

KINANTHROPOMETRIC ATTRIBUTES OF ELITE MALE JUDO, KARATE AND TAEKWONDO ATHLETES



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CARACTERÍSTICAS CINEANTROPOMÉTRICAS DE ATLETAS DO SEXO MASCULINO DE JUDÔ,
KARATÊ E TAEKWONDO

CARACTERÍSTICAS CINEANTROPOMÉTRICAS DE ATLETAS DEL SEXO MASCULINO DE YUDO,
KARATE, Y TAEKWONDO

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ABSTRACT

Introduction: It is well known that the body composition of an athlete plays a critical role in sports performance. However, although many studies exist concerning the kinanthropometric attributes of mainstream sports, few studies are forthcoming on individual martial arts disciplines, especially in elite athletes. **Objective:** This study aimed at establishing the kinanthropometric attributes of Judo, Karate, and Taekwondo athletes. **Methods:** Thirty-eight elite male Judo ($n=42$, mean age: 21.7 ± 2.9 years), Taekwondo ($n=46$, mean age: 21.1 ± 2.6 years) and Karate ($n=50$, mean age: 21.3 ± 3.0 years) athletes were chosen randomly. The study determined and compared stature, body mass (BM), body mass index (BMI), fat mass (FM), lean body mass (LBM), body surface area (BSA), sum of skinfolds ($\Sigma SK3$), percentage body fat (%BF), and somatotype. **Results:** The findings of the present study demonstrate that although within normal levels, the sampled Judo athletes have significantly ($p < 0.05$) higher FM, $\Sigma SK3$ (particularly at the triceps and subscapular skinfold sites), %BF and lower percentage LBM than either the Taekwondo and Karate athletes. In addition, the sampled Judo athletes displayed a more significant ($p < 0.05$) endomorphic somatotype when compared to the Taekwondo and Karate athletes. **Conclusions:** These findings are essential in determining the optimal kinanthropometric attributes of elite male Judo, Karate, and Taekwondo athletes and may assist in the context of talent identification.

Keywords: anthropometry; body composition; sports; martial arts.

RESUMO

Introdução: Sabe-se que a composição corporal de um atleta tem papel essencial no desempenho esportivo. No entanto, embora existam muitos estudos sobre as características cineantropométricas dos esportes predominantes, poucos são realizados sobre disciplinas individuais das artes marciais, especialmente em atletas de elite. **Objetivo:** Este estudo visa estabelecer as características cineantropométricas dos atletas de judô, karatê e taekwondo. **Métodos:** Trinta e oito atletas de elite do sexo masculino de judô ($n = 42$, média de idade: $21,7 \pm 2,9$ anos), de taekwondo ($n = 46$, média de idade: $21,1 \pm 2,6$ anos) e de karatê ($n = 50$, média de idade: $21,3 \pm 3,0$ anos) foram selecionados aleatoriamente. O estudo determinou e comparou estatura, massa corporal (MC), índice de massa corporal (IMC), massa adiposa (MA), massa magra corporal (MMC), área de superfície corporal (ASC), soma das dobras cutâneas ($\Sigma DC3$), porcentagem de gordura corporal (%GC) e somatotipo. **Resultados:** Os achados do presente estudo demonstram que, embora dentro dos níveis normais, os atletas de judô da amostra têm MA significativamente ($p < 0,05$) mais alta, assim como $\Sigma DC3$ (em especial nos locais de dobras cutâneas tri-cipitais e subescapulares), %GC e menor porcentagem de MMC que os atletas de taekwondo e karatê. Além disso, os atletas de judô amostrados apresentaram somatotipo endomórfico mais significativo ($p < 0,05$) em comparação com os de taekwondo e karatê. **Conclusões:** Esses achados são essenciais para determinar as características cineantropométricas de atletas de elite do sexo masculino de judô, karatê e taekwondo e podem auxiliar na identificação de talentos.

Descritores: antropometria; composição corporal; esportes; artes marciais.

RESUMEN

Introducción: Se sabe que la composición corporal de un atleta tiene papel esencial en el desempeño deportivo. Sin embargo, aunque existan muchos estudios sobre las características cineantropométricas de los deportes predominantes, pocos son realizados sobre disciplinas individuales de las artes marciales, especialmente en atletas de elite. **Objetivo:** Este estudio busca establecer las características cineantropométricas de los atletas de yudo, karate y taekwondo. **Métodos:** Treinta y ocho atletas de elite del sexo masculino de yudo ($n = 42$, promedio de edad: $21,7 \pm 2,9$ años), de taekwondo ($n = 46$, promedio de edad: $21,1 \pm 2,6$ años) y de karate ($n = 50$, promedio de edad: $21,3 \pm 3,0$ años) fueron seleccionados aleatoriamente. El estudio determinó y comparó estatura, masa corporal (MC), índice de masa corporal (IMC), masa adiposa (MA), masa magra corporal (MMC), área de superficie corporal (ASC), suma de los pliegues cutáneos ($\Sigma DC3$), porcentaje de grasa corporal (%GC) y somatotipo. **Resultados:** Los hallazgos del presente estudio demuestran que, aunque dentro de los niveles normales, los atletas de yudo de la muestra tienen MA significativamente ($p < 0,05$) más alta, así como $\Sigma DC3$ (en especial en los locales de pliegues cutáneos tri-cipitales)

