

Anthropometric Characteristics and Body Composition of Jelena Arnautovic, Member of the Judo National Team of BIH

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Abstract

Profiling and selection of judokas implies adequate analysis of anthropometric characteristics and physical status. Based on good detection, analysis and projection of these parameters, it is possible to define the athlete model, where the scope and nature of anthropometric profiling depend on the primary purpose of measurement. Most often, the identification of talent or the orientation of athletes to morphologically appropriate disciplines depends on the identification of relatively unchanging characteristics, comparing them with reference data. Profiling includes skin folds, circumference, length and width of bones, body composition. To monitor morphological adaptation, the focus should be on variable characteristics, such as muscle mass and subcutaneous adipose tissue. Our competitor had a higher body height (186 cm), body weight (118.6 kg), muscle mass (70.4 kg), water percentage (47.6%), higher fat percentage (37.5%). The results lead to the conclusion that it is an endo-mesomorphic somatotype with significant ectomorphism, where adipose tissue with synchronization of motor abilities proved to be a favorable and not a disruptive factor of the result success.

Keywords: Anthropometry, body composition, judo, detection, evaluation.

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1. INTRODUCTUON

Judo sport belongs to the category of martial arts which is characterized by high integration of most motor abilities (speed of movement, explosive power, repetitive power, flexibility, coordination, balance), enabling good realization of judo technique. It is a high-intensity martial art classified by weight, where the athlete tries to throw the opponent on his back or to control him during most of the fight on the field (Franchini, Nunes, Moraes, & Del Vecchio, 2007; Franchini, Del Vecchio, Matsushigue, & Artioli, 2011; Franchini, Huertas, Sterkowicz, Carratalá, Gutiérrez-Garcia, & Escobar-Molina, 2011a). Precisely because of the demands of combat, application of technique and tactics, judokas usually try to increase their muscle mass and reduce the percentage of fat in each weight category in order to gain an advantage over weaker opponents (Artioli, Franchini, Nicaastro, Sterkowicz, Solis, & Lancha, 2010; Brito, Roas, Brito, Marins, Córdova, & Franchini, 2012; Franchini, Brito, & Artioli, 2012). The exception is the +100 kg category, where the upper body weight limit is not specified.

The results of some studies show that judokas maintain body weight in the upper limit of the weight category, which supports the results of research that defines a small amount of subcutaneous adipose tissue, except in the heavy category (Franchini, Sterkowicz-Przybycien, & Takito, 2014). Most research confirms that the success of judo athletes requires high levels of upper body anaerobic capacity and muscle strength (Franchini, Takito, Kiss, & Sterkowicz, 2005a; Franchini, Del Vecchio, Matsushigue, & Artioli, 2011; Kim, Cho, Jung, & Yoon, 2011), adequate physical status (Franchini, Huertas, Sterkowicz et al. 2011, Kons, Ache-Dias, & Detanico, 2017), so the assessment of these parameters is a useful diagnosis of current physical condition, as a recommendation for training and comparison with top athletes (Callister, Callister, Fleck, Dudley, 1990; Franchini, Nunes, Moraes, & Del Vecchio, 2007; Koral, & Dosseville, 2009; Monteiro, Massuca, Garcia Garcia, & Calvo Rico, 2014).

In addition to physical abilities, previous research (Franchini, Takito, Kiss, & Sterkowicz, 2005a; Franchini, Del Vecchio, Matsushigue, & Artioli 2011;

