ÇOMÜ SPOR BİLİMLERİ DERGİSİ

http://dergipark.gov.tr/comusbd Cilt:1 Sayı:1 Yıl: 2018

Anthropometric Profiles of Physical Education and Sports Students

Fatih ÇATIKKAŞ[1], *Cem KURT*[2]

ABSTRACT

Purpose: The aim of this study was to assess the anthropometric attributes of physical education and sports students, who will teach physical education to children and young people in the future.

Method: Two hundred fifty-eight male physical education and sports students (age: 22.40 ± 2.75 years, height: 178.67 ± 9.43 cm, body weight: 73.44 ± 13.64 kg) who are exercising recreationally were assessed in terms of body mass index (BMI), ponderal index (RPI), waist-to-hip ratio (WHR), percentage of body fat, somatotype, Cormique index, Monourier index, acromio-iliac index, Martine index, bi-acromial index, and hip index.

Results: The results were as follows: BMI 22.86±2.66 kg/m2, RPI 42.89±1.77 cm/kg0.333, WHR 0.79 ± 0.05%, body fat percentage 14.43±4.41%, endomorphy component; 3.5, mesomorphy component; 4.3, ectomorphy component; 2.9 Cormique index 51.51±1.58%, Monourier index 94.31±6.10%, acromio-iliac index 63.88 ± 6.61%, Martine index 6.11±0.48%, bi-acromial index 22.32±1.86%, and hip index 13.89 ± 0.97%.

Conclusion: The subjects were found to be normal, healthy individuals in terms of BMI, WHR, and % body fat. They were found as mesomorphs who were also assessed to have mid-sized trunk, sub-macroskelia, a narrow upper body and narrow hips.

Keywords: Anthropometric attributes, body indexes, physical fitness, obesity.

ÖZET

Beden Eğitimi ve Spor Öğrencilerinin Antropometrik Profili

Amaç: Bu çalışmanın amacı, gelecekte genç insanlara ve çocuklara beden eğitimini öğretecek Beden Eğitimi ve Spor Bölümü öğrencilerinin antropometrik özelliklerini değerlendirmektir.

Yöntem: Çalışmaya rekreasyonel olarak egzersiz yapmakta olan 258 erkek beden eğitimi ve spor bölümü öğrencisi (yaş: 22.40±2.75 yıl, boy: 178.67±9.43 cm, vücut ağırlığı: 73.44±13.64 kg) vücut kütle indeksi (BMI), ponderal Indeks (RPI), bel-kalça oranı (WHR), vücut yağ yüzdesi, somatotip, Kormik Indeks, Monourier Indeks, akromio-iliak indeks, Martine indeks, bi-akromial indeks ve kalça indeksi açısından değerlendirildi.

Bulgular: Analiz Sonuçlarına göre katılımcıların vücut kütle indeksi (BMI) 22.86±2.66 kg/m2, RPI 42.89±1.77 cm/kg0.333, WHR, 0.79±%0.05, vücut yağ yüzdesi, 14.43±4.41%, endomorfi bileşeni 3.5, mezomorfi bileşeni 4.3, ektomorfi bileşeni 2.9 Kormik indeks 51.51±%1.58, Monourier indeksi 94.31±%6.10, akromio-iliak indeks 63.88±%6.61, Martine indeksi 6.11±%0.48, bi-akromial indeks, %22.32±1.86 ve kalça indeksi 13.89±%0.97 olarak tespit edildi.

Sonuç: Katılımcılar, BMI, WHR ve vücut yağ yüzdesi açısından normal ve sağlıklı olarak bulundu. Orta boyutlu gövde, sub-makroskelia, dar üst vücut ve dar kalçaya sahip olarak değerlendirilen katılımcıların mezomorfik bir yapıya sahip oldukları görülmüştür.

Anahtar Kelimeler: Antropometrik özellikler, fiziksel uygunluk, obezite, vücut indeksleri.

[1] Manisa Celal Bayar University Faculty of Sport Sciences, Manisa/TURKEY.
[2] Trakya University Kirkpinar School of Physical Education and Sport, Edirne/TURKEY.

