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NORMATIVE VALUES OF ANTHROPOMETRIC CHARACTERISTICS AND BODY COMPOSITION IN CROATIAN CADETS TAEKWONDO COMPETITORS

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(Original scientific paper)

Dražen Čular[1,2], Mirjana Milić[1], Tea Bešlija[1]
[1]Faculty of Kinesiology, University of Split, Split, Croatia
[2]Croatian institute of kinesiology and sport, Split, Croatia

Abstract

The aim of this study was to determine the normative values of body composition and anthropometric characteristics of Croatian taekwondo competitors of both sexes in the cadet age group, differentiated by weight category. The subject sample included 258 participants of the national taekwondo championship, competitors in the cadet age group (from 10 to 14 years). The sample consisted of two subsamples: male n=123 and female n=135. The study involved the total of 10 variables that, according to their role, were divided in two groups: morphological measures and variables defining body composition. The importance of this study, in addition to its scientific contribution to describing the characteristics of competitors regarding their body build and composition, is reflected in the possible application of the obtained results in the selection, monitoring of growth and development, and control of body mass in male and female taekwondo competitors.

Key words: *normative values, body build, muscle mass, body fat, body weight reduction, growth and development*

Introduction

According to the information on the official World Taekwondo Federation (WTF) website (www.wtf.org), taekwondo is practiced on 5 continents and in 208 countries, which makes it a global sport and one of the most popular combat sports in the world according to its prevalence and the number of practitioners. Taekwondo belongs to the group of polystructural contact combat sports dominated by open or semi-open movement structures that are performed in variable conditions. Taekwondo can be characterized as an individual sport in which the movements are practiced in advance (*attack-counter-attack*), but their performance depends on the opponent's reactions. The specification equation of success in taekwondo, which should refer to the hierarchical structure and mutual relations among factors which are important for achieving top results in taekwondo, has not been sufficiently investigated as to enable the use and exact application of the obtained scientific findings in the selection and sports preparation of taekwondo athletes (Čular et al., 2013). Taekwondo is a relatively young and complex sport and, besides partial investigations on the effect of certain areas of success, it is the authors' opinion that there is still a lack of quality research studies in which the scientists have succeeded to make an exact determination of the relations between the anthropological status with success in taekwondo. Based on previous findings (Marković, Mišigoj-Duraković, & Trninić, 2005; Tosković, Blessing, & Williford, 2004), it can be concluded that, to achieve success in taekwondo, all anthropological dimensions should be at a high level, however, speed and explosive power, which are naturally in the function of specific technical-tactical skills, are the most important within the motor ability area. Pieter, Bercades, & Heijmans (1998) state that taekwondo athletes are leaner that judo athletes. Due to the possibility of participating in multiple taekwondo fights in one day, aerobic functional capacities should be developed (Čular, Krstulović, & Tomljanović, 2011) and the percentage of subcutaneous fat tissue should be low (Gao Zhao, & Liu, 2001). The dominant somatotype of taekwondo athletes is a proportional build, with well-developed muscles and skeleton, and low percentage of subcutaneous fat tissue (Gao et al., 2001). Čular, D. Miletić, & A. Miletić, (2010) state that equally good performance of techniques on both sides of the body is an important factor

of success in a taekwondo competition. The aim of this study was defined considering the necessity of selection and monitoring of growth and development of young athletes in taekwondo clubs and the fact that a taekwondo competition is realized according to the age and weight categories. The aim of the study was to determine the body composition and anthropometric normative values of Croatian taekwondo competitors of both sexes in the cadet age group, differentiated by weight category.

Methods

The subject sample included 258 participants of the national taekwondo championship (Split, 2015), competitors in the cadet age group (from 10 to 14 years). The sample consisted of two subsamples: male cadets N=123 and female cadets N=135. Seven days before the study was conducted, all participants and their parents had been informed, by their club coaches and via the official website of the Croatian taekwondo federation, about the study that would be conducted as part of the project: *Anaerobic capacities in kicking combat sports*, supported by the Croatian Science Foundation No. 6524. Before taking part in the study, the participants provided a written consent singed by their parent-guardian. During the official weigh-in, the participants submitted their ID card of the Croatian Taekwondo Federation to confirm their identity. The participants had to submit a medical certificate of health status from a certified sports medicine physician as a precondition to enter the competition. Based on the analysis of papers with similar methodological approach, this study included the total of 10 variables which, based on their role, were divided into two groups representing morphological measures and variables defining body composition: *Body height*, *Sitting height*, *Body mass*, *Body mass index* (BMI – ration of body mass (kg) and body height squared (m^2)), *Body fat* (%), *Body fat* (kg), *Muscle mass* (kg), *Lean body mass* (kg), *Total body water* (kg) and *Basal metabolism* (kj). Except for the *Body height* and *Sitting height* variables in which the Martin anthropometer was used as a measuring instrument with scale precision of 0.01 cm, all other variables were analyzed by the *TANITA diagnostic scale* (BC 418), i.e., monitor which calculates body composition based on electrical resistance which differs depending on the tissue through which the electrical energy is conducted (*Bio Impedance Analysis*). The measurements on the Tanita device were performed in the morning, with an empty bladder. All measurements were taken in the sports hall of the SC Gripe, where the national championship also took place following the predefined protocol that had been announced to the participants and their coaches in advance. The measurers who performed the measuring were all experts from the Faculty of Kinesiology in Split and members of the project team of the Croatian Science Foundation No. 6524. Methods of data analysis included the calculation of descriptive statistical indicators: arithmetic mean (AM), standard deviation (SD), minimum result (MIN) and maximum result (MAX) for all 10 variables, separately for male and female participants and for each weight category.

