

SECTION – VARIA

(1.5) DOI: 10.5604/ 01.3001.0014.8206

ASSESSMENT OF BODY MASS AND FAT PERCENTAGE IN CHILDREN TRAINING JUDO COMPARED TO THEIR NON-TRAINING PEERS

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Authors' contribution:

- A. Study design/planning
- B. Data collection/entry
- C. Data analysis/statistics
- D. Data interpretation
- E. Preparation of manuscript
- F. Literature analysis/search
- G. Funds collection

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Keywords: judo, children, body build, body composition

Abstract:

Study aim: Judo training leads to an increase in the muscle mass of athletes. The consequence of this is a high level of body mass index (BMI). At the same time, the body's fat percentage is reduced. This phenomenon has been well-described in older age groups. However, body build and composition parameters of the youngest judokas are still unclear.

The aim of the study was to answer the following questions:

Do the training and recruitment of athletes influence body build and composition in the studied groups?

Are BMI and body fat percentage differentiated between children and younger children?

Are body build and composition in studied group related to competitive experience and level of achievement in competitions?

Basic procedures: The study group consisted of 21 judokas aged 11 to 12 years (younger children) and 71 non-training peers, as well as 18 judokas aged 13 to 14 years (children) and 44 of their non-training peers.

Body mass and composition were determined using the Tanita TBF-551 body composition analyser.

Examination of the judokas was conducted during regional championships.

Results and main findings: In the younger age group, significantly higher BMI and body fat percentage were observed in the group of non-training peers (20.5 and 22.2%; in judokas: 18.2 and 17.6%, respectively).

In children, significant differences were observed only in body fat percentage. Its value was lower in judokas and amounted to 16.2% (in non-athlete peers: 20.1%).

Comparison of body build and composition between judo athletes in the examined age groups revealed significant differences in the case of BMI. The value of this index in children was 20.5, which was significantly higher than in the younger children (17.6).

No correlations of body build and composition with competitive experience and level of achievement in competitions were found in the studied groups.

Conclusions: A 4-year training experience is a significant factor in the development of judo-specific body build and composition. However, their indices are not related to the level of achievement in the youngest age groups.

Introduction

Body mass index (BMI) and fat percentage (BF%) are among the characteristics of body structure and composition most frequently presented in scientific pa-

pers. BMI provides general information about the weight/height ratio and being overweight. In adult males, its normal values are between 18.5 and 24.9 kg/m². Values between 25 and 30 kg/m² indicate a problem with being overweight, while 30 kg/m² and above character-

ise obesity [1]. It should be added that these values do not apply to children whose normal BMI is significantly lower. According to the recommendations proposed by the IOTF (International Obesity Task Force), the normal range of the correct body proportions for boys aged 11-14 years is 14.98 to 22.61 kg/m² [2, 3]. The criteria for being overweight, based on BMI, do not take body composition into account. Therefore, their value as indicators of obesity is limited, especially in the case of athletes with developed body musculature. For a more complete assessment of the somatic build of athletes, the percentage of body fat should also be considered. In healthy adult men, the BF% should be between 5 and 25 [4 for 5], while in athletes, this value should be within the range of 5 and 13 [6 for 5].

Training, characteristic for a given discipline, has dominant influence on the body build and composition of an athlete. Hence, the differences between the representatives of individual disciplines.

A high BMI value (26.6 kg/m²) with a low percentage of body fat (10.2%) was recorded in professional hockey players of the Montreal Canadiens club [7]. In handball players, variations in body build and body were noted depending on their nominal position on the court. The highest BMI (26.7 kg/m²), with the highest % of adipose tissue (21.7), was recorded in pivots. The lowest BMI (23.5 kg/m²), with the lowest % of body fat (10.5), in wingers [8]. In the case of 1st-league footballers of the Sloboda-Tuzla club, BMI was 23.9 kg/m², while BF% was 12.2 [9].

Martial arts constitute a separate group of disciplines. Despite the similarities to team sports games (the dominance of open movement structures), they are differentiated into weight categories. One of the ways to gain an advantage over competitors is to select a weight category so that it be the lowest, with the lowest possible loss in muscle mass. Hence, athletes strive to maintain a low BF% level.

