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# Kinanthropometric Attributes of Young Male Combat Sports Athletes

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**A B S T R A C T**

*Although there are enough studies concerning the kinanthropometric attributes of players of sports such as football, basketball, or volleyball in Turkey, there are not enough studies on the same for combat sports. Hence, our aim is to assess the kinanthropometric attributes of different combat sports like karate, taekwondo, judo and kickboxing. The present study included 48 national level male athletes from four different combat sports (age, 20.3 (3.19) years; number of years playing the sport, 8.33 (4.59); height, 174.3 (7.15) cm; weight, 67.35 (10.55 kg). Skinfold thickness was measured with a skinfold caliper (Holtain Ltd., UK), and Yuhazs formula was used to calculate the body fat percentage. Somatotype assessment was carried out with a computer program (Sweat Technology Trial Version, South Australia). Width measurements were obtained with a slide caliper (HLT-100, Holtain Ltd.), and girth measurements were obtained with a non-flexible tape measure. The data obtained were analyzed with the computer program SPSS 17.0 in terms of the SD. The findings were as follows: body mass index (BMI), 22.00 (2.66) kg/m$^2$; body fat percentage, 12.20% (3.07%); endomorphic component, 2.9 (1.30); mesomorphic component, 4.25 (1.30); and ectomorphic component, 3.10 (1.30). The cormic index was 51.99% (1.88%); Monourier index, 92.39% (4.47%); Acromio-iliac index, 60.87% (6.61%); Martine index, 6.29% (0.70%); Biacromial index, 22.58% (0.99%); and hip index, 13.91% (0.86%). The mesomorphic component was found to be dominant in our study. Although BMIs were found to be normal, body fat percentages were low. According to body proportions, the athletes who participated in this study had wide shoulders, narrow hips, and medium-sized trunks.*

***Key words***: *combat sports, kinanthropometry, somatotype*

## Introduction

One of the most difficult and yet important things in sports is finding the appropriate athlete for a particular sport. This process is called talent identification. Even though the number of studies concerning talent identification is increasing day by day, there is no consensus on finding the right athlete. Talent identification studies have shown a positive correlation between motor performance and body composition[1].

These results have led many sport scientists to use anthropometric measures in talent identification. For instance, for basketball and volleyball, body height can be an important factor for success, depending on the role the athlete plays; for example, having long arms in boxing is probably an advantage. On the other hand, in combat sports where highly technical skills and agility are required, having excess body mass can affect the application of these attributes[2]. The factors that determine success in combat sports are motor and functional qualities such as technical skill, speed, strength, power, and coordination[3].

Karate, taekwondo, judo, and other similar combat sports require short-term, high intensity physical efforts. Hence, adenosine tri-phosphate (ATP) synthesis and re-synthesis occur through the phosphate system or lactic acid-anaerobic system because of the physical effort required by athletes. In tournaments where athletes compete in one game after another, well-developed aerobic capacity and maximum oxygen consumption ($VO_2$ max) are needed for recuperation. In combat sports, it is an advantage to have low body fat percentage and lean muscle mass. Excessive body fat does not have any role in ATP production and decreases $VO_2$ value[4].

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The increasing number of sports organizations and the concept of sports in social life have helped understand the role of body composition in sports. Although there are several methods for assessing body composition, the most commonly used one is the anthropometric method. Body composition assessment methods, which have been developed over the years, such as bioelectrical impedance and spectrophotometry, have similar application results as anthropometric methods[5].

Over the years, Turkey's success in combat sports has received the public's attention; however, although there are enough studies explaining the physical, psychological, and physiological attributes of popular sports such as football, volleyball, and basketball, this is not the case with combat sports. From this viewpoint, our aim is to assess the body composition requirement for athletes participating in combat sports such as karate, taekwondo, judo, and kick-boxing. The data obtained from anthropometric measurements are often used in talent identification, and therefore, the results from this study will be useful for bringing in new athletes for the above-mentioned combat sports.