y subescapulares), %GC y menor porcentaje de MMC que los atletas de taekwondo y karate. Además, los atletas de judo muestreados presentaron somatotipo endomórfico más significativo ($p < 0,05$) en comparación con los de taekwondo y karate. Conclusiones: Esos hallazgos son esenciales para determinar las características cineantropométricas de atletas de elite del sexo masculino de judo, karate y taekwondo y pueden ayudar en la identificación de talentos.

Descriptor: antropometría; composición corporal; deportes; artes marciales.

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INTRODUCTION

Success within any sport requires certain types of physical, physiological, psychological and social capabilities. It is well known that the body composition of an athlete plays a critical role in sports performance^{1,2}. However, although many studies exist concerning the kinanthropometric attributes of many mainstream sports, few studies are forthcoming on combat sports³, especially in elite athletes⁴ and across the various martial art disciplines. When such data is forthcoming on kinanthropometric attributes in the world's martial art disciplines, data is further lacking in the particularly strong Asian countries^{5,6}.

Knowing the kinanthropometric attributes such as body size, body proportions, physique, body shape and body composition for any sport allows the coach and conditioning specialist to optimally develop nutritional and/or training programmes to maximise athletic performance in that particular sport⁷. Specifically, it has been demonstrated that a high degree of fat-free mass and low degree of fat mass is directly linked to improved exercise skills⁸. Further, the majority of research regarding kinanthropometric attributes have illustrated that the anthropometric features of morphology (endomorph, mesomorph and ectomorph) also play an essential role in the success of the athletes in a particular sport in comparison to non-athletes⁹. As a result, coaches and conditioning specialists often consider certain kinanthropometric attributes in order to select the athletes to earn championship titles¹⁰.

In addition, the determination of kinanthropometric attributes for any sport is essential for talent identification for a particular sport¹¹. In fact, many studies in talent identification have concluded that there is a strong relationship between body composition and motor performance¹². By knowing the required kinanthropometric attributes for a particular sport, coaches and conditioning specialists will be better enabled to recognise and determine an individual's capabilities and appropriately guide him or her to the appropriate sport and to develop realistic expectations for the athlete in a particular sport.

The problem with most of the previous studies on the kinanthropometric attributes of combat sports is that they were either concentrated on a limited spectrum of morphological characteristics or were conducted in the absence of one of the somatotype characteristics, anthropometric and/or body compositions^{1,2,12,13}. As such, the present study aimed to examine the kinanthropometric attributes of three martial art disciplines (i.e., judo, karate, and taekwondo) and to juxtapose as well as to compare the kinanthropometric attributes of these three disciplines to determine if a significant difference exists among elite male athletes.

METHODS

Sample

This study included a convenient sample of 138 elite male athletes from three martial arts disciplines: Judo ($n = 42$), Taekwondo ($n = 46$) and Karate Chyurio ($n = 50$) who had won/held national, Asian or world titles (Table 1) among national athletes of Iran. Written informed consent was obtained from the participants after they were explained the purpose of the study, measurement procedures and the possible

Table 1. Descriptive statistics of subjects.

Parameters	Judo (n=42)	Karate (n=46)	Taekwondo (n=50)
Age (years)	21.7±2.9	21.1±2.6	21.3±3.0
Experience (years)	8.8±3.8	7.8±2.9	8.8±3.7
Exercise per week (hours)	11.8±8.2	13.1±5.1	12.1±9.0

negative events that could be encountered during the study¹⁴. This study was approved by the Institutional Review Boards of the Isfahan University, Iran (no:1394204/23/02/04).