In *shotokan* karate competitors, BMI was 24.4 kg/m²; BF%=13.0 [10]. The structure and body composition of the Polish Taekwondo-ITF representatives were characterised by weight category. Therefore, BMI ranged from 21.55 kg/m² in the lightweight category to 24.58 kg/m² in the above 80 kg category, while the BF% ranged from 11.94 in the lightweight category to 16.05 in the above 80 kg category. [11]. In Olympic martial arts (boxing, judo, taekwondo, wrestling), the highest BMI (26.1 kg/m²), along with the highest body fat (BF%=14.5) was recorded in judokas, while the lowest values of these indices were recorded in taekwondo representatives (BMI=20.7 kg/m²; BF%=8.8) [12].

When comparing athletes of the national senior national team - judo, it was observed that the average BMI value ranged from 22.4 (competitors from Tunisia)

to 26.9 kg/m² (representatives of Korea). On the other hand, BF% ranged from 15.3 for the Spanish to 12.1 for Portuguese athletes [13]. A lower BF% value of 10.57 for judokas was recorded by Buško et al. [14]. On the other hand, when comparing light-, medium- and heavy-weight classes of the Turkish national team, Melekoglu et al. [15] found that the BMI value increased and totalled 22.9, 25.4 and 33.3 kg/m². BF% also increased and reached 9.1, 11.0 and 20.1.

Francchini et al. [16], examining the individual age groups of athletes, found that the fat percentage in cadets (age = 16.5±0.4 years), juniors (age = 18.6±0.5) and seniors (age = 24, 1±0.4) at the Spanish national level decreased in subsequent groups and amounted to 12.1, 10.6 and 8.0%, respectively, while BMI remained at a similar level and equalled 25.8, 26.1 and 25.4 kg/m². Another regularity, examining cadets (age = 15.5±0.53) and juniors (age = 17.5±0.71), was noted by Sterkowicz et al. [17]. They found an increase in juniors for both BMI (from 22.8 to 26.3 kg/m²) and BF% (from 9.0 to 15.4).

As shown in the literature cited above, the authors often dealt with the issue of body structure and composition in the senior group, whole less often in junior and cadet groups. On the other hand, the available literature lacks research results for the youngest age groups (children, younger children).

The aim of the study is to characterise the mass and fat content of children and juniors training judo, and to answer the following questions:

Are there marked differences in body mass and fat content between judokas and their non-training peers?

Do body build and fat percentage change with increasing age and training experience among the competitors?

In the studied groups of athletes, are body build and composition related to professional experience and the level of achievement in competitions?

Material and methods

The group of subjects comprised 21 participants training judo, aged 11-12 (younger children) and 71 of their non-training peers, as well as 18 judokas aged 13-14 (children) and 44 of their non-training peers.

Tables 1 and 2 contain characteristics of age, training experience and basic somatic features of the study participants from the 2 age categories.

Body mass and composition were determined using a Tanita TBF-551 analyser. Body height (BH) was measured with a Martin anthropometer (USA). Measurements were performed to the nearest 0.5 cm. BMI was calculated by dividing body mass in kg by the square of body height in m².

Table 1. Age, experience and level of basic somatic features of study participants in the group of younger children (age 11-12)

Variable	Training judo in the group of younger children					Non-training peers				
	N	Mean	Min.	Max.	SD	N	Mean	Min.	Max.	SD
Age	21	11.43	11.00	12.00	0.51	71	11.63	11.00	12.00	0.49
Body height	21	149.19	141.00	164.00	5.78	71	155.31	141.00	177.00	8.18
Body mass	21	40.61	30.30	47.80	5.43	71	49.87	28.90	90.10	11.66
Training experience	21	4.33	1.00	7.00	1.71					
Level of achievements	21	3.93	0.00	9.00	2.97					

Table 2. Age, experience and level of basic somatic features of study participants in the group of children (age 13-14)

Variable	Training judo in the group of children					Non-training peers				
	N	Mean	Min.	Max.	SD	N	Mean	Min.	Max.	SD
Age	18	13.39	13.00	14.00	0.50	44	13.16	13.00	14.00	0.37
Body height	18	163.44	149.00	176.00	6.96	44	164.25	139.00	182.00	8.26
Body mass	18	54.79	43.10	74.70	8.31	44	58.70	36.10	80.20	10.66
Training experience	18	5.83	4.00	8.00	1.34					
Level of achievements	18	2.81	0.00	9.00	3.15					

Judokas were tested during the regional championships. Evaluation was performed on the day of the competition, after the official weigh-in. Participation in the research was voluntary. The trial was carried out in accordance with the Declaration of Helsinki. Each subject was informed about the purpose of the study and could withdraw from further research at any time, without giving any reason. The coach, who was the legal guardian of the subject during the competition, had to provide consent for testing.