INTRODUCTION

The close relationship among, somatotype, health and sports performance has been known for a long time (Peeters et al., 2007). Since body type can be affected by genetic factors, nutritional intake, socio-economic factors, age and gender, it is possible for researchers to gain valuable information about different societies from the body type (Mari Jesus et al., 2007). The most commonly used indirect methods for assessing body type are; bioelectrical impedance, spectrophotometric methods and anthropometric methods (Duren et al., 2008). Anthropometric method is relatively easy to apply and economically reasonable thus making it a popular method among researchers (Kayıhan and Ersöz, 2009, Wang et al., 2000; Karakaş et al., 2005).

Somatotype assessment may be used to describe changes in the human physique over the lifespan or as a result of physical activity and has been found to be inherited to a greater extent than body mass index (Marta et al., 2011; Reis et al., 2007). Heath and Carter's classic anthropometric somatotype method consists of three components namely; endomorph, mesomorph and ectomorph (Liiv et al., 2013). The endomorphy component describes the relative degree of fatness of the body; the mesomorphy component is characterized by the predominance of muscle, bone and connective tissue; and ectomorphy by linearity and slenderness of built (Hazır, 2010; Peeters et al., 2007). There is a substantial evidence that somatotype as a quantified description of a person's body shape and performance are related (Kandel, Baeyens and Clarys, 2014; Knechtle et al.,2011). On the other hand, somatotype can be used as an important factor both in talent identification and assessing general health (Kandel, Baeyens and Clarys,2014; Knechtle et al.,2011; Kamanlı et al., 2003).

One of the most important health issues in modern society is obesity. Obesity is generally related to inactivity, consumption of fast food, applied to high caloric diet. This kind of life style can cause abnormal glucose tolerance, visceral fat accumulation, high blood pressure, coronary heart disease, and orthopedic health problems and therefore it is a serious issue that can have multiple concurrent negative effects on the body (Hurt et al.,2010; Tremblay and Willms, 2003)

In 2011-2012, the prevalence of obesity in the United States was 16.9 in youth and 34.9% in adults (Ogden et al., 2014). United Kingdom also has a similar problem, with 19% of males and 21% of females having a BMI value over 30 kg/m2 (Susan, Kiersten and Tim, 2003). According to Berghöfer et al. (2008), the prevalence of obesity in United Kingdom was 22.2 % in men and 23.0% in women in 2003.

In modern society, obesity seems to affect children as well. Thirteen percent to 14% of children in the United States are considered obese and in England this figure is 10–17%. In 2001, in obesity research study involving 6 countries (Brazil, United Kingdom, China, Netherlands, Singapore, and the United States), it was found that children aged 4–11 have an obesity rate of 2–3%. Between the years 1984 and 1994, the percentage of overweight children has increased by 50% (Susan, Kiersten and Tim, 2003). In England in 2008, a total of 14.4% of boys and 13.3% of girls aged 11–15 years were classified as obese (Fraser et al., 2012).

The best method for preventing and stopping this fast increase in obesity rates is the combination of regular physical exercise and a balanced diet (Hills, Andersen and Byrne, 2011; Yahya et al., 2007). American College of Sports Medicine (ACSM) reported that children and adolescents should accumulate a minimum of 60 minutes of physical activity daily as part of transportation, physical education, sport, free play and planned exercise (www.acsm.org, Retrieved; 28.09.2017). From this perspective, physical exercise in primary/secondary and high school education and the availability of teachers who will organize these exercises are of great importance.

With that thinking in mind, the purpose of this study is to assess the anthropometric attributes of physical education and sports students who are going to be future leaders, and teachers of children and young people.

METHOD

Subjects

Two hundred fifty-eight male students from a school of physical education and sports who are exercising recreationally in some sports such as; water sports, athletics, soccer, volleyball, basketball, combat sports, gymnastics, badminton, court tennis, archery and fencing participated in this study (age: 22.40±2.75 years, height: 178.67±9.43 cm, body weight: 73.44±13.64 kg). The inclusion criterion was usually exercising at least three times per week and being 18 years or older. Professional players and body builder were excluded from the study.

