

Study on Physique Characteristics of Skilled Athletes

The purpose of this study is to investigate whether there are differences in physique characteristics between the excellent domestic player groups in each sport player's, to prevent epidemiologic damage of musculoskeletal system and to provide fundamental data to improve performances for players. This study has performed for total 60 student players from Y University in Yongin, Gyeonggi-do, consists of 20 Kendo players, 20 Judo players and 20 Taekwondo players. We measured the length and circumference of arm, leg, body using Martin anthropometer to collect the data for 3 groups.

There was significant difference in lower left arm length between player groups ($p < .01$), and Kendo players' right side femoral were longer than other 2 groups for leg length measurement ($p < .01$). Judo players' circumference for right/left stretched arm/bent upper arm were thicker than other 2 groups ($p < .01$). Taekwondo players' chest circumference were smaller than other 2 groups ($p < .01$), and Taekwondo players' right/left femoral circumference were thinner than other 2 groups ($p < .05$).

From this study, it was found that there are physique characteristics differences between the Kendo, Judo and Taekwondo player groups. This indicates that repeated exercise for each sport player causes physique change, and it may cause epidemiologic damage of musculoskeletal system. It is recommended to perform balancing exercise prior to main exercise.

Key words: *Athletes; Physique Characteristics; Martin Anthropometer; ISAK*

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INTRODUCTION

Sports player's physique is highly related with physical, functional growth by each sport player, and it is considered emphasized as important factor to decide the level of performance. Excellent players with highest performance have adequate physique and habitus required for the specific sport player(1, 2). Therefore, many researchers study to examine players' morphological characteristics because it can contribute improving players' performance by providing morphological characteristics data such as physique and habitus(3, 4).

Physique measurement items presented by ISAK (International Society for the Advancement of Kinanthropometry) are divided into 2 groups, the

restricted profile which has 15 items and the full profile which has 39 items(5). Habitus is generally classified as basic measurement, subcutaneous fat, circumference, length, width. Basic measurement measure length and weight as well as basic height, body weight, sitting height. Subcutaneous fat measures fat content using body weight. Circumference measures the body girth. Length measures the length of physique along the body major axis. Width measures width and thickness of right angle direction from body's major axis(2).

This study was performed to investigate Kendo, Judo, Taekwondo players' physique characteristics of body length, body width, circumference, subcutaneous fat thickness, to prevent musculoskeletal system related epidemiologic damage, and to provide fundamental data to improve performances.

MATERIALS AND METHODS

Subjects

This study has performed during March to April 2010 for total 60 student players from Y University in

Yongin, Gyeonggi-do, consists of 20 Kendo players, 20 Judo players and 20 Taekwondo players who are all over 8 years of experience in the field. All participants understood the purpose and intent of the study, and submitted written consent to participate the experiment before attending the experiment.

Table 1. Anthropometric data of group

General characteristics	Kendo(n=20)	Judo(n=20)	Taekwondo(n=20)	Total(n=60)
Age(yrs)	23.80±2.25	22.50±2.91	22.30±2.87	22.86±2.67
Height(cm)	175.30±3.82	175.40±2.50	174.20±3.50	174.97±3.27
Weight(kg)	72.08±9.11	76.66±11.64	66.64±6.90	71.89±10.10
Skeletal Muscle Mass(kg)	33.24±5.67	34.67±5.29	30.85±4.21	32.97±5.29
Body fat mass(kg)	13.49±3.92	15.68±6.51	12.15±4.56	13.78±5.18
BMI(kg/m ²)	24.35±1.73	26.17±3.10	22.75±1.54	24.44±2.57
% body fat	18.92±5.77	20.05±6.55	18.18±6.25	19.05±6.12

Body Measurement

Body measurement was performed by same measurer who is trained and has above master's degree according to ISAK Manual(2001) recommended standard method, using Martin anthropometer(Takei, Japan). Habitus measurement items such as basic measurement, subcutaneous fat, length, width are divided into upper/lower extremities and left/right. Measurement posture were eyes facing front, gather heels, open between both toes with 30 degrees, and lower both hands naturally.

Body Composition

Body composition is performed using impedance meter Inbody 720(Biospace, Korea) with max. 1000kHz and min. 20kHz, 1mA fine current which has no damage to human body, and measure intracellular fluid and extracellular fluid to examine body composition.