## Material and Methods

### *Subjects*

The study included 48 national level male athletes from four different sports (karate, 7; taekwondo, 15; judo, 11; and kickboxing, 15). The following data was obtained from the athletes: age, 20.3 (3.19) years; number of years playing the sport, 8.33 (4.59); height, 174.3 (7.15) cm; and body weight, 67.35 (10.55) kg. Written consents were obtained from the participants, and the study purpose was mentioned. They were informed about the measurement procedures and were made aware of the possibility of any negative events occurring while measuring. All measurements were obtained by the same group of people on the same day in the Performance Laboratory at the Ege University School of Physical Education and Sports.

## Measurement Tools and Devices

### *Weight and height measurement*

An electronic weighing machine (Angel, 150 MA; Istanbul/Turkey) used to determine the weight and height of athletes before official competitions was used.

### *Body fat percentage measurement*

Holtain sensitive skinfold caliper (precision, 0.2 mm) was used to measure body fat percentage (Holtain Ltd., Crosswell, Crymych, UK). Skinfold thickness was measured at the triceps brachii, biceps brachii, subscapula, suprailiac, chest, thigh, calves, and abdomen. Yuhazs formula was used to assess body fat percentage.

### *Width measurements*

Width measurements were obtained with a sliding caliper (HLT-100; Holtain Ltd.).

### *Girth measurements*

Girth measurements were obtained with a non-flexible tape measure.

### *Somatotype assessment*

Somatotype assessment was made with an analysis software (Sweat Technology Trial Version, Adelaide, South Australia).

### *Statistical Analysis*

SPSS for Windows (ver. 17.0) was used to obtain the average and standard deviation of the obtained data.

## Results

In Table 1, the weight, height, weight-to-hip ratio (WHR), ponderal index (RPI), and body fat percentage are shown. In Table 2, the circumference, breadth, length, and depth used in index assessment are showed. Table 3 shows the skinfold measurement results. In Table 4, values for endomorphic, mesomorphic, and ectomorphic components are given. Table 5 shows the body mass index (BMI), cormic index, Monourier index, Acromio-iliac index, Martine index, biacromial index, and hip index values.

The results obtained are as follows: body fat percentage, 12.20% (3.07%); endomorphic component, 2.9 (1.30); mesomorphic component, 4.25 (1.30); ectomorphic component, 3.10 (1.30); BMI, 22.00 (2.66) kg/m$^2$; cormic index, 51.99% (1.88%); Monourier index, 92.39% (4.47%); Acromio-iliac index, 60.87% (6.61%); Martine index, 6.29% (0.70%); biacromial index, 22.58% (0.99%); and hip index, 13.91% (0.86%).

**TABLE 1**
AVERAGE VALUES FOR BODY PROPORTION IN ATHLETES

| Variables | $\overline{X}$ (SD) (N=48) | Evaluation |
|---|---|---|
| Height (cm) | 174.45 (7.15) | – |
| Body weight (kg) | 67.35 (10.55) | – |
| Waist-to-hip ratio (%) | 0.79 (0.17) | Perfect |
| Ponderal index (cm/kg $^{0.333}$) | 43.03 (1.66) | Normal |
| Fat (%) | 12.20 (3.07) | Low fat percentage (in terms of age) |

**TABLE 2**
DATA OBTAINED FOR INDEX EVALUATION

| Variables | $\overline{X}$ (SD) (N=48) |
|---|---|
| Sitting height (cm) | 90.70 (3.93) |
| Chest circumference (cm) | 89.56 (6.39) |
| Hip circumference (cm) | 99.06 (6.46) |
| Thigh circumference (cm) | 51.04 (4.23) |
| Calf circumference (cm) | 35.72 (2.41) |
| Flexed biceps (cm) | 30.70 (2.94) |
| Humerus breadth (cm) | 6.74 (0.51) |
| Femur breadth (cm) | 9.58 (0.76) |
| Bi-iliac breadth (cm) | 24.25 (1.62) |
| Chest depth (cm) | 27.90 (2.50) |