Firstly, participants were informed about the measurement process and the purpose of the study. After this stage written consent was obtained from all the participants The measurements were taken during a week at the same time of day 13:00 to 17:00 in physical education and sports performance laboratory.

Weight and height measurement: A mechanical measuring machine (NK 150; Nan, Istanbul, Turkey) was used for measurement of body weight and height. Standard measurement procedures were followed.

Body fat percentage measurement: A Holtain 0.2 mm sensitive skinfold caliper was used to measure body fat percentage (Holtain Ltd, Crosswell, Crymych, UK). Skinfold thickness was taken from the regions of the triceps brachii, biceps brachii, subscapular, suprailiac region, chest, thigh, calves and abdomen. The Yuhazs formula was used to assess body fat percentage.

Width measurements: This was measured with a sliding caliper (Holtain HLT-100, UK).

Girth measurements: This was measured with a nonflexible tape measure.

Somatotype determination: Made with a Somatotype - Calculation and Analysis software (Sweat Technology, Adelaide, South Australia).

Statistical analysis

Data of the current study were analyzed using SPSS® Windows Statistical Programme Version 17.0 (IBM® Corp., 2016, Armonk, NY) Normality assumption of the related data was checked by the Kolmogorov Simirnov Test. All the variables presented normal distribution descriptive data and other variables were reported as mean ± standard deviation.

RESULTS

Weight, height, weight-to-hip ratio (WHR), ponderal index (RPI), and body fat percentage are were shown in Table 1; breadth and circumference measurements were shown in Table 2; skinfold thickness data are recorded in Table 3; body indexes in Table 4 and somatotype components were shown in Figure 1 (Somatochart).

Table 1. Average values for the body proportions of athletes.

Variables	Mean ± SD (n = 258)	Evaluation
Height (cm)	178.67±9.43	
Body weight (kg)	73.44±13.64	
*WHR (%)	0.79±0.05	Low risk
**RPI (cm/kg $^{0.333}$)	42.89±1.77	Optimal
Subcutaneous fat (%)	14.43±4.41	Optimal

**WHR= Weight-to-hip ratio; **RPI= Ponderal index*

The results are as follows: BMI 22.86±3.05 kg/m^2, body fat percentage 14.43±4.41%, endomorphy component;3.5, mesomorphy component; 4.3, ectomorphy component; 2.9, Cormique index 51.51±1.58%, Monourier index 94.31 ± 6.10%, acromio-iliac index

63.88±6.61%, Martine index 6.11±0.48%, bi-acromial index 22.32±1.86%, and hip index 13.89±0.97%.

Table 2. Data obtained for circumference and breadth evaluation.

Variables	Mean ± SD (n = 258)
Sitting height (cm)	92.01±5.14
Chest circumference (cm)	93.66±7.98
Hip circumference (cm)	101.30±7.66
Thigh circumference (cm)	51.39±5.04
Calf circumference (cm)	36.54±3.07
Flexed biceps circumference (cm)	31.76±3.35
Humeral breadth (cm)	6.73±0.50
Femoral breadth (cm)	9.78±0.77
Biiliac breadth (cm)	24.82±2.00
Chest depth **(**cm)	19.52±2.31

Table 3. Skinfold thickness data.

Variables	Mean ± SD (n = 258)
Bicipital skinfold (mm)	5.1 ± 2.56
Tricipital skinfold (mm)	8.81 ± 4.01
Abdominal skinfold (mm)	18.17 ± 11.10
Suprailiac skinfold (mm)	17.65 ± 12.18
Subscapular skinfold (mm)	11.88 ± 5.24

Table 4. Body proportion indexes.