Person to be measured wore light cloth, remove watch, etc. stand upright on the foot electrode with bare foot, and measure height from the sole of foot to the head top by automatic device. Also, measure the weight and body fat by holding handle electrode without saying a word nor any movement. Body composition analysis was performed for right hand, left hand, body, right foot, left foot using 4 frequency bands(5kHz, 50kHz 250kHz, 500kHz) by measuring electric resistance for each body parts. They were asked to urinate 30 minutes before measurement, no food for 4 hours before measurement, no exercise for 12 hours before measurement, no alcohol drink for 48 hours before measurement.

Data Analysis

The results of this study were coded and analyzed using computerized statistics program(SPSS 18.0/PC).

First, frequency and percentage were calculated using descriptive statistics to find the distribution by property of the study objects.

Second, one-way ANOVA with 0.5 significance level was performed to find the difference of experiment results between sports groups(Kendo, Judo, Taekwondo). When there is difference according to the analysis result, we performed Duncan's multiple comparison to verify the difference.

RESULTS

Players' Arm and Leg Length Difference by Sports Players

The analysis results of the players' arm length (humerus, forearm, hand), leg length(leg, femoral, tibial) by sports players is shown in Table 2. Kendo players have longer right and left lower arm than Judo and Taekwondo players on the average, and especially have significant difference in left lower arm length(p<.01). Kendo players have longer right and left femoral than Judo and Taekwondo players on the average, and especially have significant difference in right femoral length(p<.01).

Table 2. The difference of limb length in each group

Classification		Kendo	Judo	Taekwondo	F	p
Humerus	Rt	31.08±1.64	31.12±1.53	31.40±1.57	253	.777
	Lt	31.07±1.79	31.43±1.47	31.54±1.35	.560	.574
Forearm	Rt	25.73±1.66	24.74±1.29	25.22±1.77	2.207	.118
	Lt	26.04±1.32 ^{†††}	25.04±1.39	24.60±1.38	6.772	.002 ^{**}
Hand	Rt	14.53±3.62	13.63±3.61	14.97±3.96	.688	.506
	Lt	14.68±3.65	13.82±3.45	14.87±3.84	.494	.613
Leg length	Rt	92.97±5.02	92.05±5.79	93.56±7.10	.336	.716
	Lt	92.72±4.20	91.35±5.92	93.51±6.96	.756	.474
Femoral	Rt	51.73±2.76	46.73±6.78	48.11±6.82	4.916	.010 [*]
	Lt	51.72±3.18	48.05±6.70	48.60±6.57	2.936	.060
Tibial	Rt	42.33±3.48	40.79±2.84	42.39±3.35	1.662	.198
	Lt	42.12±3.11	40.58±3.08	42.38±3.23	2.030	.140

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

††† : significant difference between Taekwondo player and Kendo player.

Players' Body width Difference by Sports Players

The analysis results of the players' body width (shoulder, hip, thorax, elbow, knee) by sports players is shown in Table 3.

According to the analysis result on shoulder width, Judo players were wider than Kendo and Taekwondo players on the average, and Kendo player has statis-

tical significant difference(p<.01) than other 2 groups. For hip width, Judo players were wider than Kendo and Taekwondo players on the average. For breast width, judo players were wider than Kendo and Taekwondo players on the average, and Taekwondo players have significantly low difference(p<.05) compare to Judo and Kendo players.

Table 3. The difference of body width in each group

Classification		Kendo	Judo	Taekwondo	F	p
Shoulder		8.88±1.14 ^{†††}	10.90±.92 [†]	9.92±2.64	8.251	.001 ^{**}
Hip		16.95±2.17	17.48±1.88	16.05±1.31	3.100	.052
Thorax		18.33±1.62	19.03±1.74	17.42±1.85 ^{††}	4.471	.015 [*]
Elbow		6.42±.54	6.97±1.24	6.44±.97	2.350	.104
Knee		9.67±.63	9.38±1.13	13.33±17.60	1.071	.349

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

† : significant difference between Kendo player and Judo player.

†† : significant difference between Judo player and Taekwondo player.

††† : significant difference between Taekwondo player and Kendo player.

Players' Body Circumference by Sports Players

The analysis results of the players' body circumference(thorax, back, hip) by sports entries is shown

in Table 4.

According to the analysis result on breast circumference, Taekwondo players have smaller breast with statistical significant difference(p<.01).

Table 4. The difference of circumference of trunk in each group (cm)

Classification	Kendo	Judo	Taekwondo	F	p
Thorax	90.06±5.48 ^{***}	92.52±4.20	85.03±5.18 ^{**}	11.881	.000 ^{**}
Back	79.31±6.35	81.14±6.52	77.11±6.23	2.056	.136
Hip	98.29±4.29	98.54±5.79	95.58±4.82	2.279	.111

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

^{**} : significant difference between Judo player and Taekwondo player.