Results and Discussion

Descriptive parameters of anthropometric characteristics and body composition of Croatian male taekwondo competitors in the cadet age group (*from 10 to 14 years*) according to weight category (*+65kg, -65 kg, -61 kg, -57 kg, -53 kg, -49 kg, -45 kg, -41 kg, -37 kg, -33 kg*) are presented in Table 1.

The results in Table 1 indicate that mean values of the measuring variables increase proportionally with the weight category. The biggest range, i.e., variability of the results is seen in the body height variable for the -61-kg category (176.7±6.9).

Descriptive parameters of anthropological characteristics and body composition of Croatian female taekwondo competitors in the cadet age group (*from 10 to 14 years*), according to weight category (*+59 kg, -59 kg, -55 kg, -51 kg, -47 kg, -44 kg, -41 kg, -37 kg, -33 kg, -29 kg*) are presented in Table 2. The results in Table 2 indicate that mean values of the measuring variables increase proportionally with the weight category. The biggest range, i.e., variability of the results is seen in the body height variable for the +59-kg category (171.0±6.9). All mean values for male participants in the body fat percentage variable in all categories were lower than the values measured on the female sample, which was expected considering the characteristics of the female organism.

Determining anthropological characteristics of young Croatian taekwondo competitors was also the aim of an earlier study conducted by Čular et al. (2013), who determined the somatotype of 32 female and 30 male younger cadets by using the Heath-Carter method. Mean somatotype values were 3.71-3.19-3.70±1.42-1.02-1.14 for girls and 3.45-4.17-3.58±1.94-1.12-1.58 for boys. Based on the categorization diagram, nine somatotype categories were obtained for female and seven categories for male competitors.

Table 1. Normative values of Croatian taekwondo competitors for cadets according to weight category, sex=M