Index	Calculation Method	Mean ± SD (n = 258)	Evaluation
Body mass index (kg/m^2)	(Weight/height^2)	22.86 ± 3.05	Normal
Cormique index (%)	(Sitting height/ height) × 100	51.51 ± 1.58	Mid-sized trunk
Monourier index (%)	[(Height-sitting height)/(sitting height)] × 100	94.31 ± 6.10	Sub-macroskelia
Acromio-iliac index (%)	(Bi-iliac width/bi-acromial width) × 100	63.88 ± 27.13	Wide shoulders
Martine index (%)	(Height/chest width)	6.11 ± 0.48	Narrow upper body
Bi-acromial index (%)	(Bi-acromial width/height) × 100	22.32 ± 1.86	Normal
Hip index (%)	(Bi-iliac width/height) × 100	13.89 ± 0.97	Narrow hips

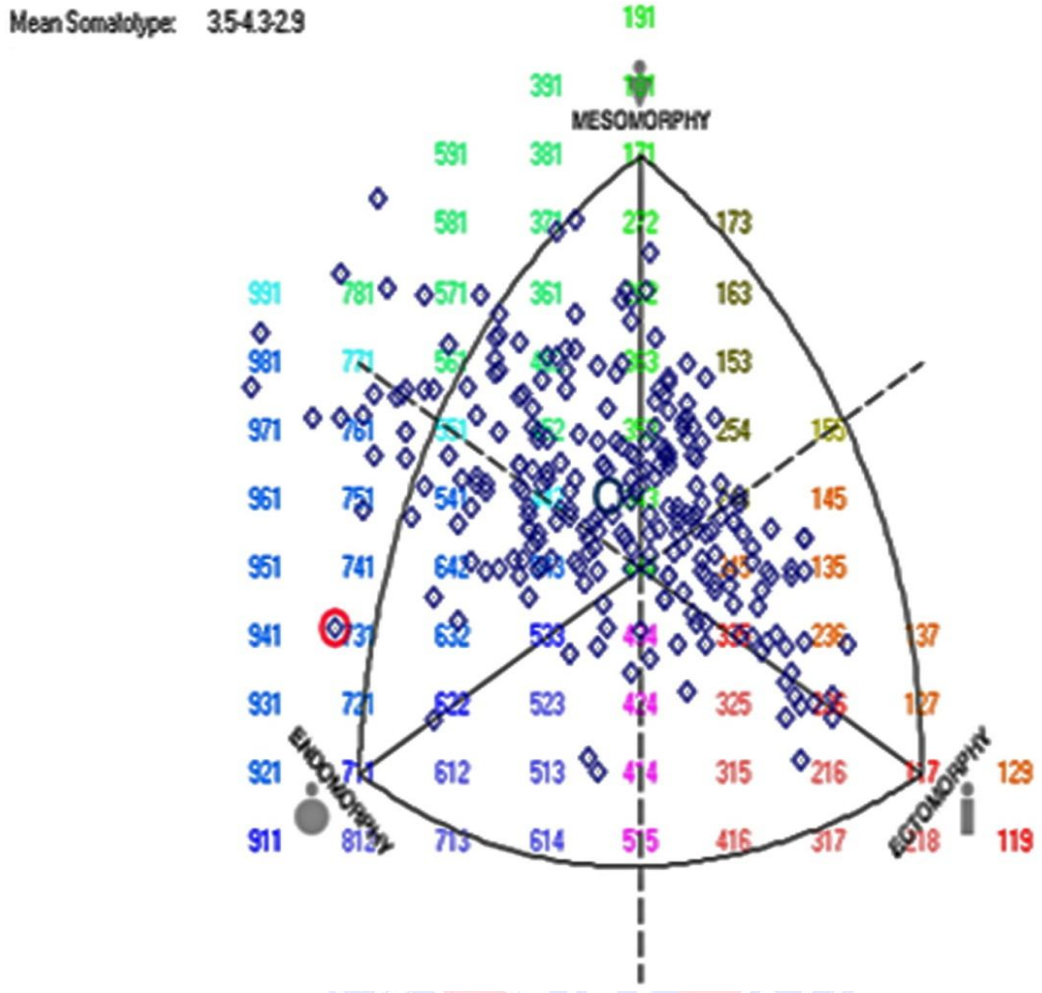

Figure 1. Somatochart

DISCUSSION

Increased BMI, RPI, and WHR can lead to potential diseases, such as coronary heart disease or diabetes mellitus. Although it has now become normal to see high values of these aforementioned criteria in modern society, it is surprising to see increasing values for athletes as well. For instance, one quarter of American football players are found to have second-degree obesity in a study done by Joyce and Hecth (2005). At the same time, Guo et al. (2013) reported that BMI values of the young and active professional athletes of strength sports in China are 38 kg/m^2 for men, 110 kg and 37 kg/m^2 for women.

A study (total sample included 15,746 undergraduate universities from 22 countries) was reported that obesity rate among university students was as 5.8 % for men and 5.2 % for women. According to this study, overall obesity rate was 22 % (Peltzer et al.,2014). Obesity

rate among Turkish university students (894 students from Çukurova University) was reported as 4.9 % for male and 1.1 % for female (Uluöz, 2016).

In a large study performed by International Health Behavior Survey in 2006, which included 22 countries and involved 18,152 university students (male: 8,115; female: 10,037), it was shown that the BMI values of subjects in certain countries were found as follows: Belgium 22.1 kg/m^2, United Kingdom 22.7 kg/m^2, France 21.9 kg/m^2, Germany 22.8 kg/m^2, United States 24.3 kg/m^2, Bulgaria 23.1 kg/m^2, Greece 23.1 kg/m2, and Italy 22.1 kg/m^2 (Wardle, Haoue and Steptoe, 2006).