Procedures

Anthropometric measurements were carried out according to the methods proposed by the International Society for the Advancement of Kinanthropometry (ISAK)¹⁵ and measured by the same technicians. Body mass (BM) was measured in kilogrammes on a calibrated medical scale (Trojan, BSA16056v, Duteck Industrial Co. Ltd, Taiwan), whilst stature was measured to the nearest millimetre, using a standardised wall mounted stadiometer (Seca Stadiometer, 216, Seca, USA). Participants were required to wear minimal clothing and no shoes whilst the technician completed these tests¹⁶. Body Mass Index (BMI) was calculated by dividing the participant's body weight (kg) by height squared (m^2) and expressed as kilogrammes per square meter ($kg \cdot m^{-2}$) while body surface area (BSA) was calculated using the following formulae: $BSA (m^2) = (\text{body mass in kg})^{0.425} \times (\text{stature in cm})^{0.725} \times 0.007184$ (Hume & Weyers, 1971). Fat mass (FM) was calculated by multiplying body mass by fat percentage and was divided by 100 to get a percentage [body mass multiplied by (fat percentage divided by 100)] while lean mass was calculated as total body mass in kilogrammes subtracted by fat mass in kilogrammes¹⁵.

Skinfolds (biceps, triceps, chest, mid-thigh, and abdominal, subscapular, suprailiac and calf) were taken on the right side of the body using a skinfold calliper (Harpender, HSB-BI, ATICO Medical Pvt. Ltd, United Kingdom) and percentage body fat (%BF) ratio was calculated using the equation of Jackson and Pollock¹⁷. In order to calculate the sum of skinfolds ($\Sigma SK3$) the triceps, subscapular and chest skinfold measurements were summed together. Upper arm and thigh circumferences were measured in centimetres (cm) in both a tensed and relaxation position, while the measurement of the calf circumference was measured with the participants sitting at the end of a table and having their legs hanging over the edge. The widths and diameters of the humerus and femur were measured to the nearest 0.1 millimetre (mm). The components of the body type (endomorph, mesomorph and ectomorph), the somatotype dispersion mean (SDM) and the somatotype attitudinal mean (SAM) were measured in terms of the recommended formula by Carter and Heath¹⁸.

Data analysis

All statistical analysis was performed using the SPSS for Windows software (version 19.0, SPSS Inc., Chicago, Illinois, USA). Data are presented as means \pm standard deviation (SD). One-way analysis of variance (ANOVA) was used to determine differences between the various martial arts disciplines in all kinanthropometric attributes, followed by Scheffe's *post hoc* tests. $P < .05$ were considered statistically significant in the interpretation of the results.

RESULTS

The findings of the present study demonstrate that the sampled Judo athletes have significantly ($p < .05$) higher fat mass, sum of skinfolds (particularly at the triceps and subscapular skinfold sites), percentage body fat and lower percentage lean mass than either the Taekwondo and Karate athletes (Table 2). In addition, the sampled Judo athletes display a more significant ($p < .05$) endomorphic somatotype when compared to the Taekwondo or Karate athletes (Table 2 and Figure 1).

Table 2. Kinanthropometric attributes of elite male judo, karate, and taekwondo athletes.

	Judo (n = 42)	Karate (n = 46)	Taekwondo (n = 50)
Stature (cm)	177.5±8.3	178±6.02	177.0±8.1
Body mass (kg)	73.8±14.9	76.9±13.7	71.8±14.9
BMI (kg.m ⁻²)	23.2±3.2	24.1±3.1	22.7±3.2
BSA (m ²)	1.9±0.2	1.9±0.2	1.9±0.2
Fat mass (kg)†,††	10.1±3.6	8.1±2.9	7.8±3.1
Lean body mass (kg)	63.7±11.9	68.8±11.5	64.0±12.6
Lean body mass (%) †,††	86.6±2.4	89.6±2.3	89.3±2.6
Bicep skinfold (mm)	8.6±3.2	8.6±2.5	7.9±2.7
Triceps skinfold (mm)†,††	10.7±3.9	9.5±3.4	9.0±3.5
Subscapular skinfold (mm) †,††	12.3±3.6	10.5±2.9	11.1±3.3
Pelvic skinfold (mm)	17.0±7.1	14.6±5.3	15.0±5.8
Mid-thigh skinfold (mm)	8.9±3.0	8.6±2.9	8.6±3.2
Thoracic skinfold (mm)††,†††	11.9±2.2	7.8±2.1	8.5±2.4
Ventral skinfold (mm)††	13.6±3.0	11.9±1.8	11.9±1.8
Sum of 3 skinfolds (mm)†,†† (triceps, subscapular and chest)	39.9±10.7	34.6±7.8	34.7±9.3
Percentage body fat (%) †,††	13.4±2.4	10.4±2.3	10.7±2.6
Knee width (cm) †	9.8±0.6	9.9±0.6	10.1±0.6
Elbow width (cm) †††	6.5±0.4	6.6±0.4	6.4±0.5
Calf circumference (cm)	40.4±2.8	40.0±1.8	40.1±2.4
Arm circumference (cm) ††	35.9±2.7	37.5±2.0	35.9±3.1
Endomorph †,††	4.0±0.9	3.5±0.8	3.5±0.9
Mesomorph	4.8±1.1	4.7±1.1	4.6±1.2
Ectomorph	2.6±1.1	2.3±1.0	2.8±1.2