Franchini, Huertas, Sterkowicz, Carratalá, Gutiérrez-Garcia, & Escobar-Molina, 2011a; Franchini, Brito, Fukuda, Artioli, 2014a; Koral, & Dosseville, 2009) determine the relevance of anthropometric variables and body composition in judo performances. Body composition is associated with achieving an elite level in judo and can affect the type of techniques used during a match. For example, low body fat content is associated with higher anaerobic capacity and number of seizures (Franchini, Takito, & Bertuzzi, 2005), improved physical performance, and competitive outcomes (Mello, & Fernandes Filho 2004). In this sense, athletes with less than 10% body fat were able to achieve better results, except in the heavy weight categories (Franchini, Huertas, Sterkowicz, Carratalá, Gutiérrez-Garcia, & Escobar-Molina, 2011a). Although the somatotype varies between different weight categories, elite judokas have a profile related to mesomorphic characteristics (Franchini, Sterkowicz Przybycien, & Takito, 2014) while judokas have endomorphic somatotype values close to the mesomorphic somatotype (Franchini, Del Vecchio, & Matsushique, & Arioli, 2011). Any assessment of body composition in athletes helps to optimize competitive performance and track the success of training regimes and is therefore of great interest to sports professionals (Ackland, Lohman, Sundgot-Borgen, Maughan, Meyer *et al.*, 2012; Rodriguez, Di Marco, Langley, 2010). Physical status is one of the most influential factors on sports performance, as there is an excess of adipose tissue in the body that acts as a ballast mass in activities such as running or jumping, while having a positive impact in judo (Reilly, & Doran, 2003; Krstulovic, Sekulić, & Sertić, 2006; Sterkowicz-Przybycien & Franchini, 2013), influencing the type of techniques applied. Improved body composition in judokas has been associated with improved cardiorespiratory abilities (Högström, Pietilä, Nordström, & Nordström, 2012) and strength Granados, Izquierdo, Ibanez, Ruesta, & Gorostiaga (2008); Silva, Fields, Heymsfield, & Sardinha (2010). It can also be associated with health complications, as health problems can occur in athletes with very low body weight, extreme weight changes due to dehydration or eating disorders (Nattiv, Loucks, Manore, Sanborn, & Sundgot-Borgen, 2007).

Body fat has been shown to be negatively associated with judoka performance in aerobic and anaerobic tests (Kim, Cho, Jung, & Yoon, 2011). Therefore, several studies aimed to obtain anthropometric parameters, such as body composition, bone diameter and circumference, due to their greatest importance for performance (Franchini, Takito, & Bertuzzi, 2005; Franchini, Nunes, Moraes, & Del Vecchio, 2007; Kubo, Chishaki, Nakamura, Muramatsu, Yamamoto, et al. 2006).

Callister, Callister, Fleck, Dudley, (1990) reported lower fat mass in higher-ranking judo athletes, compared to lower-ranking competition athletes

($5.1\pm 0.6\%$ vs. $8.2\pm 0.8\%$). In addition, Kubo, Chishaki, Nakamura, et al. (2006) confirmed that judokas who participated in the Olympic Games or the Asian Games had significantly higher body weight without fat than university judokas who did not participate in university competitions. Franchini, Takito, Kiss, & Sterkowitz, (2005A) did not find a significant difference in skin fold thickness between elite and non-elite judokas, but identified higher values of upper extremity circumference (bent arm, forearm, wrist, and medial body) and transverse dimensionality (upper arm epicondyle and femurs) in relation to non-elite judokas. However, when the competitive level of athletes is closer (national team members and their reserves), no anthropometric difference was found (Franchini, Nunes, Moraes, & Del Vecchio, 2007). Although some earlier studies (Farmosi, 1980; Claessens, Beunen, Wellens, & Geldhof, 1987) compared judokas from different weight categories, they were limited to two informal categories (light and heavy athletes), while some other studies (Iida, Nakajima, Wakayama, & Matsumoto, 1998) compared official weight distributions, but were limited to only one variable (e.g., body fat). Some of these differences are further affected by the exercises needed to change the weight category when switching between age groups or to upgrade certain technical and tactical advantages over national and international competition. The predominant body type was endo-mesomorphic type and the changes that occurred in the sample occurred mainly in accordance with this tendency (Smaruj, Orkwiszewska, Adam, Jezyk, Kostrzewa, & Laskowski, 2019). Previous research has shown that the somatotype profile of male judokas is mesomorphic, while the endomorphic component dominates in judokas. There is also a tendency to increase muscle mass and decrease body fat. Morphological and physiological variables related to technique in competitive judo are interrelated, which means that the improvement of any of these variables stimulates the improvement of others (Franchini, Takito, & Bertuzzi, 2005), as well as gender differences in terms of anthropometric characteristics. Previous cross-sectional studies of different age groups of judokas have defined the differences between these groups, but as they did not follow the same participants, the changes that occurred during the years of training could not be confirmed longitudinally. It is still not clear which anthropometric characteristics reach their full development in senior judokas. Such information can be particularly useful for identifying talent, selecting a target weight category, or finding the judo techniques that best suit individual athletes (Franchini, Huertas, Sterkowicz, Carratalá, Gutiérrez-Garcia, & Escobar-Molina, 2011a). There is an obvious lack of data on the anthropological characteristics of female judokas in B&H. This research was conducted to determine the anthropometric profile and body composition of female judokas.