On the other hand; Santos et al. (2014) found BMI for female and male soccer players were 22.2 kg/m^2 and 23.6 kg/m^2, respectively. In the same study reported that BMI value for wrestling and judo athletes were 22.5 kg/m^2 for female and 23.9 kg/m^2 for male combat athletes.

In another study on 203 male soccer players in Spain (age 19 years), the BMI value was calculated as 22.96±1.2 kg/m^2 (Gil et al., 2010). In a study done in Turkey on 153 males who had different levels of physical activity, the BMI values were found to be as follows: American football players 27.76±5.18 kg/m^2, volleyball players 24.49±2.90 kg/m^2, basketball players 24.70 ± 2.65 kg/m^2, football players 23.37±2.78 kg/m^2, and students who do not exercise regularly 23.42±3.62 kg/m^2 (Pelin et al.,2009).

Another criterion for physical fitness is the amount of subcutaneous fat tissue. Subcutaneous fat tissue value (%) differs between genders and among athletes of different sports. It is said to be between 9–15% for males, and 14-21% for female aged up to >30 years (Jeukendrup and Gleeson, 2017). In professional male judo athletes, the value was found to be 11.4±8.4% (Emerson et al., 2007). In this context; Sınırkavak et al., (2004) found the subcutaneous fat tissue value of male physical education and sports students to be 11.80±0.55%. In a further study done by Akın et al., (2004) in 5 different sports including 100 male athletes, subcutaneous fat tissue values for different sports were found as follows: wrestling 13.06%, soccer 15.1%, weight lifting 18.2%, handball 20.8%, and taekwondo 16.8%.

Bandyopadhyay (2007) found suprailiac, abdominal, tricipital, and subscapular skinfold thickness of sedentary young people aged 20-24 from West Bengal as 12.82±4.16 mm, 16.33±5.90 mm, 9.40±2.44 mm, 13.03±4.36 mm, respectively. Kamanlı et al. (2003) assessed suprailiac, abdominal, tricipital, and subscapular skinfold thickness of physical education and

sports students and found values of 11.36±6.31 mm, 12.37±4.71 mm, 9.95±5.20 mm, and 10.38±2.32 mm, respectively.

Franchini et al. (2007) studied male judo athletes with the purpose of determining their anthropometric characteristics. The findings were as follows: femoral breadth 10.1 ± 0.8 cm, humeral breadth 7.4±0.8 cm, flexed arm circumference 38.1±4.2 cm, chest circumference 106.4±11.0 cm, hip circumference 102.5 ± 9.0 cm, and calf circumference 40.9±5.8 cm.

