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Original Paper

Biomedical Human Kinetics, 10, 169–177, 2018
DOI: 10.1515/bhk-2018-0025

Morphological characteristics of judo cadets with respect to sex-related differences and athletic achievements

Anna Nikolova, Diana Dimitrova

Department of Sports Medicine, National Sports Academy "Vasil Levski", Sofia, Bulgaria

Summary

Study aim: Understanding the morphological determinants of performance is important for talent identification and optimization of training programs. The aim of this study was to examine the morphological characteristics of male and female cadet judokas considering the sex-related differences and athletic achievements.
Material and methods: Seventy-four (30 female and 44 male) cadet judokas from the Bulgarian National Team underwent an anthropometric assessment of height, weight, lengths, circumferences, and 8 skinfolds. Body fat percentage (%BF) was calculated using Slaughter et al. skinfold equations. Absolute and relative muscle mass, and arm and thigh muscle circumferences were also evaluated.
Results: Except for the lower limb circumferences and thigh muscle circumference, a significant difference in most body dimensions was observed between the sexes. Male cadets had lower body fatness, but greater muscle mass as compared to female cadets. Medal winners from both sexes had lower %BF as compared to non-medalists. Male judokas with higher athletic achievements were significantly taller and had a larger arm span than their counterparts who are non-medalists ($p < 0.05$).
Conclusions: Identified apparent sex-specific differences in almost all anthropometric variables and body composition parameters in adolescent judo cadets followed the pattern typical for adult athletes. Both male and female medal-winner cadets had lower %BF compared to the less successful athletes, but did not differ from them in the absolute and relative muscle mass and limb muscle circumferences. Our results suggest that maintenance of low body fat rather than higher muscle mass is essential for the competitive success of judo players.

Key words: Anthropometric characteristics – Body composition – Adolescent judo athletes – Sex-specific differences – Athletic achievements

Introduction

Body size and composition are key factors that significantly influence biomechanics of movement and the sport performance of athletes [11, 28, 32].

Most athletes emphasize high muscularity and low body fat as a prerequisite for success. However, differences in the body composition of athletes from different sports exist due to the sport-specific requirements [26].

Judo is a dynamic martial art that originated in Japan. In addition to being a martial art, judo is a competitive sport that became an official Olympic sport in 1972 for men and in 1992 for women. Along with tactical skills, judo demands strength, speed, flexibility, agility, dynamic and static balance, coordination, explosive power, anaerobic power and endurance [7, 24, 35]. Motor ability improvements are closely related to the morphological characteristics of athletes and their body composition [14, 15].

Anthropometric characteristics and body composition of male athletes practicing judo have been extensively studied with regard to age, weight categories, sporting experience and competitive level [9, 12, 13, 18, 20, 31, 35, 37].

Some recently published studies even tried to systematize the information in an attempt to characterize the morphological and physiological profiles of judo athletes [13, 37], with limited success. On one hand, this is due to the different methodologies used. On the other, the athletes from different countries have different physical characteristics as an expression of heredity and some extrinsic factors such as sociocultural factors, specific exercise prescription and nutrition.

Successful performance in youth sport is affected by a wide range of physical and physiological factors in a sport-specific manner [2]. The research on body composition of

Author's address Diana Dimitrova, Department of Sports Medicine, National Sports Academy "Vasil Levski", Studentski grad, 1700 Sofia, Bulgaria diananSa@yahoo.com

young athletes can be helpful for coaches to track the optimal growth and development of the athletes and to detect talent. The morphological characteristics of adolescent athletes reflect the growth and maturation as well as the selection practice in specific sport, and the effect of training load. Most of the studies on body composition of judo contestants examine senior athletes, while data about cadets are scarce and incomplete.

The comparisons made by Sterkowicz et al. (2011) between young male judo fighters and untrained peers did not establish differences in weight, height, BMI or body composition between cadets and untrained boys [34]. Another study failed to establish significant differences in the anthropometric parameters among cadets in different military sports including judo, suggesting that selection of athletes was based on specific skills, not on physical characteristics [30]. However, the samples examined in both studies were too small (cadets n = 8) to draw definite conclusions.