In the study, a questionnaire was also used regarding information about: age, training experience and number of training session per week. The level of achievement was determined on the basis of the place assumed in the tournament. Thus, 1st place - 9 points; 2nd - 7 points; 3rd - 5 points, 5th - 3.5 points, 7th - 1.5 points; 9th- 0.5 points.

The comparative group consisted of students from schools in the Małopolskie Voivodeship. They had obtained their parents' written consent to participate in the research. The heads of schools at which the measurements were carried out also consented to participation in the study. As in the case of judokas, each subject was informed about the objective and could withdraw from further testing at any time without giving reason. Individuals, whose body height was approximately within the range of variability of this index in the group of judoka, were qualified for the study.

In the characteristics of the research material, cross-tabulation was used. For mean comparisons, depending on the distribution and homogeneity of variance, the Stu-

dent's *t*-test for independent groups, the Cochran-Cox test and the Mann-Whitney U test were used. Homogeneity of variance was checked using Levene's test. The assumption about the normality of the distributions was verified with the Shapiro-Wilk W test. Calculations were performed via the STATISTICA PL program.

Pearson's linear correlation coefficient or its non-parametric equivalent were used in correlation analysis.

Results

In Figure 1, the average values of BMI and BF% are shown for the group of younger children training judo and their non-training peers.

Comparing the mean, significantly higher values of BMI (C-C=-3.54; *p*<0.001) and the percentage of adipose tissue (C-C=-3.06; *p*<0.05) were noted in the group comprising non-exercising peers (respectively: 20.5 kg/m² and 22.2%; in judokas: 18.2 kg/m² and 17.6%).

In Figure 2, the average values of BMI and BF% are presented for the group of training children and their non-training peers.

Comparing the mean values in the evaluated groups of children, significant differences were recorded only in the percentage of adipose tissue (*t*=-2.01; *p*<0.05). Its value was lower in judokas and totalled 16.2% (20.1% in non-training peers).

In Figure 3, the mean values of BMI and BF% are shown for judokas in the group of younger children and children.

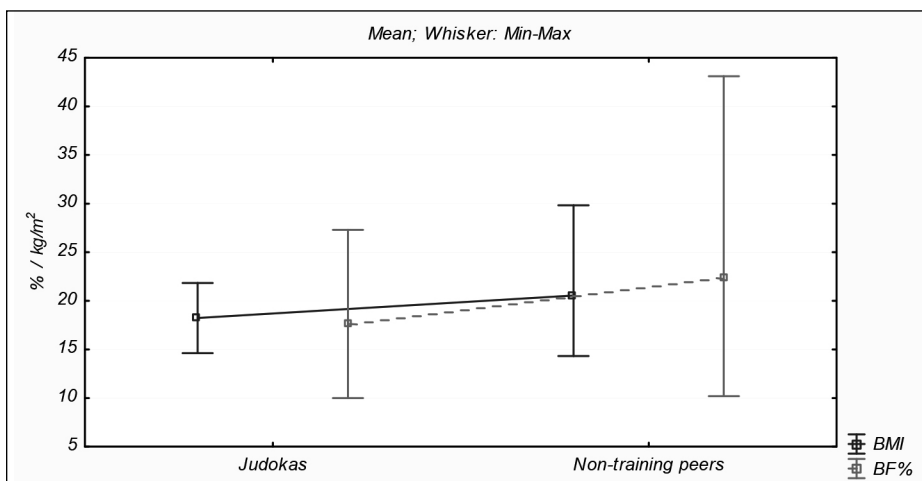


Figure 1. Mean values of BMI and BF% in the younger children's judo group and their non-training peers

