognition.

#### 2) Appearance Management Behavior

Appearance Management Behavior is an appearance management effort that indicates the degree to which one recognizes the importance of appearance or takes a positive attitude toward appearance. It consisted of 6 questions and one factor. Appearance Management Behaviors is a 5-point Likert scale, with the higher score indicating the more positive of behaviors.

#### 2.3. Research model

The independent variable was defined as Body Image Recognition, and its sub-factors were defined as Social Aware-ness, Life-habit Awareness, Health Awareness, and Self-body Image Recognition. Dependent variables was defined as Appearance Management Behaviors. The research model is shown in <Figure 1> and <Figure 2>.

Figure 1. Simple regression analysis model.



#### 2.4. Data analysis

The data of this study were statistically analyzed by using SPSS 25.0, whose details are as follows.

First, the feasibility analysis of the measurement tool was performed by performing exploratory factor analysis. In order to analyze the items constituting the factors, reliability was analyzed using Cronbach's alpha coefficient. Second, frequency analysis and descriptive statistical analysis were performed to understand the research subjects' perceptions and actual conditions of manipulative therapy and general characteristics of the research subjects, and descriptive statistical analysis was performed to understand the level of research variables.

Independent sample t-test, one-way ANOVA, and Scheffe's post hoc test were performed to determine whether there are differences in study variables according to the characteristics of the study subjects.

Simple regression analysis and multiple regression analysis were performed to investigate the effect of Body Image Recognition and sub-factors on Appearance Management Behaviors. In the statistical analysis, statistical significance was determined based on the significance level of 5%.

#### 3. Results

#### 3.1. General characteristics of the study subjects

For this study, a survey was conducted with 225 people, and the general characteristics of the subjects are as follows.

By gender, there were 52 men(23.1%) and 173 women(76.9%), and by age group, 10 people in their 20s(4.4%), 29 people in their 30s(12.9%), and 77 people in their 40s(34.2%), 50 or older, 109(48.4%), and marital status was 184 (81.8%) married, 31(13.8%) unmarried, and 10(4.4%) other persons. As for their final educational background, 56 people(24.9%) had a high school diploma or less, 37 people(16.4%) graduated from a junior college, 48 people(21.3%) graduated from a four-year system, and 84 people(37.3%) were enrolled in or graduated from graduate school. By occupation, 3 students(1.3%), 21 general office workers(9.3%), 27(12.0%) service(sales) workers, 50 self-employed(22.2%), 21 full-time housewives(9.3%) %), civil servants 8(3.6%), professional workers 48(21.3%), technical (skilled) workers 21(9.3%), others 26(11.6%), and the average monthly income was 20 people(8.9%) with less than 1 to 2 million won, 35(15.6%) with less than 2 to 3 million won, 47(20.9%) with 3 to 4 million won, 42 people(18.7%) with less than 4 to 5 million won, 81 persons(36.0%) who had more than 5 million won appeared.

#### 3.2. Validation

Exploratory factor analysis was conducted to verify the validity of the measurement tool used in this study. Principal component analysis and Varimax rotation analysis were used. The conditions for factor classification should be an eigenvalue of 1 or more, and if the factor loading exceeds .40, it was classified as the corresponding factor.

#### 1) Body Image Recognition

In the Body Image Recognition, 5 items that hinder validity(Body Image Recognition 4, 5, 6, 9, 14) were excluded, and finally, factor analysis was conducted with 12 items. As a result of factor analysis, the KMO measurement was .706, and the result of Bartlett's sphericity verification was also significant(p<.001), so the factor analysis model was judged to be suitable.

Body Image Recognition was classified into 4 factors, and they showed 68.7% of fac-tor explanatory power. The first factor is 'Health Awareness' with 5 items, the second factor is 'Selfbody Image Recognition' with 3 items, the third factor is 'Social Awareness' with 2 items, and the fourth factor is 'Life-habit Awareness' with 2 items.

#### 2) Appearance Management Behaviors

As for Appearance Management Behavior, one item that hinders validity(Appearance Management Behavior No. 6) was excluded, and a factor analysis was finally conducted with 5 items. As a result of factor analysis, the KMO measurement was 0.830, and the result of Bartlett's sphericity verification was also significant(p<.001), so the factor analysis model was judged to be suitable.

Appearance management behavior was classified as one factor, and one factor showed factor explanatory power of 60.4%.