Reports about the impact of intensive sport training on body size and composition of female judokas are also limited [8, 35]. Although the sex differences in body composition of the average men and women are well established, some authors have proposed that intensive training may result in a decrease of these differences in elite athletes. Furthermore, early sports specialization and excessive training stress can delay sexual maturation in athletic girls, with negative health consequences [3].

Another important aspect of the training process, especially in sports with weight categories, is knowledge of the coaches about the physical characteristics that affect the achievement of a high performance level of athletes. Understanding the morphological determinants of the performance is essential for talent identification and optimization of the training programs [5]. Aiming to investigate the physical characteristics that contribute to sporting success, some authors have compared top-level with non-elite athletes [12]. It could be assumed that the physique and body composition of the best athletes, medalists from World and European championships, differ from less successful players. The study of Kubo et al. [21] demonstrated significantly larger fat-free mass and higher, normalized to height, muscle thickness of elbow extensor and flexor muscles in judo athletes who had participated in the Olympic Games or in the Asian Games as compared to university level judo athletes. However, the study of morphological characteristics of male judokas of the Brazilian Team A and Teams B and C showed no significant differences. In addition, a negative correlation between higher body fat percentage and performance in activities with body mass locomotion was distinguished [14].

The review of the literature showed that studies on the body size and composition of adolescent judokas from both sexes are incomplete and fragmented. There are still many uncertainties about the impact of judo training on body composition of maturing athletes from both sexes and the importance of physical characteristics for sporting success.

Therefore, the main objective of this study was to assess selected anthropometric features and body composition of the Bulgarian National Team cadet judokas, taking into account sex-related differences and athletic achievements.

Material and methods

The investigation was performed in accordance with the ethical standards of the Helsinki Declaration. All research procedures including the testing protocol received approval from the Ethical Board of the National Sports Academy. University-approved informed consent was obtained from the parents of surveyed athletes.

Participants

Seventy-four (30 female and 44 male) cadet judo athletes participated in this study. The age of athletes was between 15 and 17 years. All participants were members of the Bulgarian National Team at the time of the study and had taken part in national or international competitions. Judo athletes were evaluated at the end of the preparatory periods of 2016 and 2017.

Male and female cadet judokas were divided into groups with respect to their sport achievements – medalists (from international championships) and non-medalists.

Anthropometric measurements

All athletes underwent an anthropometric assessment, including selected variables characterizing the body size and body composition. All measurements were performed in the morning between 9:00 and 11:00 am by the same experienced investigator following the international standards for anthropometric assessment published by the International Society for the Advancement of Kinanthropometry (ISAK) [27]. The equipment used to obtain anthropometric measures was calibrated at the beginning and end of each examining day. Participants were wearing light clothing and no shoes during measurements. Body mass was measured with a calibrated electronic weighing scale with precision of 0.1 kg. Height, arm span and leg length were measured using a GPM anthropometer (Switzerland) with accuracy of 0.1 cm. Body circumferences (arm relaxed, forearm, thigh, and calf) were taken with non-elastic tape. Also, 8 skinfold thickness measurements (chest, triceps, biceps, axillary, abdominal, subscapular, supraspinale, and front thigh) were taken with a Lange Skinfold Caliper (Cambridge Scientific, Cambridge, MD, USA) to the nearest 0.1 mm. Duplicate readings were taken at each site, and the average value was used for the analysis. If the two readings differed by more than 2 mm, a third one was taken, and the closest two were averaged.

Body composition estimation

Anthropometric measures were used for prediction of body composition variables. Body mass index (BMI) was calculated as body mass in kilograms divided by height in meters squared ($kg \cdot m^{-2}$).

Body fat percentage (%BF) was predicted based on 2 skinfolds (triceps and subscapular) using the equations of Slaughter, et al. [33]. Several derived variables were calculated using the following formulas:

$$\text{Fat mass (FM)} = (BW \times \%BF)/100 \text{ [kg]}$$
$$\text{Fat-free mass (FFM)} = BW - FM \text{ [kg]}$$
$$\text{Fat-free mass index (FFMI)} = FFM/H^2 \text{ (kg.m}^{-2}\text{)} \quad (11)$$

Since prediction equations for estimation of body fatness have not been without criticism, we also evaluated the body composition with the sum of 8 skinfolds – chest, triceps, biceps, subscapular, axillary, abdominal, supraspinale, front thigh.

