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ANTHROPOMETRIC CHARACTERISTICS AND BODY COMPOSITION OF UROŠ GUTIĆ, RUNNER AT 5000m

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ABSTRACT

Profiling and selection of runners for medium and long distances implies adequate analysis of anthropometric characteristics and physical status (composition). Based on good detection, analysis and projection of these parameters, it is possible to define a runner model, where the scope and nature of anthropometric profiling depend on the primary purpose of the 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 the bones. To monitor morphological adaptation, the focus should be on variable characteristics, such as muscle mass and subcutaneous adipose tissue.
Keywords: *Anthropometry, body composition, detection, evaluation.*

1. INTRODUCTION

Anthropometry is the most commonly used method of assessing body composition and body composition in the sports population. Anthropometric characteristics (AC) define the dimensions of the human body and skeleton (body weight, height, measurement of skin folds, body circumference and different body diameters) allowing individual or combined predictions of body composition, energy content, regional fat, body fat and fat mass (Molla, 2017). Skin fold analysis is a common field assessment to predict the amount of subcutaneous adipose tissue, and as much as 50-70% of stored fat lies between the skin and muscle forming subcutaneous adipose tissue. A study by Wang, Thornton, Kolesnik, & Pierson (2000) proved that 40-60% of body fat is found in the subcutaneous region. Certain skin folds provide information about local fat depots and the distribution of fat in the athlete's body, which are extremely important parameters when top athletes are concerned.

Some authors point out that some anthropometric characteristics and body composition are associated with running performance in elite middle-distance, long-distance, and ultramarathon runners (Arrese & Ostariz, 2006; Knechtle, Knechtle, Schulze, & Kohler, 2008). Significant running performances are correlated with body height and weight (Maldonado, Mujika, & Padilla, 2002), cranial limb circumference (Knechtle, Knechtle,

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Schulze, & Kohler, 2008), different skin folds, and caudal limb circumferences (Arrese & Ostariz, 2006), different sums of skin folds (Kong & de Heer, 2008; Legaz & Eston, 2005). Runners with a proportionately smaller amount of body mass concentrated in the extremities, especially in the legs, perform less work by moving body segments during running if all other factors are unchanged. Therefore, leg mass and leg mass distribution can be important performance characteristics of long-distance runners (Molla, 2017).

Despite previous studies describing different anthropometric parameters related to middle- and long-distance running performance, a relatively small number of studies investigate the association between specific anthropometric relationships of caudal extremities and running performance in different racing disciplines. A study by Lucia et al., (2006) defines the relationship between leg length and body height in top Spanish long distance runners compared to one of the best Eritrean runners. Body size and strength have been shown to contribute to motor performance (Mohammad, 2016), and an increase in strength is associated with an increase in total muscle mass (Mohammad, 2015a,b,c). A significant positive correlation between strength and performance suggests that stronger individuals were athletes who performed better (Ball, Massey, Misner, McKeown, & Lohman, 1992). However, the pattern of improving strength and physical performance is not uniform in all tasks, because strength may be important for the successful performance of some motor performance, but it is not so important for others. Body shape and body composition were found to have a significant relationship to physical performance (Gabbett & Georgieff, 2007; Mohammad, 2015a,b,c; Mohammad, 2016; Mohammad, & Tareq, 2016) where a high degree of endomorphic component limits physical abilities, while a high degree of mesomorphic component is more adapted to motor performance. The relationship between skin fold thickness and motor performance is mostly negative (Vučetić, Matković, & Sentija, 2008) and mechanical (excess adipose tissue impairs performance involving acceleration of body weight by adding non-producing mass) and metabolic (excess adipose tissue increases metabolic consumption in activities that require movement of total body mass). Thus, in most athletic performances involving body weight translocation, low relative fat is favorable in both mechanical and metabolic terms, and thus in running (Hussain, Mohammad, & Khan, 2011). Obviously, high-performance athletes require specific biological profiles with exceptional abilities and strong psychological characteristics. Biometric quality or anthropometric measurements of an individual are an important value of sports, so they are considered one of the main criteria for success in many sports disciplines (Bompa, 1999). Research by Bayios, Bergeles, Apostolidis, Noutsos and Koskolou (2006), Gabbett & Georgieff (2007), Ziv and Lidor (2009) shows significant differences in body size between athletes in different sports (whether measured by weight, height, length, widths, girths or folds of skin), between sports or within a sport.

