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

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Abstract

The aim of this study was to determine the normative values of body composition and anthropometric characteristics of senior Croatian taekwondo competitors of both sexes, according to weight category. The subject sample consisted of 137 participants of the national senior taekwondo championships (Split, 2015). The subject sample was divided into two subsamples: male seniors (n=73) and female seniors (n=64). Nine variables were measured and according to their role, they were divided in two groups: morphological measures (body height, body mass) and variables defining 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 measurements were taken by the Martin anthropometer and the TANITA diagnostic measuring device, model BC 418, based on the bioimpedance principle. The obtained results – mean value, variability (SD) and the ranges of values (MIN-MAX) – are the Croatian reference values of anthropometric characteristics and body composition for male and female senior taekwondo competitors of different weight category. Apart from its direct scientific contribution to describing the characteristics of competitors in terms of their body build and composition, the importance of this study is in possible control of body mass in male and female taekwondo competitors.

Key words*: Croatian reference values, body build, body composition, body weight reduction, dehydration*

Introduction

Taekwondo is a global sport and, according to the number of practitioners around the world, one of the most popular combat sports as it is practiced, according to the official World Taekwondo Federation (WT) website, in 208 countries and 5 different continents. Taekwondo is a polystructural contact combat sport, dominated by open or semi-open movement structures performed in variable conditions. It is an individual sport in which the movements are pre-trained (attack-counter-attack), but their performance depends on the opponent's reactions. Considering taekwondo is a relatively young and complex sport, there have only been partial investigations regarding the effect certain areas have on success. There is still a lack of quality research studies which have successfully determined the relations of anthropological status with success in taekwondo. Previous findings (Tosković et al., 2004; Marković et al., 2005) indicate that a high level of all anthropological dimensions is required for success in taekwondo, but within the area of motor abilities, speed and explosive power, which are naturally in the function of specific technical-tactical skills, are the most important. Čular et al. (2013) state that the specification equation of success in taekwondo, which should reveal the hierarchical structure and mutual relations between the factors important for achieving high taekwondo results, has not been adequately explored yet, at least not to the extent which would allow the use and exact application of the obtained scientific findings in the selection and sports preparation of taekwondo athletes.

Due to the possibility of taekwondo athletes participating in multiple fights in the same day, aerobic functional capacities should be developed (Čular et al., 2011), and the percentage of subcutaneous fat tissue should be low (Gao et al., 2001). According to Pieter et al. (1998), taekwondo athletes are leaner than judo athletes. Gao et al. (2001) determined the dominant somatotype of taekwondo athletes as that of proportional build, with well-developed muscles and skeleton, and a low percentage of subcutaneous fat tissue. According to Čular et al. (2010), equally good performance of techniques on both sides of the body greatly determines success in a taekwondo competition.

The most frequently tested segments of anthropological status are athletes' motor-functional abilities and morphological characteristics. This is due to the fact that the measuring instruments used to assess these characteristics have satisfactory metric characteristics, thus the obtained results are exact and interpretable, and are of great importance for success in almost every sport (Krstulović, 2006).

The aim of the study was to determine the body composition and anthropometric reference values of senior Croatian taekwondo competitors of both sexes, according to weight category.

Methods

The subject sample consisted of 137 participants of the national taekwondo championships for seniors (Split, 2015), divided into two subsamples: male seniors (n=73) and female seniors (n=64). The variable sample was defined by a set of 9 measurements, including morphological measurements and variables defining body composition: *body height*, *body mass*, *body mass index* (BMI – ratio of body mass (kg) and body height squared (m2)), *body fat (%), body fat (kg), muscle mass (kg), lean body mass (kg)*, *total body water (kg)* and *basal metabolism (kJ).*The *body height* variable was measured by the Martin anthropometer, with scale precision of 0.01 cm, whereas all other variables were analysed 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*). All measurements were taken in the morning, in the sports hall of the SC Gripe, where the national championship took place, following the predefined protocol that had been announced to the participants and their coaches in advance. 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 underaged participants provided a written consent singed by their parent-guardian, i.e., personal statement. During the official weigh-in, the participants submitted their ID card of the Croatian Taekwondo Federation to confirm their identity. A precondition to enter the competition was a clean health status, which was verified by a medical certificate from a certified sports medicine physician. 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 Project No. 6524. Methods of data analysis included the calculation of descriptive statistical indicators: mean values (Mean), standard deviation (SD), minimum result (min), and maximum result (max) for all 9 variables, separately for male and female senior competitors as well as for each weight category.

Results and discussion

Descriptive parameters of anthropometric characteristics and body composition of senior male Croatian taekwondo competitors according to weight category *(+87g, -87 kg, -80 kg, -74 kg, -68 kg, -63 kg, -58 kg, -54 kg*) are presented in Table 1.

By inspecting Table 1 it is evident that average values of the measured values increase proportionally to the weight category. The greatest range, i.e., variability of results is found in the variables of body fat (%, kg) and muscle mass (kg).