Skeletal muscle mass was estimated by the predictive equations of Lee et al. [23]. Arm muscle circumference (AMC) was derived from the arm circumference (AC) in cm and the triceps skinfold (TSF) in mm using the following formula proposed by Lukascki [25]:

$$AMC = AC - (\pi \times TSF/10) \text{ [cm]}$$

Thigh muscle circumference (TMC) was predicted from thigh circumference (TC) in cm and the front thigh skinfold (FTSF) in mm by the following formula (Lukascki, 2005) [25]:

$$TMC = TC - (\pi \times FTSF/10) \text{ [cm]}$$

Statistical analysis

Statistical analysis was performed using SPSS-23.0. Descriptive statistics including mean and standard deviation (SD) were computed for all variables. An independent samples t-test was used for evaluation of differences in all quantitative anthropometric and body composition variables of the groups of judo medalists and non-medalists in both sexes, and between male and female athletes. The Pearson criterion χ^2 was used to compare the %BF and %MM. A probability level of $p < 0.05$ was used to establish significance for all procedures.

Results

Comparisons of anthropometric characteristics and body composition between male and female judo cadets

Table 1 presents the main anthropometric characteristics of the surveyed judo cadets.

Table 1. Personal and somatic characteristics of male and female judo cadets

Variable	Cadets – whole group (n=74)		
	Male (n = 44)	Female (n = 30)	Mean difference[a]
Age [years]	16.1 ± 0.9	16.2 ± 0.8	0.1
Training experience [years]	7.1 ± 0.7	6.8 ± 0.8	0.3
Height [cm]	171.3 ± 8.1	160.9 ± 5.7	10.4*
Weight [kg]	72.1 ± 18.5	63.5 ± 13.6	8.6*
Leg length [cm]	96.6 ± 5.0	90.6 ± 4.3	6.0*
Arm span [cm]	176.2 ± 10.5	163.1 ± 7.8	13.1*
Relaxed arm circumference [cm]	29.1 ± 3.4	26.6 ± 2.8	2.5*
Forearm circumference [cm]	27.5 ± 2.4	24.6 ± 1.9	2.9*
Front thigh circumference [cm]	54.5 ± 6.6	57.2 ± 6.7	2.7
Medial calf circumference [cm]	36.5 ± 3.9	35.7 ± 4.1	0.8
SFT – chest [mm]	4.2 ± 1.1	5.2 ± 1.7	1.0*
SFT – triceps [mm]	8.8 ± 4.1	15.4 ± 5.3	6.6*
SFT – subscapular [mm]	9.6 ± 4.2	12.4 ± 5.6	2.8*
SFT – abdominal [mm]	9.9 ± 5.2	11.1 ± 5.0	1.2*
SFT – axillary [mm]	8.1 ± 5.2	14.0 ± 7.3	5.9*
SFT – supraspinale [mm]	8.6 ± 5.3	16.0 ± 6.8	7.4*
SFT – biceps [mm]	4.1 ± 1.6	6.7 ± 3.6	2.6*
SFT – front thigh [mm]	11.7 ± 5.6	24.5 ± 7.7	13.0*

Values are mean ± SD; SFT – skinfold thickness; [a] – mean difference between male and female judokas; * – $p < 0.05$.

Male judo players were significantly taller (171.3 ± 8.1 cm) than female judokas (160.9 ± 5.7 cm) at the same age. Males also presented higher values of the other measured body lengths (arm span and leg length). Comparisons showed a significant difference ($p < 0.05$) with higher values in male athletes compared to female athletes of upper limb circumferences (relaxed arm and forearm), but no effect of gender on lower limb circumferences (front thigh and medial calf).

All 8 measured skinfolds (chest, triceps, subscapular, abdominal, axillary, supraspinale, biceps and front thigh) showed greater thickness in female judokas ($p < 0.05$).

The results from the evaluation of body composition are presented in Table 2.