The aim of this study is to analyze the Anthropometric profile and Body composition structure Jelena Arnautović (BIH Judo team).

2. MATERIAL AND METHODS

2.1. Participants

The study was conducted with Jelena Arnautović (27 years old; 15 years in judo sport) a member of Judo Club "Romanija", and the BIH national Judo team. She was Vice-Champion of Bosnia and Herzegovina for seniors and younger seniors (under 23); She is the 2018 (Kavadarci, North Macedonia) and 2019 (Tirana, Albania) Balkan Champion female seniors (+78). The aim of the study was to analyze Anthropometric characteristics and Body composition (BC).

2.2 The sample of variables

The total of 15 variables (1-16) were variables of anthropometric space which primarily referred to longitudinal, circular and body mass dimensions and skin folds dimensions and 18 variables of Body composition (17-34).

1. Body height (cm)
2. Body weight (kg)
3. Body mass index-(BMI (kg/m²))
4. Chest perimeter (cm)
5. Upper arm perimeter (cm)
6. Forearm perimeter (cm)
7. Abdomen perimeter (cm)
8. Upper leg perimeter (cm)
9. Lower leg perimeter (cm)
10. Triceps skinfold (mm)
11. Biceps skinfold (mm)
12. Subscapular skinfold (mm)
13. Suprailiac skinfold (mm)
14. Abdomen skinfold (mm)
15. Front thigh skinfold (mm)
16. Rear thigh skinfold (mm)
17. Body fat mass (%)
18. Body water (%)
19. Body muscle (kg)
20. Bones (kg)
21. Right hand muscle (kg)
22. Left hand muscle (kg)
23. Torso muscle (kg)
24. Right leg muscle (kg)
25. Left leg muscle (kg)

26. Right hand fat (%)
27. Left hand fat (%)
28. Torso fat (%)
29. Right leg fat (%)
30. Left leg fat (%)
31. Basal metabolism (kCal)
32. Daily calorie intake (kCal)
33. Metabolic years
34. Viscular fat

2.3 Experimental design

Anthropometric measurements were performed according to the methodology of the International Society for the Assessment of Kinanthropometry - ISAK standard procedures. The standard metric instruments were applied: Stadiometer-used for measuring body height (SECA 206, Germany); flexible tape used for measuring the body perimeter and its segments. Body weight and Body Composition were assessed with the bioelectrical impedance method using a body composition analyser (Tanita InnerScanV BC-545N, Tokyo, JAPAN), in accordance with the measurement protocol. The Caliper for measuring skin folds (GIMA-model Plicometro, ITALY). Anthropometric measurements were conducted during training at 1. October, 2021. All measurements were in accordance with the procedures of the Declaration of Helsinki.

3. RESULTS AND DISCUSSION

The main aim of the study was to analyze the anthropometric profile and fitness profile of the judo female contestants J.A, the Vice-Champion of Bosnia and Herzegovina and Balkan Champion female seniors (+78kg). To assess the physical characteristics of the sample, used the so-called anthropometric map of judo's profile and BC (Table 1, Figure 1, 2 & 3). An overall assessment of physical characteristics can be performed on this profile. The table is useful as a review device and the specific individual context of the interpretation of the results of judo. According to Vernillo, Schena, Berardelli *et al.*, (2013) the anthropometric profile of an athlete plays an important role in determining potential for success within a sports discipline. Specific physical characteristics or anthropometric profiles together with body composition are required for the highest levels of performance in a judo sport.