In a Brazilian study involving champion bodybuilding athletes, body composition elements were found to be as follows: femoral breadth 9.26±0.51 cm, humeral breadth 6.79±0.45 cm, flexed arm circumference 41.12 ± 3.38 cm, and calf circumference 38.83±3.11 cm (Silva, Trindade and Rose, 2003). Rathore and Mishra (2016) reported that thigh and calf circumferences of the male physical education students were 51.13±4.71 cm. and 34.92±2.88 cm.

Franchini et al.(2011) reported that endomorphy, mesomorphy and ectomorphy components of Hungarian high level male judo athletes as 3.6±1.9, 7.0±1.5 and 1.6±0.9 respectively. Endomorphy, mesomorphy and ectomorphy components of the Brazilian elite female judo athletes were determined as 3.6±1.9, 5.1±1.7 and 1.5±0.9.

Kamanlı et al. (2003) also determined endomorphy, mesomorphy and ectomorphy components of physical education and sports students as 2.15±0.75, 2.42 ±1.03 and 3.01±0.93, respectively. According to the same authors, medical students endomorphy, mesomorphy and ectomorphy components were found as; 2.69±0.74, 2.29±1.24, 2.79±1.03 respectively.

Chan et al., (2003) found endomorphy, mesomorphy and ectomorphy components of recreational taekwondo athletes as; 4.2±1.1, 4.7±1.0 and 2.9±1.0 respectively. Giannopoulos et al. (2017) determined endomorphy, mesomorphy and ectomorphy components of the elite level male volleyball players were 3.05±0.74, 2.32±1.09 and 2.93±1.01 respectively.

As we understand that there are many factors affecting body shape such as; genetics, developmental history, physiology, age, physical activity level, environment, diet, ethnicity, and social background (https://www.ncbi.nlm.nih.gov, Retrieved;30.09.2017)

The main limitation of the study may be a small sample size. Therefore, replication of this study on larger samples will be helpful to obtain more reliable results. It is notable that although there are numerous studies assessing physical fitness according to anthropometric attributes, there are not many studies concerning body proportions for physical fitness.

Turkish young male combat athletes were determined to have wide shoulders, narrow hips, and medium-sized trunks (Çatıkkaş, Kurt and Atalağ, 2013). On the other hand, handball players were found to have wide shoulders, narrow hips, and a mid-sized trunk, whereas soccer players had a long body and narrow hips (Çakıroğlu et al., 2002; Çıkmaz et al., 2005).

CONCLUSION

The participants in our study were found to have normal BMI, RPI, WHR, and % fat values. According to the body indexes, they were found as mesomorphs who had sub-macroskelia, mid-sized trunks, wide shoulders, and narrow upper bodies and hips.

KAYNAKLAR

Akın G, Özder A, Özet BK, Gültekin T. (2004). Body composition values in elite male athletes. *Ankara University Journal of the Faculty of Letters*, 44(81), 125-134.

Bandyopadhyay A. (2007). Anthropometry and body composition in soccer and volleyball players in West Bengal, India. *Journal of Physiological Anthropology*, *26*(4), 501-505.

Berghöfer A, Pischon T, Reinhold T, Apovian CM, Sharma AM, Willich SN. (2008). Obesity prevalence from a European perspective: a systematic review. *BMC public health*, *8*(1), 200.

Chan K, Pieter W, Moloney K. (2003). Kinathropomteric profile of recreational taekwondo athletes. *Biology of Sport*, 20(3), 175-179.

Çakıroğlu M, Uluçam E, CigalI BS, Yılmaz A. (2002). Body propositions measured in handball players. *Medical Journal of Trakya University*, 19(1), 35-38.

Çatikkaş F, Kurt C, Atalağ O. (2013). Kinanthropometric attributes of young male combat sports athletes. *Collegium Antropologicum*, *37*(4), 1365-1368.