^{***} : significant difference between Taekwondo player and Kendo player.

Players' Arm, Leg Circumference Difference by Sports Players

The analysis results of the players' arm circumference(extension brachium, flexion brachium, forearm, wrist), leg circumference(femoral, tibial, ankle) by sports entries is shown in Table 5.

According to the analysis results of the players' right/left stretched upper arm and bent upper arm, Judo players are thicker than Kendo and Taekwondo players on the average, and has statistically significant difference(p<.01). For the right/left lower arm circumference difference, Kendo player were thicker than judo or Taekwondo player on the average, and had significant difference(p<.01). For the right wrist circumference difference, Judo player were thicker than Kendo or Taekwondo player on the average,

and had significant difference(p<.01). Also, for the left wrist circumference difference, Judo player were thicker than Kendo or Taekwondo player on the average, and had significant difference(p<.05).

For right/left femoral circumference, Taekwondo players were thinner than Kendo and Judo players on the average, and had statistical significant difference(p<.05). For calf circumference, Kendo player were thicker than Judo, Taekwondo players on the average, but there were no significant difference. For right ankle circumference, Taekwondo players were thinner than Kendo, Judo players on the average, and had significant difference(p<.01). For left ankle circumference, Kendo players were thicker than Judo, Taekwondo players on the average with significant difference(p<.01).

Table 5. The difference of circumference of extremities in each group (cm)

Classification		Kendo	Judo	Taekwondo	F	p
Extension brachium	Rt	29.30±2.33 ^{***}	31.17±2.64 [†]	26.16±1.87 ^{**}	24.588	.000 ^{**}
	Lt	28.60±2.34 ^{***}	30.83±2.23 [†]	26.41±1.75 ^{**}	21.922	.000 ^{**}
Flexion brachium	Rt	32.32±2.30 ^{***}	33.29±2.39	28.20±1.94 ^{**}	30.260	.000 ^{**}
	Lt	31.00±2.47 ^{***}	32.43±2.09 [†]	28.06±2.06 ^{**}	20.344	.000 ^{**}
Forearm	Rt	26.82±2.00 ^{***}	26.50±1.78	24.12±1.76 ^{**}	13.380	.000 ^{**}
	Lt	26.25±2.85 ^{***}	26.07±1.49	23.72±1.57 ^{**}	9.261	.000 ^{**}
Wrist	Rt	16.58±.80 ^{***}	16.63±.98	15.77±.97 ^{**}	5.904	.004 ^{**}
	Lt	16.47±.97 ^{***}	16.58±.97	15.75±.92 ^{**}	4.635	.013 [*]
Femoral	Rt	57.48±5.51	58.81±4.50	52.40±13.21 ^{**}	3.334	.042 [*]
	Lt	56.88±5.06 ^{***}	58.40±4.34	51.67±13.34 ^{**}	3.688	.031 [*]
Tibial	Rt	38.74±2.23	38.55±2.64	38.43±2.03	.106	.900
	Lt	39.38±1.99	38.70±2.82	38.19±2.30	1.414	.251
Ankle	Rt	24.20±2.02 ^{***}	23.43±2.25	22.20±1.28 ^{**}	6.105	.004 ^{**}
	Lt	24.05±2.08 ^{***}	22.90±1.39 [†]	21.94±1.27	9.210	.000 ^{**}

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

[†] : significant difference between Kendo player and Judo player.

^{**} : significant difference between Judo player and Taekwondo player.

^{***} : significant difference between Taekwondo player and Kendo player.

Players' Subcutaneous Fat Thickness Difference by Sports Players

Analysis results for subcutaneous fat thickness(triceps brachii muscle, subscapularis muscle, biceps brachii muscle, iliac crest, abdomen, femoral, tibial) difference of the players by sports entries is shown in Table 6.

For subcutaneous fat thickness of femoral, Kendo player were thicker than Judo, Taekwondo players on the average, and Judo players were thinner with significant difference($p < .01$). For subcutaneous fat thickness of calf, Kendo players also were thicker than judo, Taekwondo players on the average, and Judo players were thinner with significant difference($p < .05$).