Table 1: Anthropometric characteristics and Body composition J.A

Measured parameters	Value
Body height (cm)	186
Body weight (kg)	118,6
BMI (kg/m ²)	34,3
Chest perimeter (cm)	109
Upper arm perimeter (cm)	40
Forearm perimeter (cm)	31
Abdomen perimeter (cm)	99
Upper leg perimeter (cm)	70

Measured parameters		Value
Lower leg perimeter (cm)		45
Triceps skinfold (mm)		23
Biceps skinfold (mm)		8,6
Subscapular skinfold (mm)		29
Abdomen skinfold (mm)		38
Suprailiac skinfold (mm)		23
Front thigh skinfold (mm)		25
Rear thigh skinfold (mm)		22
Sum of all skinfolds (cm)		16,86
Body Fat Mass (%)		37,5
Body Water (%)		47,6
Body Muscle (kg)		70,4
Bones (kg)		3,7
Basal metabolism (kCal)		2297
Daily calorie intake–DCI (kCal)		9611
Metabolic years		42
Visceral fat		7
Segmental values	Muscle (kg)	Fat %
Right hand	4,3	37,3
Left hand	4,3	39,5
Torso	40,1	33,5
Right leg	11	43,3
Left leg	10,7	43,6

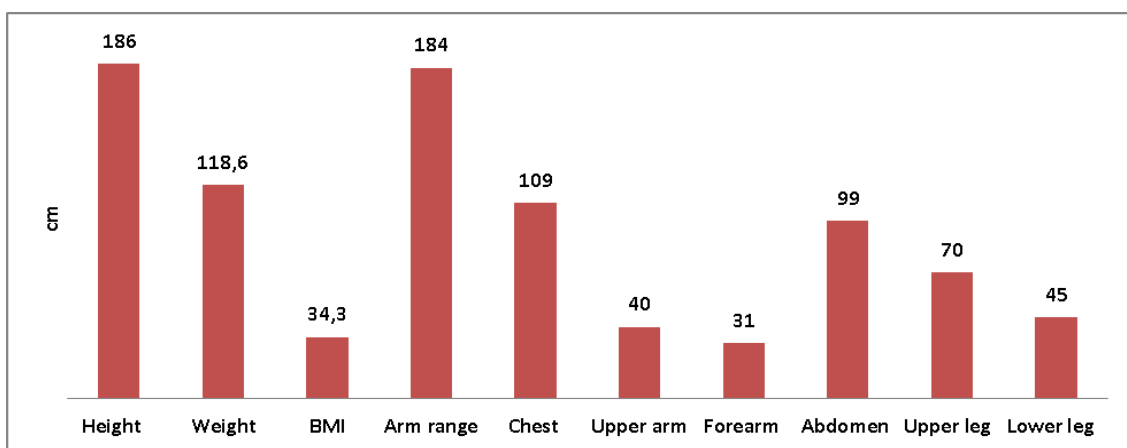


Figure 1: Anthropometric parameters

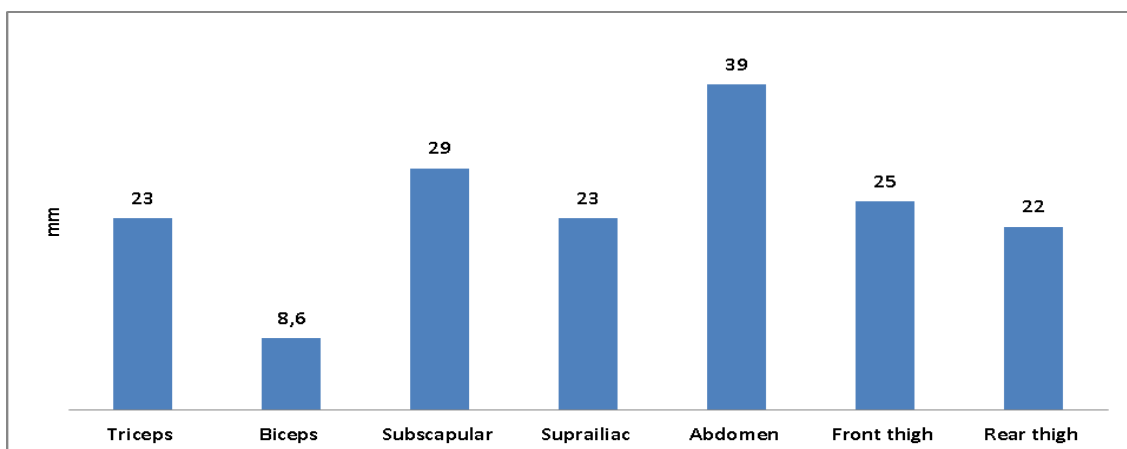


Figure 2: Body skinfolds

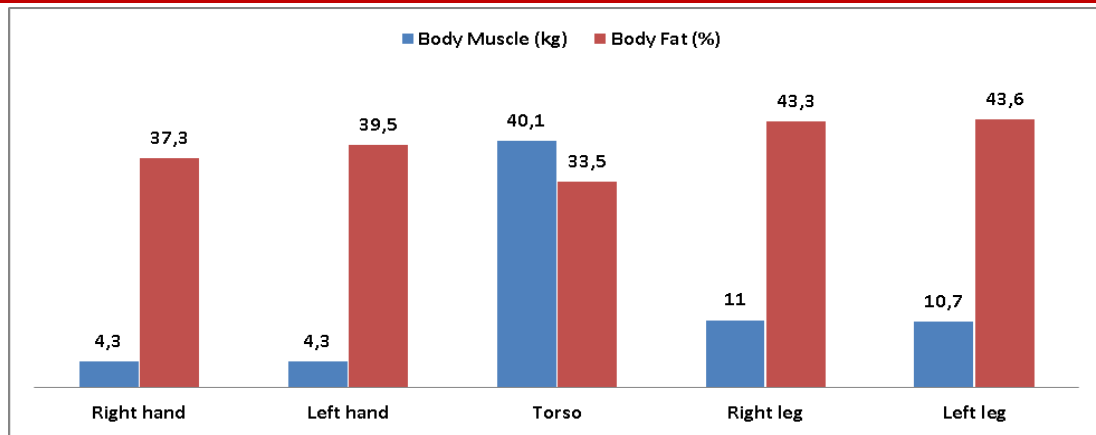


Figure 3: Segmental body composition

Identical to other sports, anthropometry is the most commonly used method for assessing morphological status and body composition in a judo population. According to Molla (2017), anthropometric characteristics define the dimensions of the human body and skeleton by enabling individual or combined predictions of body composition, energy content, regional fats, body fats, and skin folds. Body weight and fat are the main performance variables in many sports, however, extreme weight loss can lead to serious health problems (Sengeis, Müller, Störchle P, Führhapter-Rieger, 2019).

Judo is a sport in which, in addition to good technical skills and tactical strategy, conditional (physical and physiological) characteristics are necessary for a competitive result. Only a developed awareness of the anthropometric and physiological characteristics of an elite athlete will pave the way for his success (Katralli, & Goudar, 2012). In judo, different anthropological parameters determine performance, while body composition is an important component