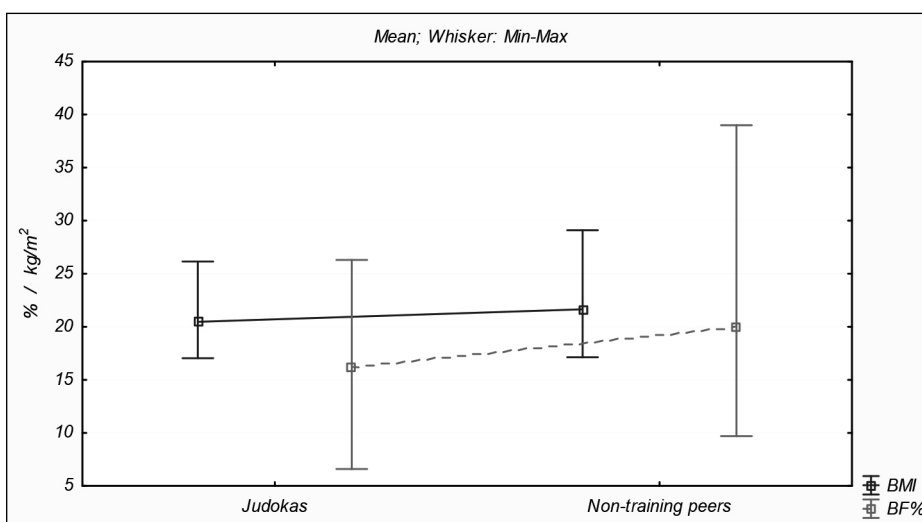


Figure 2. Mean values of BMI and BF% in the children's judo group and their non-training peers

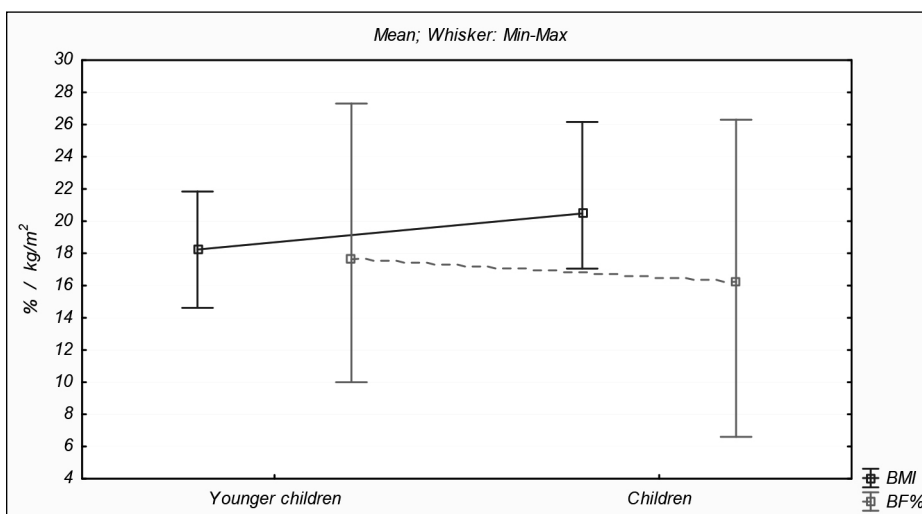


Figure 3. Mean values of BMI and BF% in the judo groups comprising younger children and children

Table 3. Values of correlation coefficients and levels of significance characterising relationships between training experience, level of achievement and body composition indices of younger children practicing judo

Correlated variables	n	Correlation coefficient	p
Training experience & BMI	21	$r' = -0.15$	0.773770
Training experience & BF%	21	$r = -0.08$	0.960308
Level of achievements & BMI	21	$R'' = 0.11$	0.621723
Level of achievements & BF%	21	$R = -0.07$	0.774624

*Pearson's linear correlation coefficient; **Spearman's signed rank correlation coefficient

Table 4. Values of correlation coefficients and levels of significance characterising relationships between training experience, level of achievement and body build indices of children training judo

Correlated variables	n	Correlation coefficient	p
Training experience & BMI	18	$R' = 0.05$	0.843479
Training experience & BF%	18	$R = 0.03$	0.909731
Level of achievements & BMI	18	$R = -0.10$	0.700662
Level of achievements & BF%	18	$R = 0.07$	0.789395

*Spearman's signed rank correlation coefficient

Comparing the mean values in the examined groups of judokas, significant differences were found in the case of BMI ($t = -2.99$; $p < 0.05$). In children, the value of this index was 20.5 kg/m^2 , which was significantly higher than in the analogous group comprising younger children (18.3 kg/m^2).