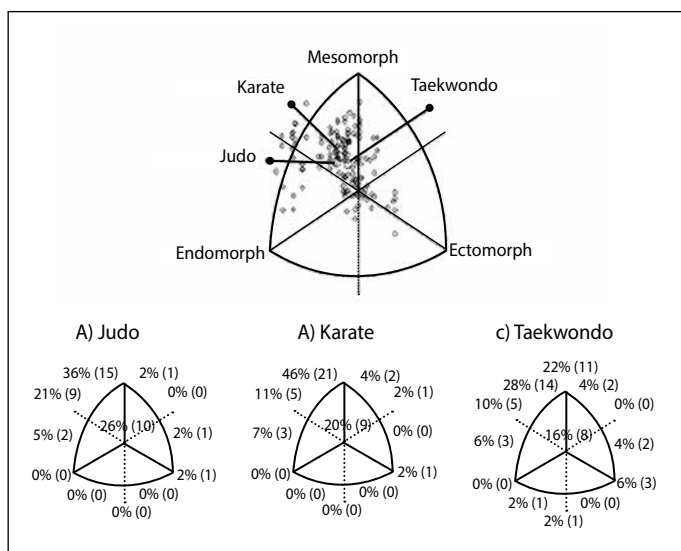


Figure 1. Somatotypes of elite male judo, karate, and taekwondo athletes.

DISCUSSION

Success within any sport requires certain types of physical, physiological, psychological and social capabilities. It is well known that the kinanthropometric attributes of an athlete plays a critical role in sports performance¹ and talent identification³. In spite of their importance,

very few studies have been done to compare the kinanthropometric attributes among sub-disciplines and especially in elite athletes^{4,19}. In this study, critical kinanthropometric attributes (i.e., stature, body mass, BMI, fat mass, lean body mass, body surface area, sum of skinfolds, %BF, and somatotypes) that could affect athletic performance were investigated among male Judo, Karate and Taekwondo elite athletes.

The findings of the present study demonstrate that the sampled Judo athletes displayed higher fat mass, sum of skinfolds (particularly at the triceps and subscapular skinfold sites), percentage body fat and lower percentage lean body mass than either the Taekwondo and Karate athletes. In addition, the sampled Judo athletes displayed a more endomorphic somatotype when compared to the Taekwondo and Karate athletes. This finding may support the proposal of King and Williams in that Karate and Taekwondo athletes, but not Judoists, require moving their bodies in the utmost possible speed in the existing space.

The results of the present study showed that the three sub-disciplines of combat sport did not display any difference in many kinanthropometric characteristics such as stature, body mass, BMI and body surface area. This may be as a result of the common nature of these three similar combat sports, which utilise similar aerobic and anaerobic energy systems³. As a result, all of these three sports require high muscular strength and power. It has previously been demonstrated that stature has a positive effect on the performance of the athletes^{8,20} and it is no surprise that the Judo, Karate and Taekwondo athletes did not differ in height. This finding is confirmed in other studies of athletes from other countries¹¹.

While the Judo athletes were found to have had a higher level of body fat percentage than the Karate and Taekwondo athletes, these findings are comparable to those of similar studies⁷. Likewise, the findings of the present study on somatotype are consistent with the results of the majority of previous studies^{4,8,19}. Interestingly, existing literature indicates that at all levels of competition, the mesomorphic component is the dominant somatotype component. Although this is true for the Karate and Taekwondo athletes in this study, the endomorph component of the Judo athletes is higher in comparison to sampled Karate and Taekwondo athletes. This increased mesomorphy, and indeed endomorphy in the Judoists, is essential in that the larger muscle mass reflected in the mesomorphy component can be considered a significant benefit for the athletes who encounter harsh physical confrontations during exercise and competitions, while the increased fat mass in the Judoists may prove beneficial in the throwing and related impacts in absorbing and dissipating such forces.

CONCLUSIONS

The findings of the present study demonstrate that the sampled elite Judo athletes displayed higher fat mass, sum of skinfolds (particularly at the triceps and subscapular skinfold sites), percentage body fat and lower percentage lean body mass than either the elite Taekwondo and Karate athletes. In addition, the sampled Judo athletes displayed a more endomorphic somatotype when compared to the Taekwondo and Karate athletes, who displayed a more mesomorphic type. These findings are essential since long-term training programmes may be implemented to improve identified kinanthropometric attributes in athletes associated with sports performance, and those athletes with appropriate kinanthropometric attributes may be identified and guided to and within the appropriate sporting discipline. Based on these results, it can be said that different athletes have different kinanthropometric attributes that is related to the source of their sport and specialised training.

All authors declare no potential conflict of interest related to this article.

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