#### **3.3.** Reliability analysis

Reliability means that the same result appears even when the target is measured several times, and there is consistency between the items constituting a certain indicator.

To verify this, Cronbach's alpha coefficient was used. The alpha coefficients of all variables were found to be 0.6 or higher, indicating high reliability, as shown in <Table 1>.

	Variables	No. of items	Cronbach's α
	Health awareness	5	0.784
	Self-body image recognition	3	0.743
Body image	Social awareness	2	0.786
recognition	Life-habit awareness	2	0.741
	Total	12	0.68
Appearan	ce management behaviors	5	0.832

Table 1. Reliability for each variable.

#### 3.4. Differences in manipulative therapy according to the characteristics of study subjects

Chi-squared test was performed to determine whether there is a difference in terms of manual therapy according to the general characteristics of the study subjects.

Looking at the face areas they want to improve according to gender, the forehead is 'male' 7 people(13.5%), 'female' 19 people(11.0%), the eyes are 'male' 14 people(26.9%), 'female' 13 people(7.5%), 'male' 7 people(13.5%), 'female' 8 people(4.6%), clown 6 people 'male'(11.5%), 'female' 14 people(8.1%), lips 'Male' 0 people(0.0%), 'Female' 5 people(2.9%), 'male' 2 people(3.8%), 'female' 22 people(12.7%), neck wrinkles 'male' 9 Persons(17.3%), 'female' 34 people(19.7%), and nasolabial folds were 'male' 7 people(13.5%) and 'female' 58 people(33.5%). Men said they wanted to improve the eyes and women wanted to improve the nasolabial folds, and this difference was also statistically significant( $\chi$ 2=28.121, p<.001).

Looking at the parts of the body that you want to improve according to the age of the subject, the clavicle & back neck line is in '20s' 1 person(10.0%), '30s' 5 people(17.2%), '40s' 5 people(6.5%), 16 people in '50s or older'(14.7%), 2 people in '20s'(20.0%), 6 people in '30s(20.7%), 9 people in '40s(11.7%),' back and chest Over 50' 15(13.8%), Abdomen and waist 4 '20's(40.0%), '30's' 9 people(31.0%), '40's' 41 people(53.2%), '50 'Over age' 68(62.4%), buttocks '20's' 0(0.0%), '30's' 1 person(3.4%), '40's' 3 people(3.9%), '50's or older' 2 people(1.8%), lower body, calf 3 people in '20's(30.0%), 8 people in '30s(27.6%), 19 people in '40s'(24.7%), 8 people in '50s or older' people(7.3%). People in their 20's, 30's, 40's, and 50's said that they wanted to change the abdomen and waist, and this difference was found to be statistically significant( $\chi$ 2=22.033, p<.05).

#### **3.5.** Differences in appearance management behavior according to general characteristics

Along Independent sample t-test, one-way ANOVA, and Scheffe's post hoc test were performed to determine whether there is a difference in appearance management behavior according to the general characteristics of the study subjects.

It was found that there was a statistically significant difference in health perception and selfbody perception according to gender. Health perception(t=-2.961, p<.01) was lower in men than in women, and self-body recognition(t=3.247, p<.01) was higher in men than in women.

#### **3.6.** Correlation analysis

Along Pearson's correlation analysis was performed to understand the correlation between the variables in this study.

Appearance management behavior showed a statistically significant positive(+) correla-tion with body type recognition(r=.381, p<.001), and health awareness, a sub-factor of body type recognition(r=.270, p<.001). (+)showed a positive correlation, as shown in <Table 2>.

Also, as the absolute value of the correlation coefficient between the measured variables was less than .80, there was no problem of multicollinearity.

	Body image recognition	Health awareness	Self-body image recognition	Social awareness	Life-habit awareness	Appearance management behaviors
Body image recognition	1					
Health awareness	.698***	1				
Self-body image recognition	.500***	-0.001	1			
Social awareness	.590***	.257***	0.093	1		
Life-habit awareness	.305***	.388***	179**	.189**	1	
Appearance management behaviors	.381***	.270***	.179**	.162*	.175**	1

Table 2. Correlation analysis.

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

#### 3.7. Effect of body image recognition on appearance management behaviors

Simple regression analysis was conducted to verify the effect of Body Image Recognition on appearance management behavior, which is shown in <Table 3> below.