in all weight-sensitive sports, so judokas are often involved in weight reduction exercises. Traditionally, before a competition, most judokas quickly lose weight in an attempt to qualify for the lighter weight category in order to gain an advantage over smaller and weaker opponents. Knowledge and adequate monitoring of the body composition of judo athletes is of the utmost importance to guarantee optimal growth and development combined with optimal performance in an acceptable weight category (Clarys, Geelen, Aerenhouts, Deriemaeker, Zinzen, 2011). Table 1 and Graphs (1, 2 & 3) contain the results of anthropometric characteristics and body composition of our competitor. The obtained results quantitatively and qualitatively define the endo-mesomorphic somatotype of female judokas and are in line with the results of some previous research in this area of interest (Franchini, Del Vecchio, Matsushique, & Arioli, 2011). Strong body height (186 cm) with body weight (118.6 kg) and BMI (34.3 kg/m²) are good indicators of the pronounced endomorphic and mesomorphic components of our competitor, which is primarily in

women's judo, confirming the results of research with elite judokas (Iida, Nakajima, Wakayama, & Matsumoto, 1998; Smaruj, Orkwiszewska, Adam, Jezyk, Kostrzewa, & Laskowski, 2019), where elite judokas have higher upper extremity values than lower-ranking judokas (Kubo, Chishaki, Nakamura *et al.*, 2006). Almost identical results were confirmed in the current research, which is expected because it is a top competitor. Values of longitudinal dimensionality (height) are also expressed, which together with transversality significantly saturate the ectomorphic component. The ectomorphic component is accompanied by defined body volume parameters of larger numerical values, which significantly determines our sample, since body volume defines endo-mesomorphic somatotype, where the numerical volume of the lower extremities (Upper leg perimeter, 70cm; Lower leg perimeter, 45cm) linearly follows values Abdomen perimeter (99cm), chest (Chest perimeter, 109cm) and upper extremities (Upper arm perimeter, 40cm; Forearm perimeter, 31cm).