	AM±SD (MIN-MAX)									
	+65kg	**-65 kg**	**-61 kg**	**-57 kg**	**-53 kg**	**-49 kg**	**-45 kg**	**-41 kg**	**-37 kg**	**-33 kg**
Body height (cm)	178.1±5.9 (169.5-187.3)	174.3±6.4 (168.5-184.7)	176.7±6.9 (169.6-183.4)	168.2±4.3 (159.4-173.0)	166.0±6.1 (155.7-177.0)	163.9±5.0 (156.1-173.5)	158.2±3.3 (152.3-168.0)	154.0±4.9 (146.7-167.0)	149.1±4.3 (142.2-155.8)	145.1±5.6 (132.6-152.9)
Sitting height (cm)	90.2±2.5 (87.8-94.8)	88.3±3.6 (83.8-92.2)	88.8±1.5 (87.4-90.4)	86.3±3.1 (81.8-91.0)	83.7±3.4 (78.8-89.6)	83.7±3.6 (76.8-89.3)	79.6±2.6 (73.7-83.3)	78.5±2.4 (75.2-87.0)	75.5±2.7 (69.5-78.6)	74.3±2.8 (68.3-77.8)
Body mass (kg)	70.6±3.7 (65.0-75.1)	63.6±1.1 (62.0-64.6)	59.0±0.8 (58.2-59.8)	55.9±1.0 (54.1-57.0)	51.9±1.1 (50.2-53.6)	48.2±1.2 (45.9-49.6)	44.3±1.0 (42.5-45.8)	40.4±1.1 (38.1-43.2)	36.0±1.7 (31.3-37.7)	32.7±0.4 (32.1-33.3)
Body mass index	22.3±1.7 (20.7-25.4)	21.5±1.1 (20.2-22.9)	19.7±1.1 (18.9-20.9)	20.0±1.0 (19.1-22.5)	18.8±1.2 (16.8-21.6)	18.0±0.9 (16.4-19.8)	17.7±0.9 (15.5-19.3)	17.0±0.9 (15.5-18.8)	16.5±1.3 (15.0-19.5)	15.7±0.8 (14.3-16.9)
Body fat perc.	17.5±2.8 (14.1-21.7)	17.8±2.7 (14.9-22.2)	15.2±3.3 (12.9-18.9)	15.9±2.9 (12.6-20.8)	16.5±4.0 (12.1-24.9)	14.5±2.1 (11.5-18.4)	16.0±2.9 (11.3-21.0)	15.5±3.4 (9.7-23.3)	15.8±3.0 (12.1-24.5)	14.8±2.0 (11.1-17.4)
Body fat (kg)	12.3±2.1 (10.2-15.4)	11.4±1.8 (9.4-14.3)	9.0±2.0 (7.6-11.3)	8.9±1.7 (7.1-11.7)	8.6±2.1 (6.2-12.6)	7.0±0.9 (5.6-9.1)	7.1±1.3 (5.1-9.4)	6.2±1.4 (3.9-9.0)	6.0±1.9 (4.2-12.6)	4.8±0.6 (3.7-5.6)
Muscle mass (kg)	55.6±3.4 (52.1-60.0)	50.0±1.6 (48.1-51.4)	47.8±1.5 (46.3-49.2)	45.0±1.5 (42.8-47.1)	41.5±2.1 (36.5-44.6)	39.5±1.6 (36.2-41.5)	35.7±1.6 (32.9-38.2)	32.8±1.6 (28.7-35.7)	30.0±2.1 (27.2-36.8)	26.8±0.9 (25.6-28.5)
Lean b. mass (kg)	58.3±3.6 (54.5-63.0)	52.3±1.7 (50.3-53.7)	50.1±1.5 (48.5-51.5)	47.0±1.6 (44.7-49.1)	43.3±2.2 (38.1-46.7)	41.2±1.7 (37.7-43.3)	37.2±1.7 (34.3-39.9)	34.2±1.7 (29.8-37.2)	31.2±2.2 (28.3-38.7)	27.8±0.9 (26.6-29.6)
Total body water	42.7±2.6 (39.9-46.1)	38.3±1.2 (36.8-39.3)	36.7±1.1 (35.5-37.7)	34.4±1.1 (32.7-35.9)	31.7±1.6 (27.9-34.2)	30.2±1.3 (27.6-31.7)	27.2±1.2 (25.1-29.2)	25.0±1.2 (21.8-27.2)	22.9±1.6 (20.7-28.3)	20.4±0.6 (19.5-21.7)
Basal metabolism	8424±421 (7929-8954)	7819±146 (7665-7966)	7545±15 (7531-7560)	7177±120 (6887-7280)	6798±175 (6439-7184)	6582±159 (6217-6761)	6210±123 (5996-6473)	5914±125 (5627-6134)	5586±151 (5163-5837)	5290±66 (5167-5376)

Legend: AM – arithmetic mean; SD – standard deviation; MAX – minimum; MAX – maximum.

Table 2. Normative values of Croatian taekwondo competitors for cadets according to weight category, sex=F