Numerous studies analyze the anthropometric characteristics, the physique of athletes, trying to define an adequate profile for certain athletic disciplines (Ahsan, & Mohammad, 2018; Ali, & Mohammad, 2012; Hussain, Ahmed, Mohammad, & Ali, 2013). Back in 1964, anthropologist Tanner analyzed the physique of athletes participating in the Olympic Games in Rome and Tokyo. The obtained results in the body structure differentiate sprinters, hurdlers, walkers and middle runners, at the same time defining their morphological profile. Novak, Hyatt, & Alexander (1968) proved in a sample of marathoners and runners that runners in the 400m and 800m have significantly larger skin folds on the triceps and subscapular sites than marathoners. The values of the sum of the six skin folds of runners at 400m, 800m, 1500m, 3000m, 5000m, 10000m are reduced with a distance of 33.5mm (800m-3000m) to 22.6mm (long distance and marathon). Costill, Bowers, Kammer (1970) determined the average age of marathoners (26.1 years), average height (175.7 cm), body weight (64.2 kg) and percentage of body fat (7.5%) in 114 marathoners. De Garay, Levine, Carter (1974) investigated athletes participating in the Olympic Games in Mexico. They found that the sum of the three folds of skin in all groups of tracks was low, but most were in long-distance running. The smallest 11.2mm skin crease was in long-distance runners. Similar studies were performed on other participants in European championships and the Olympic Games in order to analyze anthropometric parameters and physique, cardiovascular performance and anthropometric parameters (Kalra, 1986), which most often defined models of short-distance runners on medium and long tracks determining their proportions of body height, weight and age. The results of a study of the skin fold thickness of 162 athletes (sprinters, long distance, obstacles) Singh, and Koley (2002) showed significant differences in the subscapular skin fold between sprinters and long-distance runners and between long-distance runners and hurdle runners. Significant differences in suprailiuminal fold were found between sprinters and long-distance runners. Analysis of the results showed that 800m runners have higher average parameters of anthropometric characteristics (weight, height, width, skin folds), endomorphic and mesomorphic score, thigh length-shin length index, hip width-growth index, heart rate and vital capacity of 1500-5000m and 5000-10000m runners. While runners at 5000-10000m are higher in the average BMI index than runners at 800m and 1500-5000m. However, no significant differences were found in humeral biepicondylar diameter, femur biepicondylar diameter, ectomorphic score, sitting height-trunk index, upper arm length-lower arm length index and shoulder width-growth index 800m 1500-5000m and 5000-10000m.

Medium and long distance running are very demanding athletic disciplines which, in addition to good functional abilities, require appropriate anthropometric characteristics and adequate body composition from athletes. It is known that physical characteristics and body composition are important for excellence in athletic performance, where most often for certain athletic disciplines a different type of body composition and body mass is required for maximum performance. (Wan Nudri, Ismail, & Zawiak, 1996). The study of body composition divides and quantifies body weight or mass into its basic components, where body weight is a gross measure of body weight. It can be analyzed from basic chemical elements and specific tissues to the whole body, while body composition is a factor that can affect sports performance and as such is of great interest to athletes and coaches (Malina, 2007).

According to Khan, Ahmed and Raja, (2016) such competitions are a product of the overall physique of the athlete which implies a certain body size and its shape taking a major role in the movement of runners. Variables associated with motor performance include physical characteristics, maximum oxygen consumption (Billat, Beillot, Jan, Rochcongar, & Carre, 1996; Bassett, & Howley, 2000; Maldonado-Martin, Mujika, & Padilla, 2004; Ahsan, & Mohammad, 2018), body composition, thigh length (Deason, Powers, Lawyer, Ayers, & Stuart, 1991; Brandon, & Boileau, 1992; Abe, Yanagawa, Yamanobe, & Tamura, 1988; ; Ali, & Mohammad, 2012), lactate threshold, energy expenditure during running (Daniels, & Daniels, 1992; Maldonado, Mujika, & Padilla, 2002), running economy (Conley, & Krahenbuhl, 1980; Sjödin, & Svedenhag, 1985) and stride length (Heinert, Serfass, & Stull, 1988; Hussain, Ahmed, Mohammad, & Ali, 2013).