In the studied age groups, no correlations were found between body build as well as composition, and experience as well as the level of achievement (Tab. 3 and 4).

Discussion

As mentioned in the 'Introduction', the available literature lacks research results on the body build and composition of judokas in the youngest age groups. Hence, the attempt to determine the impact of training at this stage of professional development and its comparison to other disciplines.

In child footballers, similar values of BMI (20.4 and 19.7 kg/m^2) and BF% (20.3 and 20.4) were found by Esco et al. (2018) [18] and Nikolaidis and Karydis [19]. A similar BMI value (19.9 kg/m^2), with a much lower fat content (BF% = 16.2), was observed by Nikolaidis [20]. In this study, the results were very similar to those obtained by the that author (BMI = 20.5 kg/m^2 ; BF% = 16.2). Taking the results of the above-mentioned studies into account, it may be concluded that judokas from the children's category have similar weight-height ratios and fat levels to those at their age training football.

Based on comparisons of the indices analysed in the study between judokas and their non-training peers in the group of younger children, lower values of both BMI and

BF% were noted. On the other hand, children were characterised by lower BF% values with a simultaneous lack of differences in BMI, which indicates better developed body musculature. Considering the fact that there were no significant correlations between training experience and the analysed indices in the studied groups, it should be assumed that these differences are mainly influenced by the selection process. This probably causes resignation from further training this discipline by individuals in whom excessive BF% makes it difficult to perform exercises of a certain volume and intensity. Comparing judo seniors at the age of 18.6 to their non-training peers, the judokas had significantly higher BMI values (judokas - 25.32 ; non-training peers - 23.08), with a lower BF% value (10.57 and 13.26 , respectively) [14]. Therefore, it seems that the long training experience (totalling 10 years in the group of judokas under study) shapes body build and composition in a different way than at the initial stage of training and selection.

Comparing BMI and BF% between the different age groups of judokas, a higher BMI was noted in the older group, with no differences in BF%. The higher BMI value is probably influenced by greater muscle mass, which occurs without changes in the % of body fat, related to development processes. At the age of puberty, there is a marked increase in skeletal and muscle mass. Other regularities were observed in the studies cited in the 'Introduction' section, concerning older age groups. BF% decreased in successive age groups (from cadets to seniors), while BMI remained at a similar level [15]. In juniors (compared to cadets), both BMI and BF% increased [16]. Therefore, a regularity characteristic for

the whole group of subjects cannot be found. These changes probably take place in a different way depending on the subjects' age and specificity of the training process.

In this study, it has been shown that in younger age groups, it is motor efficiency that has decisive influence on the level of achievement [21]. Muscle mass has obvious effects on some components of motor performance. Hence, it is surprising that there are no noticeable relationships in the studied groups, especially between BF% and the level of achievement in competitions. These results can be explained by low variability of the discussed indices, as evidenced by low values of SD.

It should be borne in mind that training in the youngest age groups has different objects than in senior groups. Here, the sports result (the place in the tournament) is not of the greatest significance. The phenomenon of weight regulation is also rare (it should be clearly defined as pathological). In order to eliminate this, the PZ

Judo sports regulations include a provision that weight categories in the group of younger children are determined after the competitors are weighed [22].

Conclusions

1. Judokas demonstrate differences in body mass and tissue composition compared to their non-training peers, which can be considered an effect of selection and training. In the group comprising younger children, it is manifested by a lower % of fat content and BMI. In the group of children, a lower percentage of adipose tissue is observed, with no significant differences in the values of the weight-growth index.
2. With age, BMI increases in young athletes, while BF% does not undergo significant changes, which is consistent with developmental processes.
3. BMI and % of fat content are not related to sports levels in the youngest age groups.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Ethics Committee

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