The mean values of BMI of male and female judo players were respectively 24.3 kg · m^{-2} and 24.4 kg · m^{-2}, and they were in the acceptable range, according to the WHO standards.

Body fat was characterized by both sum of 8 skinfolds and %BF, calculated by the equations of Slaughter et al. [33] for children and youth. As can be seen from Table 2, the sum of 8 SF in male athletes (65.0 ± 30.6 mm) was significantly smaller ($p < 0.05$) compared to female athletes (105.3 ± 39.2 mm). Male judokas presented lower %BF (13.5 ± 6.5%) ($p < 0.05$) compared to female judokas (23.1 ± 5.4%). There was also a gender difference regarding the derived variables – fat mass, fat-free mass and fat-free mass index, which had significantly lower values in male athletes.

Estimated absolute and relative muscle mass, as well as arm muscle circumference, showed higher values in male athletes. The thigh muscle circumference was the only variable that did not differ between the sexes.

Comparisons of anthropometric characteristics and body composition between medalist and non-medalist judokas

A comparison of anthropometric characteristics between more and less successful athletes is presented in Table 3.

Male medalists are significantly taller and have a greater arm span than male non-medalists ($p < 0.05$). In female judokas significant differences between medalists and non-medalists were found only in the skinfold thickness of the chest, biceps and supraspinale.

The comparison of the body composition variables of medal winners with non-winners revealed lower values in relative and absolute body fat in both male and female medal-winners compared to their less successful peers (Table 4). The fat-free mass of male medalists was higher than in non-medalists, but a significant difference in the same variable in female judokas was not found.

In all other indicators characterizing the composition of body mass, no significant differences were detected between medalists and non-medalists (Table 4).

Discussion

The first objective of the present study was to compare the body size and composition of male and female judo

Table 2. Body composition of judo cadets

Variable	Cadets – whole group (n=74)		
	Male (n = 44)	Female (n = 30)	Mean difference[a]
BMI [kg · m^{-2}]	24.3 ± 4.4	24.4 ± 4.6	0.1
∑ 8SF [mm]	65.0 ± 30.6	105.3 ± 39.2	40.3*
% BF	13.5 ± 6.5	23.1 ± 5.4	9.6*
FM [kg]	10.8 ± 8.6	15.2 ± 6.4	4.4*
FFM [kg]	61.4 ± 11.0	48.3 ± 7.4	13.1*
FFMI [kg · m^{-2}]	20.8 ± 2.2	18.6 ± 2.6	2.2*
MM [kg]	36.0 ± 3.4	28.8 ± 5.0	7.2*
% MM	49.2 ± 2.9	45.8 ± 2.6	3.4*
AMC [cm]	28.8 ± 3.3	26.1 ± 2.7	3,7*
TMC [cm]	54.1 ± 6.5	56.4 ± 6.6	2.1

Values are mean ± SD; BMI – body mass index; ∑8SF – sum of 8 skinfolds (chest, triceps, biceps, subscapular, axillary, abdominal, supraspinale, front thigh); %BF – body fat percentage; FM – fat mass; FFM – fat-free mass; FFMI – fat-free mass index; AMC – arm muscular circumference; TMC – thigh muscular circumference [a] – mean difference between male and female judokas; * – $p < 0.05$.

Table 3. Personal and somatic characteristics of judo cadets with different athletic achievements