**TABLE 3**
SKINFOLD THICKNESS DATA

| Variables | $\overline{X}$ (SD) (N=48) |
|---|---|
| Biceps (mm) | 4.34 (1.45) |
| Triceps (mm) | 7.79 (3.20) |
| Abdominal (mm) | 12.86 (7.26) |
| Suprailiac (mm) | 12.45 (7.27) |
| Subscapular (mm) | 9.28 (4.01) |

**TABLE 4**
SOMATOTYPE COMPONENTS

| Somatotype | $\overline{X}$ (SD) (N=48) |
|---|---|
| Endomorphy | 2.9 (1.30) |
| Mesomorphy | 4.25 (1.30) |
| Ectomorphy | 3.10 (1.30) |

## Discussion

Obesity and obesity-related diseases are important health problems in modern societies. The number of people with hypokinetic-based obesity is increasing and is not only limited to non-athletes but is found among athletes as well. It is known that one-fourth of American football players have second-degree obesity[6]. From this viewpoint, body composition is not only used for assessing performance but also used widely for evaluating overall health. It has been known long since that there is a close relationship between certain body types (somatotypes) and some diseases[7–9]. Recent studies have shown that there is a relationship between BMI, RPI, WHR, and body chemistry.

In athletes participating in combat sports, the BMI and body fat percentage, which are considered indicators of obesity, are between normal levels. The obesity rate increases as the weight category increases in combat sports. Kazemi et al.[10] found the BMI value of taekwondo players to be 21.9 (2.4) kg/m$^2$. Similarly, in a study conducted by Przybycien et al., BMI values of Polish karate athletes were found to be 26.8 (2.00) kg/m$^2$, whereas those of national level athletes were found to be 24.9 (1.74)[11]. Pieter et al.[12] stated that the body fat percentage of Canadian male judo athletes was found to be 12.27%. In freestyle boxing and wrestling (junior category), body fat percentages were found to be 6.9% (1.6%) and 7.9% (2.7%), respectively[13].

RPI is also another measure of body fat percentage. Chan et al.[14] found that recreational taekwondo athletes have RPI values of 43.1 (1.4) cm/kg$^{0.333}$. With regard to BMI, RPI, and percentage fat values, our findings are similar to those found in previous studies.

Somatotype is another important factor in talent identification and training organization. There is a close relationship between somatotypes (ectomorphs, endomorphs, and mesomorphs), psychological attributes, and technical capacity. It has been stated that ectomorphs and mesomorphs are more successful in sports that require good technique[15]. Khanna et al.[16] found the following values for somatotype in young boxers: endomorphic component, 1.8 (0.5); mesomorphic component, 3.2 (0.6); and ectomorphic component, 4.0 (0.8). Further, according to a study by Pieter et al.[17], somatotype values for young karate athletes were found to be as follows: endomorphic component, 2.42 (0.72); mesomorphic component, 4.70 (0.95); and ectomorphic component, 2.55 (1.10). Charzewski stated that although the mesomorphic component is generally the dominant one in wrestling, Greco-Roman wrestlers were found to have more endomorphic component than freestyle wrestlers[18]. In a study on elite male taekwondo athletes, the endomorphic, mesomorphic, and ectomorphic components were found to be 1.7, 4.5, and 3.6, respectively. According to his findings, elite taekwondo players are mesomorphs[19]. In another study by Chan et al., Polish elite karate athletes were

**TABLE 5**
BODY PROPORTION INDICES

| Index | Calculation Method | $\overline{X}$ (SD) (N=48) | Evaluation |
|---|---|---|---|
| Body mass index (kg/m$^2$) | (weight/height$^2$) | 22.00 (2.66) | Normal |
| Cormic index (%) | (Sitting height/height) × 100 | 51.99 (1.18) | Medium-sized trunk |
| Monourier index (%) | (Height-sitting height/sitting height) × 100 | 92.39 (4.47) | Sub-macroskelie |
| Acromio-iliac index (%) | (Bi-iliac width/biacromial width) × 100 | 60.87 (6.61) | Shoulder width more than normal |
| Martine index (%) | (height/chest width) × 100 | 6.29 (0.70) | Narrower than normal trunk |
| Biacromial index (%) | (Biacromial width/height) × 100 | 22.58 (0.99) | Normal |
| Hip index (%) | (Bi-iliac width/height) × 100 | 13.91 (0.86) | Narrow hips |