As a result of verifying the regression model, the regression model was suitable as F=37.933(p<.001), and the explanatory power of the model was about 14.5%. Meanwhile, the Durbin-Watson statistic was 1.753, which was close to 2, so there was no problem in assuming the independence of the residuals.

As a result of verifying the significance of the regression coefficient, it was found that Body Image Recognition had a significantly positive(+) effect on Appearance Management Behaviors( $\beta$ =.381, p<.001). In other words, it can be said that the higher the Body Image Recognition, the higher the Appearance Management Behaviors.

Variables	В	S.E	β	t	р	
(Constant)	1.155	0.398		2.901**	0.004	
Body image recognition	0.677	0.11	0.381	6.159***	<.001	
F=37.933(p<.001), R <sup>2</sup> =.145, adjusted R <sup>2</sup> =.142, Durbin-Watson=1.753						

Table 3. Effect of body image recognition on appearance management behaviors.

Note: \*\* p<.01 \*\*\* p<.001.

#### 3.8. Effect of subfactors of body image recognition on appearance management behaviors

Multiple regression analysis was conducted to verify the effect of sub-factors of Body Image Recognition on Appearance Management Behavior.

As a result of testing the regression model, as shown in <Table 4> below, the regression model was suitable with F=7.633(p<.001), and the explanatory power of the model was about 12.2%. Meanwhile, the Durbin-Watson statistic was 1.753, which was close to 2, so there was no problem in assuming the independence of the residuals. The tolerance was all 0.1 or higher and VIF(Variance Inflation Factor) was less than 10, so the multicollinearity problem did not appear.

As a result of verifying the significance of the regression coefficient, it was found that health perception and self-body perception had a statistically significant positive(+) effect on appearance management behavior. In other words, it can be said that the higher the health awareness and body shape awareness, the higher the appearance management behavior.

Health perception( $\beta$ =.207, p<.01) and self-body recognition( $\beta$ =.193, p<.01) were found to have an effect on appearance management behavior in the order, whereas social awareness and lifestyle awareness There was no significant effect on appearance management behavior.

Variables	В	S.E	β	t	р	tolerance	VIF
(Constant)	1.369	0.414		3.304**	0.001		
Health awareness	0.281	0.095	0.207	2.959**	0.003	0.812	1.231
Self-body image recognition	0.152	0.051	0.193	2.978**	0.003	0.949	1.054
Social awareness	0.057	0.055	0.069	1.036	0.302	0.911	1.097
Life-habit awareness	0.102	0.062	0.116	1.646	0.101	0.805	1.242
F=7.633(p<.001), R <sup>2</sup> =.122, adjusted R <sup>2</sup> =.106, Durbin-Watson=1.753							

Table 4. Effect of subfactors of body image recognition on appearance management behaviors.

Note: \*\* p<.01.

#### 4. Summary and Conclusion

According to gender, men want to improve wrinkles around the eyes and women want to improve nasolabial folds( $\chi$ 2=28.121, p<.001). However, as the next priority, those in their 20s and 40s wanted the lower body and calves, and those in their 50s and over wanted the collar-bone and back neckline( $\chi$ 2=22.033, p<.05). As each gender and age group has different desires to improve with manual therapy, it is necessary to develop a differentiated program. The results of responses to the use of beauty services are similar to those of other studies in that there are differences according to gender[28][29] and age[30][31]. It is thought that beauty experts should further increase their knowledge of body manipulation and pay attention to clinical and in-depth education.

Second, according to gender, women were perceived to be healthier than men(t=-2.961, p<.01), but the level of self-body recognition was low(t=3.247, p<.01). This can be seen as a woman who is not confident in her body type, so she has become the main customer of beauty shops.

Third, Body Image Recognition was found to have a positive effect on Appearance Management Behavior( $\beta$ =.381, p<.001). In other words, it can be said that the more positively she perceives her body type, the more active she is in Appearance Management Behavior. In detail, it was found that the higher the level of Health Awareness( $\beta$ =.207, p<.01) and Self-body Image Recognition( $\beta$ =.193, p<.01) induce Appearance Management Behaviors. It was found that Health Awareness had a greater influence on Appearance Management Behaviors than Self-body Image Recognition.

The result that the appearance management behavior increases as customers positively perceive their health and body image[32][33] supports the results of previous studies. Therefore, it can be seen that there is a high possibility that it has a positive effect on the appearance management behavior of customers and that various levels of management behavior lead to consumption of beauty and health services.

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#### 6. Appendix

#### 6.1. Authors contribution

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