	Cadets – whole group (n = 74)					
	Male athletes			Female athletes		
	Non-medalists n = 39	Medalists n = 5	Mean diff.[b]	Non-medalists n = 24	Medalists n = 6	Mean diff.[c]
Age [years]	16.2 ± 0.8	16.8 ± 0.4	0.6	16.6 ± 0.3	16.8 ± 0.6	0.2
Training experience [years]	7.3 ± 0.6	7.0 ± 0.7	0.3	*6.9* ± 0.5	6.8 ± 6.8	0.1
Height [cm]	170.3 ± 7.8	178.2 ± 7.9	8.0*	*160.*9 ± 5.1	161.2 ± 8.5	0.3
Weight [kg]	71.4 ± 18.8	77.6 ± 17.4	6.2	64.1 ± 12.9	60.7 ± 17.5	3.4
Leg length [cm]	96.0 ± 4.8	101.2 ± 4.8	5.3	90.9 ± 4.0	89.4 ± 5.8	1.6
Arm span [cm]	174.9 ± 9.8	186.3 ± 10.6	11.4*	163.6 ± 6.8	160.9 ± 11.7	2.7
Relaxed arm circumf. [cm]	29.0 ± 3,3	33.0 ± 4.1	1.0	26.7 ± 2.5	26.1 ± 4.0	0.6
Forearm circumf. [cm]	27.5 ± 2,4	28.1 ± 2.7	0.6	24.5 ± 1.9	24.8 ± 2.1	0.2
Front thigh circumf. [cm]	54.4 ± 6.7	55.6 ± 6.0	1.2	57.7 ± 6.4	55.3 ± 8.5	2.3
Medial calf circumf. [cm]	36.5 ± 3,9	37.0 ± 4.8	0.5	36.1 ± 4.1	34.1 ± 4.4	2.0
SFT – chest [mm]	4.3 ± 1,1	3.5 ± 0.6	0.8	5.3 ± 1.8	4.1 ± 0.6	1.3*
SFT – triceps [mm]	9.0 ± 4,2	7.2 ± 3.0	1.8	16.3 ± 5.0	11.8 ± 5.3	4.5
SFT – subscapular [mm]	9.9 ± 4.4	7.6 ± 1.6	2.3	13.1 ± 5.8	9.6 ± 3.7	3.5
SFT – abdominal [mm]	10.3 ± 6.5	6.7 ± 1.9	3.6	17.1 ± 6.8	11.9 ± 5.5	5.2
SFT – axillary [mm]	8.3 ± 5.5	6.5 ± 3.2	1.8	11.7 ± 4.9	8.8 ± 4.9	2.9
SFT – supraspinale [mm]	8.9 ± 5.5	6.2 ± 1.6	2.7	15.1 ± 7.6	9.6 ± 4.1	5.5*
SFT – biceps [mm]	4.2 ± 1.7	3.2 ± 0.5	1.0	7.1 ± 3.8	4.8 ± 1.6	2.3*
SFT- –front thigh [mm]	12.2 ± 5.7	7.8 ±2.6	4.4	25.5 ± 7.6	20.3 ± 6.9	5.2

Values are mean ± SD; SFT – skinfold thickness; [a] – mean difference between male and female judokas; * – $p < 0.05$.

Table 4. Body composition of judo cadets with different athletic achievements

Variable	Cadets – whole group (n = 74)					
	Male athletes			Female athletes		
	Non-medalists n = 39	Medalists n = 5	Mean diff.[b]	Non-medalists n = 24	Medalists n = 6	Mean diff.[c]
BMI [kg · m^{-2}]	23.9 ± 3.8	24.2 ± 4.6	0.3	24.7 ± 4.6	23.0 ± 4.5	1.7
Σ 8SF [mm]	67.1 ± 31.7	48.7 ± 12.6	18.4*	111.4 ± 32.2	81.0 ± 30.8	30.5*
%BF	13.9 ± 3.1	10.5 ± 3.4	3.4*	24.1 ± 4.8	19.2 ± 5.9	4.9*
FM [kg]	11.0 ± 2.3	8.7 ± 3.1	2.3*	15.9 ± 3.3	12.5 ± 4.1	3.4*
FFM [kg]	60.4 ± 8.6	68.9 ± 10.5	8.5*	48.3 ± 11.0	48.3 ± 10.9	0
FFMI [kg · m^{-2}]	20.7 ± 2.3	21.5 ± 2.2	0.8	18.7 ± 2.7	18.4 ± 2.4	0.3
MM [kg]	34.1 ± 6.0	37.2 ± 7.1	3.1	29.1 ± 4.7	27.9 ± 6.7	1.2
%MM	49.3 ± 2.9	48.1 ± 2.4	1.2	45.7 ± 2.5	46.5 ± 3.2	3.2
AMC [cm]	28.7 ± 3.2	29.8 ± 4.0	1.1	26.2 ± 2.4	25.8 ± 3.9	0.5
TMC [cm]	54.0 ± 6.6	55.3 ± 5.9	1.4	56.9 ± 6.2	54.7 ± 8.3	2.2