Descriptive parameters of anthropometric characteristics and body composition of senior female Croatian taekwondo competitors according to weight category *(+73 kg, -73 kg, -67 kg, -62 kg, -57 kg, -53 kg, -49 kg*) are presented in Table 2.

It is evident in Table 2 that average values of the measured values increase proportionally to the weight category. The greatest range, i.e., variability of results is found in the variables of *body fat* (% and kg). All average values for male seniors in the variable *body fat* (%) in all categories were lower than the values measured on a sample of female seniors, which was expected considering the characteristics of the female organism. Confirming the results of Gao et al. (1998), this study confirmed that the percentage of body fat tissue in elite taekwondo athletes is relatively lower than that of average athletes. According to Pieter et al. (2002), the mesomorphic component is predictive for success in taekwondo. It can be expected, due to characteristics of using leg techniques and a system of weight categories, that more successful taekwondo athletes should, among other things, also be more ectomorphic (*length of extremities*), which should be further investigated and tested in future research (Čular et al., 2017).

The results of the percentage of hydration of the organism are interesting and cause for concern. A highest average percentage of only 62.3% in male +87kg category, but also a minimum result of only 30.6% in female -49kg category are two ultimate values of hydration recorded. And while the first value is over the limit of normal (56% for that age), the second value of only 30.6% indicates a serious dehydration of female athletes. According to Petterson et al. (2013), body mass reduction to achieve physical dominance over the opponent is common in combat sports, and also leads to dehydration. Quick body mass reduction is unhealthy, especially if it is done in the short period before the weigh-in, because athletes do not find enough time to make up for body water loss, which is the main cause of the seeming weight loss (Utter et al., 2012). Young athletes who are not properly balanced and hydrated can experience deficits in strength, speed and endurance, as well as decreased focus, increased fatigue and increased risk of injury (Bonci, 2010). Furthermore, rapid weight loss affects cognitive performance and mood, and these are parameters that can affect performance in combat sports since it requires concentration, qualitative assessment and a certain level of skill (Hall & Lane, 2001; Landers et al., 2001). Following the results of this study, it turns out that female taekwondo athletes are at greater risk of dehydration and, therefore, the consequences that dehydration can bring.

Table 1. Reference values of senior Croatian taekwondo competitors according to weight category, sex=M

	Mean ± SD (min-max)							
	+87kg	**-87 kg**	**-80 kg**	**-74 kg**	**-68kg**	**-63 kg**	**-58 kg**	**-54 kg**
Body height (cm)	191.6±7,0 (180.5-197.3)	182,1±5.72 (172.5-190.7)	179,9±4.2 (177.0-186.0)	185,1±6.2 (177.0-197.5)	179,4±3.9 (171.0-185.0)	173.6±5.9 (170.0-184.0)	171.5±3.0 (168.0-176.0)	168.0±1.00 (167.0-169.0)
Body mass (kg)	100.9±9.3 (88.3-112.9)	84.3±1.5 (82.7-86.5)	78.4.±1.4 (77.3-80.4)	73.3±0.5 (72.6-74.1)	67.0±1.3 (64.2-68.1)	62.2±0.5 (62.4-63.7)	57.6±0.7 (56.2-58.3)	53.9±0.4 (53.7-54.2)
Body mass index	26.3±3.3 (23.2-32.1)	25.5±2.0 (23.5-29.2)	24.3±0.7 (23.2-24.7)	21.4±1.3 (18.9-23.2)	20.8±1.1 (18.8-23.2)	21.0±1.4 (18.6-22.0)	19.6±0.6 (18.8-20.5)	19.1±0.1 (19.0-19.2)
Body fat (%)	15.5±3.3 (10.3-22.7)	14.2±3.8 (8.8-19.9)	9.8±6.5 (4.2-15.9)	7.3±3.9 (2.0-14.0)	8.6±3.7 (1.5-14.1)	6.1±3.5 (1.9-10.1)	8.2±3.2 (5.2-12.7)	8.4±3.3 (6.1-10.7)
Body fat (kg)	15.9±6.4 (10.3-23.6)	12.0±3.3 (7.3-17.2)	7.7±4.9 (3.4-12.3)	5.3±2.8 (1.5-10.2)	5.8±2.5 (1.0-9.6)	3.8±2.2 (1.2-6.4)	4.7±1.8 (3.0-7.3)	4.6±1.8 (3.3-5.8)
Muscle mass (kg)	81.1±6.4 (74.3-88.9)	69.0±2.5 (48.1-51.4)	67.01±5.0 (62.1-72.3)	64.7±2.9 (59.9-67.6)	58.4±2.6 (54.1-63.0)	56.5±1.9 (54.6-58.7)	50.5±1.8 (48.0-52.7)	47.3±1.4 (46.3-48.3)
Lean b. mass (kg)	85.1±6.7 (78.2-93.0)	72.3±2.6 (69.1-74.5)	70.7±6.0 (65.0-77.0)	68.0±3.1 (62.8-71.8)	61.3-3.0 (56.5-67.1)	59.3±2.4 (57.1-62.5)	52.9±1.9 (50.2-55.2)	49.4±1.4 (48.4-50.4)
Total body water (kg)	62.3±4.9 (39.9-46.1)	53.0±1.9 (50.6-55.2)	51.8±4.4 (47.6-56.4)	49.8±2.3 (46.0-52.6)	44.8±2.2 (41.4-49.1)	43.4±1.7 (41.8-45.8)	38.7±1.4 (36.8-40.4)	36.2±1.1 (35.4-36.9)
Basal metabolism (kJ)	10722.0±914.5 (9669-11686)	9057±313 (8619-9431)	8714.5±686.5 (8000-9431)	8605.4±398.1 (8083-9167)	7720.0±384.3 (97130-8573)	7331.2±272.6 (7025-7694)	6918.8±203.6 (6581-7142)	6501.5±337.3 (6263-6740)