Çıkmaz S, Taşkinalp O, Uluçam E, Yılmaz A, Çakıroğlu M. (2005). Anthropometric measurements and portions of body constitution in football players. *Medical Journal of Trakya University*, 22(1), 32-36.

Duren DL, Sherwood RJ, Czerwinski SA, Lee M, Choh AC, Siervogel RM, Chumlea WC. (2008). Body composition methods: comparisons and interpretation. *Journal of Diabetes Science and Technology*, *2*(6), 1139-1146.

Emerson F., Alexandre VN, Josue MM, Fabricio BDV. (2007). Physical fitness and anthropometrical profile of the Brazilian male judo team. *J Physiol Anthropol*, 26(2), 59-67.

Franchini E, Nunes VA, Moraes MJ, Vecchio del BF. (2007). Physical fitness and anthropometrical profile of the Brazilian male judo team. *J Physiol Anthropol*, 26(2), 59-67.

Fraser LK, Clarke GP, Cade JE, Edwards KL. (2012). Fast food and obesity: a spatial analysis in a large United Kingdom population of children aged 13–15. *American Journal of Preventive Medicine*, 42(5), e77-e85.

Giannopoulos N, Vagenas G, Noutsos K, Barzouka K, Bergeles N. (2017). Somatotype, Level of Competition, and Performance in Attack in Elite Male Volleyball. *Journal of Human Kinetics*, 58(1), 131-140.

Gil SM, Gil J, Ruiz F, Irazusta A, Irazusta J. (2010). Anthropometrical characteristics and somatotype of young soccer players and their comparison with the general population. *Biol Sport*, 27(1), 17-24.

Guo J, Zhang X, Wang L, Guo Y, Xie M. (2013). Prevalence of metabolic syndrome and its components among Chinese professional athletes of strength sports with different body weight categories. *PLoS One*, 8(11), e79758.

Franchini E, Del Vecchio FB, Matsushigue KA, Artioli GG. (2011). Physiological profiles of elite judo athletes. *Sports Medicine*, 41(2), 147-166.

Hazır T. (2010). Physical Characteristics and somatotype of soccer players according to playing level and position. *Journal of Human Kinetics*, 26, 83-95.

Hills AP, Andersen LB, Byrne NM. (2011). Physical activity and obesity in children. *Brt J Sports Med*, 45(11), 866-870.

Hurt RT, Kulisek C, Buchanan LA, McClave SA. (2010). The obesity epidemic: challenges, health initiatives, and implications for gastroenterologists. *Gastroenterol Hepatol*, 6(12), 780-792.

Jeukendrup A, Gleeson M. Normal ranges of body weight and body fat. http://www.humankinetics.com/excerpts/excerpts/normal-ranges-of-body-weight-and-body-fat. Retrieved: 29.09.2017.

Joyce B, Hecth, L.H. (2005). Obesity in the National Football League. *JAMA*, 293, 1061-1062.

Kamanlı A, Özmerdivenli R, Karacabey K, Kutlu M, Ardıçlı Ö. (2003). Somatotype distribution in students of sports academy and medical school. *Turkish J Rheumatol*, 18(1), 12-14.

Kandel M, Baeyens JP, Clarys P. (2014). Somatotype, training and performance in Ironman athletes. *European Journal of Sport Science*, 14(4), 301-308.

Karakaş S, Taşer F, Yıldız Y, Köse H. (2005). Comparison of body composition between medical school students and physical education and sports school students by using bioelectrical impedance analysis (BIA) method. *Journal of Adnan Menderes University Medical Faculty*, 6(3), 5-9.

Kayıhan G, Ersöz G. (2009). Comparison of different methods of measurement used in the detection of body fat rate and diagnosis of obesity in adolescents aged from 15 up to 18. *J Sport Sci*, 1(2), 107-16.

Knechtle B, Wirth A, Rüst CA, Rosemann T. (2011). The relationship between anthropometry and split performance in recreational male Ironman triathletes. *Asian Journal of Sports Medicine*, 2(1), 23.