Values are mean ± SD; BMI – body mass index; Σ8SF – sum of 8 skinfolds (chest, triceps, biceps, subscapular, axillary, abdominal, supraspinale, front thigh); %BF – body fat percentage; FM – fat mass; FFM – fat-free mass; FFMI – fat-free mass index; AMC – arm muscular circumference; TMC – thigh muscular circumference; [a] – mean difference between male and female judokas; * – $p < 0.05$.

cadets in terms of their sex and in the context of their biological age.

Considerable evidence exists to demonstrate minor gender differences in the size of most body dimensions during the preadolescence period. The pubertal growth spurt revealed differences favoring boys in physical size. According to Malina et al. [26], at the ages between 15 and 17 years, the variations in body size of young athletes, due to individuality in timing and tempo of the growth spurt, are reduced.

The results of the present study showed significantly higher values of weight, body lengths (height, leg length and arm span) and upper limb circumferences (arm and forearm circumference) in male judokas compared to females at the same age. However, the differences in the circumferences of the lower limb (front thigh and medial calf) between the sexes were insignificant. It is difficult to explain whether this is due to the biological development or to the impact of the specific training loads. Ross & Ward (1982) observed a large difference (more than 2 Z-scores) in the fat-corrected arm circumference in favor of males as compared to females, but a very small difference (0.3 Z-scores) in the fat-corrected thigh circumference between the sexes [29]. Additionally, some other authors found larger sex-related differences in the arm strength than in the leg strength, which have been thought to be a result of more frequent engagement of men in strenuous physical activities with upper arms and similar habitual physical activity in the legs for both sexes [4, 39]. Bishop et al. (1988) did not find a significant difference in adjusted fat-free cross-sectional limb areas (FFCSAs) between male and female swimmers with similar physical activity [4]. Also, male non-athletes had significantly larger adjusted upper-arm and forearm FFCSAs than the female non-athletes, but thigh FFCSAs were not significantly different.

In general, intensive sport training increases the fat-free mass and reduces body fat levels. However, various sports and associated training regimes differently influence the body composition among athletes [1, 10]. There has been limited research comparing sex differences in anthropometric features and body composition in cadet judokas. Our data indicated significant differences between sexes in the variables for fatness, which is typical for human sexual dimorphism in body composition, characterized by a substantially higher amount of body fat and a substantially lower amount of lean body mass among women. Studied female judokas had a higher sum of eight skinfold site thickness, %BF, and fat mass. The body fat percentage of male judokas (13.5 ± 6.5%) is comparable with the data of Buśkok et al. [6] (14.81 ± 2.15%) for male judo athletes with mean age 18.6 ± 1.9 years, as well as with the results presented by Franchini et al. [16] for elite male Spanish cadets (12.1 ± 1.7%).

The %BF of female judokas (23.1 ± 5.4%) was higher than values reported by Franchini et al. [16] for female cadets from the National Spanish team (19.5 ± 1.8%), but close to data of Elipkhanov et al. [12] (22.7 ± 5.2%) for older female judokas (age 18.2 ± 2.7 years). However, caution is needed comparing %BF, due to different prediction equations used in the studies.

Fat-free mass is often used as an indirect measure of muscle mass. Male judokas exhibited on average 13.1 kg more fat-free mass and a higher fat-free mass index than female judokas. The difference in fat-free mass favoring male cadets was also apparent in the absolute and relative values of predicted muscle mass, as well as in FFMI.

BMI of male and female judokas was quite similar and did not reflect a difference in body composition between the sexes. This confirms the well-known fact that BMI is an inaccurate measure of body composition of athletes, because it presents the excess weight per unit of height and it makes no difference whether this weight is fat or muscle mass.

Arm and thigh muscle circumferences are estimates of the circumference of the bone and muscle portions in the respective areas. The analysis of results showed significantly higher AMC and insignificantly lower TMC in male judo athletes compared to female athletes. Although the skinfold thickness in the front thigh site was significantly greater in female judokas compared to male judokas, the difference in the thigh muscle circumference remained small and insignificant.