	AM±SD (MIN-MAX)									
	+59 kg	**-59 kg**	**-55 kg**	**-51 kg**	**-47 kg**	**-44 kg**	**-41 kg**	**-37 kg**	**-33 kg**	**-29 kg**
Body height (cm)	171.0±6.9 (161.8-182.6)	169.3±7.0 (163.8-186.7)	163.8±4.2 (157.3-171.9)	163.9±5.6 (154.4-183.3)	162.0±5.1 (155.9-174.4)	157.5±5.3 (147.5-168.5)	155.1±6.2 (142.2-168.6)	151.7±6.7 (144.1-164.4)	146.8±1.0 (145.2-147.6)	142.3±0.6 (141.9-142.7)
Sitting height (cm)	88.5±3.2 (83.9-94.8)	87.6±2.3 (82.4-89.6)	84.3±3.7 (77.0-90.6)	84.3±3.1 (79.3-93.1)	82.9±3.3 (76.9-88.3)	81.5±3.3 (75.8-87.5)	79.6±3.3 (71.0-86.5)	78.2±3.0 (74.7-83.0)	74.8±2.2 (71.4-77.8)	74.9±3.1 (72.7-77.1)
Body mass (kg)	69.7±7.2 (61.4-85.4)	58.5±1.0 (57.3-60.0)	53.4±1.9 (49.0-55.1)	50.5±1.1 (48.2-51.9)	46.5±1.0 (44.6-48.8)	44.0±0.4 (43.4-44.6)	40.4±0.9 (37.8-41.5)	36.7±0.5 (35.9-37.8)	32.7±1.0 (30.8-33.8)	28.4±1.4 (27.4-29.4)
Body mass index	24.3±2.6 (20.0-29.8)	20.7±1.2 (19.0-22.2)	19.9±1.1 (18.2-21.5)	18.8±1.0 (16.6-21.9)	17.7±1.0 (15.6-19.1)	18.0±1.6 (15.5-22.1)	16.7±1.1 (14.5-18.9)	16.3±1.2 (14.7-17.7)	15.4±0.9 (14.3-17.0)	14.0±0.6 (13.6-14.4)
Body fat perc	27.1±3.5 (21.7-32.5)	24.7±2.4 (21.6-28.6)	23.5±2.4 (17.7-26.0)	22.3±2.0 (17.9-25.5)	21.0±2.4 (16.4-24.7)	22.1±4.0 (18.0-33.6)	20.0±2.6 (15.2-25.4)	18.4±2.0 (14.8-21.5)	18.0±0.7 (17.2-19.5)	17.7±0.9 (17.0-18.3)
Body fat (kg)	19.0±3.7 (13.3-25.7)	14.5±1.4 (12.5-16.6)	12.6±1.4 (9.5-14.3)	11.3±1.2 (8.9-13.1)	9.8±1.1 (7.8-11.4)	9.7±1.7 (8.0-14.6)	8.1±1.1 (6.2-10.3)	6.7±0.7 (5.4-7.7)	6.0±0.4 (5.5-6.6)	5.0±0.0 (5.0-5.0)
Muscle mass (kg)	48.1±4.5 (42.6-59.4)	41.8±1.6 (39.3-44.4)	38.8±1.7 (35.6-41.9)	37.3±0.9 (35.8-39.2)	34.9±1.4 (33.1-37.8)	32.6±1.7 (27.5-34.5)	30.7±1.1 (28.5-32.7)	28.6±1.0 (26.7-29.8)	25.9±1.3 (24.1-28.6)	22.3±1.4 (21.3-23.3)
Lean b.mass (kg)	50.7±4.7 (45.0-62.7)	44.0±1.7 (41.3-46.8)	40.8±1.8 (37.4-44.2)	39.2±0.9 (37.7-41.2)	36.7±1.5 (34.6-39.7)	34.2±1.8 (28.8-36.2)	32.3±1.2 (29.9-34.4)	30.0±1.0 (28.2-31.2)	27.2±1.4 (25.2-30.1)	23.4±1.4 (22.4-24.4)
Total body water	37.1±3.5 (32.9-45.9)	32.2±1.2 (30.2-34.3)	29.9±1.4 (27.4-32.4)	28.7±0.6 (27.6-30.2)	26.9±1.1 (25.3-29.1)	25.1±1.3 (21.1-26.5)	23.6±0.9 (21.9-25.2)	22.0±0.7 (20.6-22.8)	19.9±1.0 (18.5-22.0)	17.2±1.1 (16.4-17.9)
Basal metabolism	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)	7226±537 (6573-8594)

Legend: AM – arithmetic mean; SD – standard deviation; MAX – minimum; MAX – maximum.

The majority of young female competitors fit the balanced ectomorph (28.13%) and mesomorphic ectomorph (15.63%) category. The majority of young male competitors fit the mesomorphic ectomorph (43.33%) and mesomorphic endomorph (23.33%) category. Analysis of variance (ANOVA) showed no statistically significant differences in somatotype according to sex. Petterson Ekström, & Berg (2013) state that the reduction of body mass due to physical dominance over the opponent is often seen in combat sports. Quick reduction of body weight is unhealthy, especially if it occurs shortly before the weigh-in, because, as stated by Utter et al. (2012), there is not enough time to compensate for the lost body water which is the main cause for the virtual weight loss. The obtained normative values can help coaches in the planned transition from lower to higher weight category, the precondition of which is growth and development, taking health of young taekwondo athletes into consideration.

Conclusion

On a sample of 258 Croatian male and female taekwondo competitors in the cadet age group (from 10 to 14 years), 10 anthropometric characteristics were measured, including morphological measures: *body height, sitting height,* and *body mass*); and characteristics of body composition: *Body mass index, body fat (%), body fat (kg), muscle mass (kg), lean body mass (kg), total body water (kg),* and *basal metabolism (kj).* The obtained mean results (AM), variability (SD), and range of results (MIN-MAX) represent the Croatian normative values of anthropometric characteristics and body compositions for male and female cadets according to weight category in taekwondo. The importance of this study, in addition to its scientific contribution to describing the characteristics of competitors regarding their body build and composition, is also reflected in the possible application of the obtained results in the process of selection, monitoring of growth and development, and control of body mass in male and female taekwondo competitors. In future research, it is necessary to determine the normative values for other age groups and weight categories of taekwondo competitors, to calculate somatotype according to weight categories, and to compare the obtained results with biological age in order to determine the existence of correlation to result success in taekwondo.

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