Table 6. The difference of subcutaneous fat thickness in each group (cm)

Classification	Kendo	Judo	Taekwondo	F	p
Triceps	16.43±5.89	15.12±8.70	15.19±7.62	.231	.794
Subscapularis	17.64±5.57	14.10±6.66	14.05±6.92	2.448	.095
Biceps	12.52±16.01	8.10±5.26	9.67±6.15	.987	.378
Iliac crest	17.98±7.86	19.85±10.34	17.76±12.42	.270	.764
Abdomen	22.32±6.13	17.62±8.44	18.25±8.80	2.521	.088
Femoral	28.60±12.75	15.57±13.62 [†]	21.65±12.94	5.696	.005**
Tibial	17.05±8.54	10.90±7.80 [†]	13.88±7.18	3.464	.037*

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

[†] : significant difference between Kendo player and Judo player.

DISCUSSION

For all sports entries, physical strength and value for exercise capacity are the factors to decide players' performance, and these become important data to ratify excellent player. Along with global trend, there is domestic trend recently to find performance decision factors by players' physical characteristics or physical fitness(6).

However, it is very hard to investigate what is the ideal physique. When we consider the recent trend of westernized physique, excellent physique in the past may not be always the same with current excellent physique. It is true that the concept for ideal physique is changing along with time as lifestyle changes(7).

Jin reported that from the national representative players' physique, superior players have significant difference in leg length and breast circumference compare to others(8). Choi and Jung reported that there were significant difference in breast circumference, leg length, femoral length, subcutaneous fat in their comparison between weight class(9).

From this study, Taekwondo players have longer upper arm length than Kendo, Judo players.

Especially for left lower arm length, Kendo players were longer than Judo, Taekwondo players($p < .01$). For leg length difference, Taekwondo players were longer than Kendo, Judo players. Especially for femoral length, fencing players were longer than Judo, Taekwondo players($p < .01$). For calf length, Taekwondo players were longer than the other 2 groups.

From the comparison between Taekwondo weight classes, there were significant difference in breast circumference, leg length, femoral length, subcutaneous fat. For Judo players, their height, weight, leg length, arm length, shoulder width are superior than other normal Korean with the same age, which agrees with existing study results(9).

As in the above, arm length is the sum of upper arm, lower arm, palm length. These characteristics can be easily acquired by influence. Leg length gets the most environmental influence among other parts of body. When we consider the height as sitting height plus leg length, sitting height is regulated by genetic while leg length is influenced by environment.

From this study, for body circumference, Taekwondo players were smaller than other 2 groups with significant difference($p < .01$). For waist circumference, Judo players were wider than Kendo, Taekwondo players.

For hip circumference, Taekwondo players were wider than fencing, judo players. Physique comparison study for local martial arts players by Jang reported that the breast circumference are wide in sequence of judo, wrestling, Taekwondo players which matches with this study result(10). These study results of wider breast and waist circumference are considered to appear for Judo players who play the game using mainly with body and arm force. Taekwondo players' hip circumference is wider because they use more foot technique in the game.

For upper arm circumference difference, Judo player were thicker than fencing, Taekwondo players in stretched upper arm and bent upper arm($p < .01$). For lower arm circumference difference, Kendo player were thicker than judo, Taekwondo players($p < .01$). For wrist circumference difference, Judo players' right hand were thicker than fencing, Taekwondo player($p < .01$). Judo players should play the game in bent posture during catching position, which made thicker stretched upper arm, bent upper arm and wrist. For Kendo players who play game at separated distance, it caused thicker lower arm circumference which matches existing study results(11, 12).

For leg circumference difference, Taekwondo players' femoral were smaller than Kendo, Judo player($p < .05$), and Kendo players' calf circumference were thicker than other 2 groups, Taekwondo players' right ankle circumference were smaller than Kendo, Judo players($p < .01$). This indicates the same results of existing study that Judo players have thicker, while Taekwondo players have thinner physique in the comparison by sport entries(13, 14). Taekwondo increases its body tension level by exercising jump in place for faster reaction. It is considered that this exercise cause the lowest femoral circumference, Judo players' standing posture caused thicker thigh, and Kendo players' calf are thicker because maintain the posture must also be considered.

CONCLUSION

The purpose of this study is to investigate physique characteristics for total 60 players, 20 players each from Kendo, judo, Taekwondo, and to prevent epidemiologic damage of musculoskeletal system and to provide fundamental data to improve performances for players.

The result of leg length difference between the players indicated that Kendo players have longer femoral length, Taekwondo players have narrower breast circumference than the other 2 groups. For leg circumference difference results, Taekwondo players were thinner than other 2 groups in right/left femoral circumference, Taekwondo players were thinner than other 2 groups in right ankle circumference, Kendo players were thicker than other 2 groups in left ankle circumference.

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