The second objective of this study was to attempt to clarify whether judo cadets who show better performance in international competitions and have won medals differ in their body size and composition from other athletes who are not so successful.

Comparisons of the anthropometric characteristics of both male groups with respect to their sports achievements found that male judo cadets who have won medals were taller and had a longer arm span. The impact of body height on judo performance is elusive. Lech et al. [22] have analyzed judo tournaments to establish how the height influences the way of fighting and achievement level. A moderate correlation between judokas' body height and their achievements and highest reliability of attacks with tipping the opponent forward in tall fighters were found. The height also determines the preferred technique – short and medium height fighters preferred hand techniques and taller fighter preferred leg techniques. Kazemi et al. [19] reported that in both sexes, the winners in taekwondo in the Olympic games between the years 2000 and 2010 had a greater mean height than did the non-winners.

Our study showed that more successful male judo cadets possessed less fat and more fat-free mass. The reduced body fat content in medalists was confirmed by the smaller sum of 8 skinfolds, percentage of body fat and

absolute fat mass. Although there was no significant difference between the two groups of male judo cadets in the thickness of the individual skinfolds, their mean values in medal winners were lower. On the other hand, based on the significantly higher values of fat-free mass in male judo medalists compared with non-medalists and the lack of difference in their muscle mass, it can be assumed that medalists have greater bone mass.

The results presented by other authors concerning differences in body composition of elite and non-elite judo athletes are somewhat contradictory. No significant difference in the thickness of 7 skinfold sites, body circumferences, or in %BF, was found by Jayasudha et al. [18] in a study among Indian judo players with training experience ≤5 years and >5 years. No significant difference in six skinfold thicknesses (Franchini, et al., [15]) and body circumferences (Franchini, et al., [17]) was also demonstrated for Brazilian national and international medalists and non-medalists. The results of Kubo et al. [21] indicated lower body fat percentage and higher fat-free mass in male judo athletes with a higher competitive level.

In female medalists, in addition to the lower values of body fat percentage and fat mass, significant differences in the thickness of some skinfolds were documented, in particular in the chest, suprailiac and biceps sites. The values of the fat-free mass of both female groups were quite similar.

The study of Franchini et al. [17] suggested better performance of judokas who had a lower body fat percentage in activities with body mass locomotion.

This study did not detect any significant difference between more and less successful judo cadets from both sexes in the limb circumferences and in the arm and thigh muscle circumferences. Also without significance were the differences in absolute and relative muscle mass, as well as height-normalized fat-free mass (FFMI). Elipkhanov et al. [12] compared highly skilled Russian female judokas with less skilled athletes, and they also did not find a significant difference in the circumferences of the thigh, mid-thigh and calf between the groups. However, the same authors emphasized the lower thickness of the skinfolds in the same areas. Further studies are needed to elucidate how the training loads and type of fight affect the fat distribution and muscle mass in upper and lower extremities.

Limitations

It is important to emphasize that all body composition variables in this study are derived based on prediction equations using skinfold thickness. The mean error of prediction equations, as it is recognized, can vary between 3 and 6%. Another limitation of this study is that weight classes were not taken into account.

Conclusions

This study identified in adolescent judo cadets apparent sex-specific differences in most of the anthropometric variables and body composition that are typical for adult athletes. The exceptions were insignificant differences between the sexes in the front thigh and calf circumferences as well in the thigh muscle circumferences. Both male and female judo cadets who are medal winners had lower body fatness compared to the less successful athletes at the same age, but did not differ from them in relative and absolute muscle mass and limb muscle circumferences. Male judokas with higher athletic achievements were taller and had a larger arm span than their counterparts who are non-medalists, but in female judokas similar differences were not detected. Our results suggest that maintenance of low body fat rather than higher muscle mass is essential for the competitive success of judo players.

Conflict of interest: Authors state no conflict of interest.

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Received 29.08.2018
Accepted 20.11.2018

Acknowledgments

The authors thank the athletes who participated in this study and Bulgarian Judo Federation for the opportunity to carry out these measurements.