Table 2. Reference values of senior Croatian taekwondo competitors according to weight category, sex=F

	Mean ± SD (min-max)						
	+73 kg	**-73 kg**	**-67 kg**	**-62 kg**	**-57 kg**	**-53 kg**	**-49 kg**
Body height (cm)	183.5±2.1 (182.0-185.0)	173.7±5.9 (167.0-182.0)	172.8±6.1 (166.0-182.0)	171.6±4.7 (165.0-179.0)	171.8±6.1 (166.0-183.0)	165.1±5.3 (157.0-177.0)	164.3±3.5 (160.0-169.0)
Body mass (kg)	85.8±5.6 (81.8-89.7)	70.4±1.9 (67.4-72.8)	66.5±1.0 (64.5-67.3)	61.4±1.2 (58.7-62.4)	56.3±0.8 (54.8-57.1)	52.4±0.9 (49.9-53.3)	48.8±0.4 (48.1-49.3)
Body mass index	25.5±2.3 (23.9-27.1)	23.4±1.3 (22.0-25.2)	22.3±1.4 (20.4-23.9)	20.9±1.3 (18.3-22.8)	191±1.1 (17.1-20.1)	19.3±1.3 (16.8-21.4)	18.1±0.6 (17.2-18.9)
Body fat (%)	25.4±7.0 (20.4-30.3)	22.4±3.4 (16.7-26.1)	21.9±2.5 (16.9-24.6)	20.7±4.3 (14.1-29.3)	16.0±2.4 (12.8-19.0)	16.7±3.2 (9.7-21.3)	14.4±4.6 (8.7-21.4)
Body fat (kg)	21.9±7.4 (16.7-27.2)	15.8±2.4 (12.2-18.2)	14.5±1.6 (11.3-16.4)	12.8±2.7 (8.8-18.1)	9.0±1.5 (7.2-10.7)	8.8±1.7 (5.1-11.4)	7.0±2.2 (4.3-10.4)
Muscle mass (kg)	60.5±1.7 (59.3-61.7)	51.8±2.9 (48.7-57.6)	49.3±1.9 (47.4-52.6)	46.2±2.5 (41.4-50.9)	44.9±1.1 (43.3-46.4)	41.5±1.9 (39.3-45.1)	39.7±2.4 (36.2-42.7)
Lean b.mass (kg)	63.8±41.8 (62.5-65.1)	54.6±3.1 (1.3-60.6)	51.9±2.0 (50.0-55.4)	48.7±2.6 (43.6-53.5)	47.3±1.1 (45.6-48.9)	43.7±2.0 (41.3-47.5)	41.8±2.6 (38.0-45.0)
Total body water (kg)	46.8±1.3 (45.8-47.7)	40.0±2.3 (37.6-44.4)	38.0±1.5 (36.6-40.6)	35.7±1.9 (31.9-39.2)	34.6±0.8 (33.4-35.8)	32.0±1.5 (30.2-34.8)	30.6±1.9 (27.8-32.9)
Basal metabolism (kJ)	8056.5±120.9 (7971-8142)	6967.0±282.4 (6581-7527)	6757.6±248.9 (6422-7180)	6380.2±151.3 (6117-6556)	6085.7±156.5 (5849-6309)	5688.7±231.7 (5489-6201)	5396.7±228.9 (5100-5711)

All this justifies the aim of this study, which was to determine the normative values for male and female senior taekwondo competitors. The obtained normative values can help coaches in planned transition from a lower to a higher weight category, considering health of taekwondo athletes. However, the limitations of the study are read in the fact that these are values obtained just prior to the competition, during weigh-in, where contestants probably lose some of the body mass to fit in a desired weight category. This is certainly a reason for concern and can maybe be the reason for possible change in the way of categorization in this sport since athletes are significantly endangering their health.

Conclusion

Results obtained by this study represent Croatian normative values of anthropometric characteristics and body composition for male and female seniors according to weight category in taekwondo. Apart from its direct scientific contribution to describing the characteristics of competitors in terms of their body build and composition, the importance of this study is in possible application of the obtained results in the selection process, monitoring of growth and development, and control of body mass in male and female taekwondo competitors. In future research, normative values for other age groups and weight categories of taekwondo competitors should be determined, somatotype

should be calculated according to weight category, and the obtained results should be compared to biological age to determine if there is a correlation with result efficiency in taekwondo.

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