Liiv H, Wyon MA, Jürimäe T, Saar M, Mäestu J, Jürimäe J. (2013). Anthropometry, somatotypes, and aerobic power in ballet, contemporary dance, and dancesport. *Med Probl Perform Art*, 28(4), 207-11.

Mari Jesus MC, Itziar S, Marta A, Laura A, Ana Maria R, Esther R. (2007). Body shape in relation to socio-economic status in young adults from the Basque Country. *Coll Antropol*, 31(4), 963-968.

Marta C, Marinho D, Costa A, Barbosa T, Marques M. (2011). Somatotype is more interactive with strength than fat mass and physical activity in peripubertal children. *Journal of Human Kinetics*, 29(Special Issue), 83-91.

Ogden CL, Carroll MD, Kit BK, Flegal KM. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Jama*, 311(8), 806-814.

Peltzer K, Pengpid S, Samuels T, Özcan NK, Mantilla C, Rahamefy OH, Gasparishvili A. (2014). Prevalence of overweight/obesity and its associated factors among university students from 22 countries. *International Journal of Environmental Research and Public Health*, 11(7), 7425-7441.

Peeters MW, Thomis MA, Loos RJF, Derom CA, Fagard R, Claessens AL, et al. (2007). Heritability of somatotype components: a multivariate analysis. *International Journal of Obesity*, 31(8), 1295.

Pelin C, Kürkçüoğlu A, Özener B, Yazici CA. (2009). Anthropometric characteristics of young Turkish male athletes. *Coll Antropol*, 33(4), 1057-1063.

Physical activity in children and adolescent. https://www.acsm.org/docs/default-source/brochures/physical-activity-in-children-and-adolescents.pdf.Retrieved:28.09.2017.

Rathore VS, Mishra MK. (2016). Anthropometric variables as predictors of speed ability of physical education students. *International Journal of Physical Education, Sports and Health*, 3(1), 140-144.

Reis VM, Machado JV, Fortes MS, Fernandes PR, Silva AJ, Dantas PS, Fernandes Filho J. (2007). Evidence for higher heritability of somatotype compared to body mass index in female twins. *Journal of Physiological Anthropology*, 26(1), 9-14.

Santos DA, Dawson JA, Matias CN, Rocha PM, Minderico CS, Allison DB, et al. (2014). Reference values for body composition and anthropometric measurements in athletes. *PloS One*, 9(5), e97846.

Sınırkavak G, Dal U, Çetinkaya Ö. (2004). The relation between the body composition and maximal oxygen capacity in elite sportsmen. *Cumhuriyet Med J*, 26(4), 171-176.

Silva da PRP, Trindade Souza de R, Rose de HE. (2003). Body composition, somatotype and proportionality of elite body builders in Brazil. *Rev Bras Med Esporte*, 9(6), 408-412.

Susan AJ, Kiersten LR, Tim JC. (2003). Prevalence of overweight and obesity among young people in Great Britain. *Public Health Nutr*, 7(3), 461-465.

Tremblay MS, Willms JD. (2003). Is the Canadian childhood obesity epidemic related to physical inactivity?. *International Journal of Obesity*, 27(9), 1100-1105.

Uluöz E. (2016). Overweightness and obesity prevalence among university students in 2015-2016 educational season. *Journal of Human Sciences*, 13(3), 5884-5900.

Wardle J, Haoue AM, Steptoe A. (2006). Body image and weight control in young adults: international comparisons in university students from 22 countries. *Int J Obesity*, 30(4), 646-651.

Wang J, Thornton JC, Kolesnik S, Pierson RN. (2000). Anthropometry in body composition: an overview. *Annals of the New York Academy of Sciences*, 904(1), 317-326.

Weight Management: State of the Science and Opportunities for Military Programs. https://www.ncbi.nlm.nih.gov/books/NBK221834/ Retrieved:30.09.2017.

Yahya EL-N, Michael SD, Mark, L, Lorayne W. (2007). Body fatness and physical activity levels of young children. *Ann Hum Biol*, 34(1), 1-12.