found to be mesomorphs, and their somatotype components were as follows: endomorphy, 3.1; mesomorphy, 5.1; and ectomorphy, 1.8[14]. In the present study, we concluded that our athletes have a meso-ectomorph somatotype. Similarly, Maughan found the endomorphic, mesomorphic, and ectomorphic components of international taekwondo athletes as 1.4, 4.1, and 3.2, respectively[20].

In Turkish as well as other foreign studies, we could not find a study in which athletes were classified according to their body indices (cormic index, Martine index, etc.) According to the results obtained in our study, Turkish combat sports athletes have medium-sized trunks, wide shoulders, and narrow upper body and hips. While Çakiroglu et al.[21] describe handball players as having medium-sized trunks, wide shoulders, and wide upper body and narrow hips, Çikmaz et al.[22] describe soccer players as having lengthy trunks, normal upper body, and well-proportioned shoulders and narrow hips.

## Conclusion

Young Turkish combat sports athletes have normal BMI values and low body fat percentage. These athletes are meso-ectomorphs. In terms of body proportions, they have medium-sized trunks, wide shoulders, and a narrow upper body and narrow hips. This kinanthropometric overview of combat sports is very important in talent identification. Even though long-term training affects the body structure and body type, guiding athletes who have ectomorphic, mesomorphic, or both components, and medium-sized trunks, wide shoulders, and narrow hips can affect the success of players in combat sports.

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## KINANTROPOMETRIJSKE KARAKTERISTIKE MLADIH SPORTAŠA BORILAČKIH SPORTOVA

## SAŽETAK

Iako postoji dovoljno studija o kinanthropometrijskim karakteristikama igrača sportova kao što su nogomet, košarka ili odbojka u Turskoj, ne postoji dovoljno istih istraživanja za borbene sportove. Dakle, naš cilj je bio procijeniti kinanthropometrijske karakteristike različitih borbenih sportova poput karata, taekwondoa, juda i kickboxinga. Ispitivanje je obuhvatilo 48 muških sportaša na nacionalnoj razini iz četiri različita borilačka sportova (dob 20,3 (3,19) godina; broj godina baveći se sportom 8,33 (4,59); visina 174,3 (7.15) cm; težina 67,35 (10,55) kg). Debljina kožnog nabora je mjerena s kaliperom (Holtain doo, UK), a Yuhazs formula koristla se za izračunavanje postotak tjelesne masti. Somatotipa procjena je provedena računalnim programom (Sweat Technology Trial Version, Južna Australija). Mjerenja širina dobivene su s kliznim kaliperom (HLT – 100, Holtain Ltd) te mjerenja obujma dobivena su s nesavitljivom mjernom vrpcom. Dobiveni podaci analizirani su uz računalni program SPSS 17.0 u smislu SD. Nalazi su kako slijedi: indeks tjelesne mase (BMI) 22.00 (2,66) kg/m2; postotak masnog tkiva 12,20% (3,07%), endomorfna komponenta 2,9 (1,30); mezomorfna komponenta 4,25 (1,30) i ektomorfna komponenta 3,10 (0, 1,30). Kormički indeks bio je 51,99% (1,88%); monourier indeks, 92,39% (4,47%); acromij-ilijačni indeks, 60.87% (6,61%); martine indeks 6,29% (0,70%); biakromijalni indeks, 22.58% (0,99%); a indeks bokova 13,91% (0,86%). Utvrđeno je da je mezomorfna komponenta dominantna u našem istraživanju. Iako je utvrđeno da je BMI normalna, postoci mast u tijelu su bile niske. Prema proporcijama tijela, sportaši koji su sudjelovali u ovom istraživanju imaju široka ramena, uske bokove i srednje veliki trup.