Several researchers have published the physical characteristics of different types of runners (Knechtle, Knechtle, Schulze, & Kohler, 2005; Legaz Arrese, González Badillo, & Serrano Ostáriz, 2005). Arrese, & Ostariz (2006) proved that the amount of subcutaneous adipose tissue of the lower limbs in men is directly related to the result of running 1500m and 10,000m, allowing a much more efficient effect of activity (Brandon, & Boileau, 1987). Middle-aged male top-level runners have greater muscle mass in the lower extremities and torso, and less subcutaneous fat thickness in the central parts of the body than middle-aged men who usually run at the middle level or do not run at all Oguri, Zhao, Du, Kato, et all. (2004). Some studies (Billat, Demarle, Slawinski, Paiva, & Koralsztein, 2001; Muñoz, Muros, Belmonte, & Zabala, 2020) have studied the anthropometric characteristics, somatotype, and body composition of elite male runners. However, to our knowledge, few studies have conducted research for individual and cumulative values of skin folds among runners as well as individual anthropometric characteristics (Arazi, Mirzaei, & Nobari, 2015, Khan, Ahmed, & Raja, 2016).

The aim of this study was to analyze the anthropometric profile and body composition structure represented by B&H athlete, the current record holder in the 5000m category.

2. METHODS AND MATERIALS

2.1 The Sample of Participants

The study was conducted with Uroš Gutić, (23 years old; Pulse= 41bpm, saturation O_2 = 97%, VO_2 max average 69, 56ml/kg, %HRmax average 81,51bpm), a member of AK Sarajevo and the BiH national team on middle and long distances. His current record of BiH in the 5000m (15:04.05min).

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/m^2)
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. Viscelar fat

2.3 Testing Protocol

Anthropometric measurements were performed according to the methodology of the International Society for the Assessment of Kinanthropometry - ISAK standard procedures (Marfell-Jones, Olds, Stew, & Carter, 2006). The standard metric instruments were applied: Stadiometer-used for measuring body height; flexible tape used for measuring the body perimeter and its segments; Body weight and Body Composition (BC) were assessed with the bioelectrical impedance method using a body composition analyser (Tanita Inner Scan V 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 regular training at May, 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 physical status of the athlete Uroš Gutić, the B&H record holder in the 5000m. To assess the physical characteristics of the sample, the so-called anthropometric map of runner's profile and BC (Table 1). An overall assessment of physical characteristics can be performed on this profile.

Table 1: Anthropometric characteristics and parameters of body composition Uroš Gutić

Measured parameters		Value
Body height		181 cm
Body weight		67 kg
BMI kg/m2		20.02
Chest perimeter		90 cm
Upper arm perimeter		27 cm
Forearm perimeter		25 cm
Abdomen perimeter		70 cm
Upper leg perimeter		51 cm
Lower leg perimeter		34 cm
Triceps skinfold		5.4 mm
Biceps skinfold		2.5 mm
Subscapular skinfold		6.7 mm
Chest skinfold		4.4 mm
Abdomen skinfold		10 mm
Suprailiac skinfold		5.4 mm
Front thig skinfold		7 mm
Rear thig skinfold		4 mm
Sum of 8 skinfolds		45.4 mm
Body Fat Mass %		6.3
Body Water%		67.9
Body Muscle (kg)		59.6
Bones (kg)		3.2
Basal metabolism		1826
Daily calorie intake- DCI		7640
Metabolic years		12
Viscelar fat		1
Segmental values	**Muscle (kg)**	**Fat %**
Right hand	3.7	6.6
Left hand	3.6	7.7
Torso	32.2	5
Right leg	10.2	7.6
Left leg	9.9	7.9

The table is useful as a review device and the specific individual context of the interpretation of the results must be taken into account in all analysis. According to Vernillo et al. (2013) the anthropometric profile of an athlete plays an important role in determining his or her 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 given discipline.