In 90% of similar studies, subcutaneous adipose tissue significantly defines the total ballast mass of judokas in determining the total body composition. The sum of 7 skin folds (168.6mm) is significantly pronounced which is an indicator of the endomorphic component which with strength and good technique makes a crucial success factor in female judokas. Compared to the results of the Serbian sample of judokas (Drapsin, Drid, Grujic, Trivic, 2009), Iranian (Ali, Hanachi, Nejad, 2010), Turkish (Ceylan, Gurses, Akgul, Baydil, Franchini, 2018) and Colombian (Quintero, Da Rosa Orssatto, Pulgarin, Follmer, 2019) anthropometric parameters and the percentage of fat of our competitor are higher values, while the muscle component is slightly lower. The share of muscle mass in total body weight of J.A is 70.4%, while adipose tissue saturates about 38% of total body mass which corresponds to the endomorphic component approaching the mesomorphic one. This relationship confirms the fact that judokas only in the heavyweight category do not maintain body weight in the upper limit with a smaller amount of subcutaneous adipose tissue

(Franchini, Sterkowicz-Przybycien, & Takito, 2014), where adipose tissue has a positive impact on outcome success (Franchini, Huertas, Sterkowicz, Carratalá, Gutiérrez-García, & Escobar-Molina, 2011a).

The body fat of our competitor is represented in a significant percentage and in relation to the previous results of the research, it records an index number of 7, which is still a healthy level. The percentage of water in the muscles is about 48% and is an indicator of significant hydration and stable muscle function in the conditions of anaerobic regime, because judo consists of fast intense movements of short duration. Muscle mass accounts for 59.35% of total body mass with significant bone mass (3.7kg), basal metabolic rate (2297kCal) and daily energy expenditure of 9611kCal. All these parameters together with the parameters of physical status define the metabolic age of 42 years, which is 15 years more than its biological age. This may be a parameter that should be corrected through a reduction in body fat. Analysis of segmental body status defines a greater presence of muscle mass in the torso (40.1 kg), then there are almost equal values of caudal extremities (left leg 10.7 kg - right leg 11 kg) and equal values of cranial extremities (left arm 4.3 kg - right arm 4.3kg). Out of a total of 37.5% of body fat, the smallest percentage is topographically occupied by the trunk region (33.5%), slightly higher for caudal extremities (left leg 43.6% - right leg 43.3%) and cranial extremities 39 (left arm 39.5% - right hand 37.3%). The relatively inverse relationship between muscle mass and percentage of fat by segments is noticeable.

Although body fat may be increased in relation to muscle mass, the current condition of our competitor is such that with good synchronization of motor skills, good technique and tactics, this value has no negative impact, given the overall ranking.

4. CONCLUSION

The presented results of the study define the quantitative values of anthropometric characteristics and body composition of judoka J.A. senior vice champion of B&H and two-time champion of the Balkans. The obtained numerical parameters of anthropometric characteristics and body composition can serve as normative values and a kind of reference point for coaches and judokas who would help in identifying future female competitors in the heavyweight category. Comparing the results with similar research, our competitor had higher values of anthropometric characteristics (height, 186cm; body weight, 118.6 kg) and body status (muscle mass, 70.4kg; water, 47.6%; fat, 37.5%). These values of the ratio of muscle mass and adipose tissue are in the allowed values because it is a category of competitor +100kg. The results lead to the conclusion that it is an endo-mesomorphic somatotype with significant ectomorphism. Although the ratio of muscle mass and

percentage of fat is in a smaller numerical range, good synchronization of motor skills of the competitor, good technique and adequate tactics are indicators that adipose tissue is favorable and not a disruptive factor of success, which speaks of the overall ranking of our competitor.

Conflict of Interest Statement: The author declare no conflicts of interests.

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