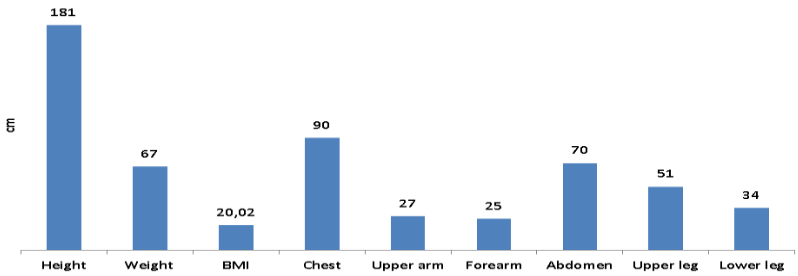

Figure 1: Anthropometric parameters

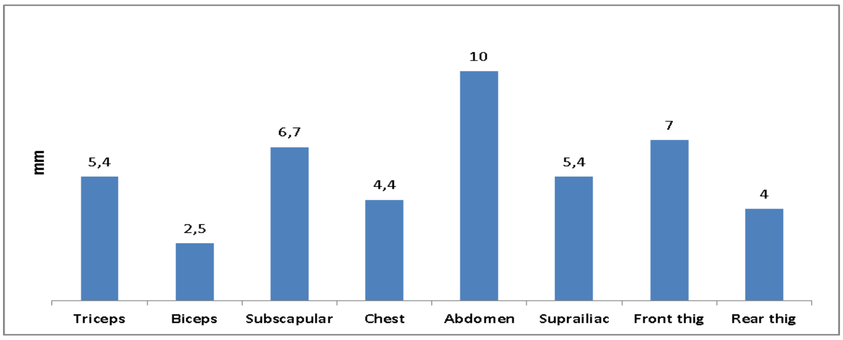

Figure 2: Body skinfolds

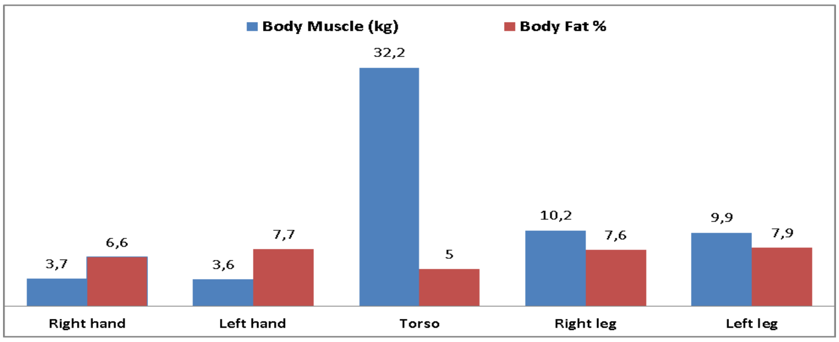

Figure 3: Segmental body composition

The results of anthropometric characteristics and body composition of our sample quantitatively and qualitatively define an adequate ectomorphic-mesomorphic model of runners on medium and long tracks (Table 1, Graph 1, 2, 3). Average height (181cm) with body weight (67kg) and BMI (20.02kg/m2) are good indicators of pronounced longitudinality in relation to body weight and volume, which is primarily in athletic disciplines of medium and long distances, which is consistent with the study Arrese & Ostariz, 2006). These three anthropometric parameters of our runner correspond to the results of the research of middle and long distance runners (Knechtle, Knechtle, Schulze, & Kohler, 2008; Muñoz, Muros, Belmonte, Zabala, 2020), because it is on the 90th percentile for height, 80th percentile for body weight and 50th percentile for BMI. Body volume parameters are also within the limits that are dominant for this sample of runners and together with longitudinality significantly determine the ectomorphic somatotype. There is a significant difference between the cranial and the caudal extremities. Compared to the elite sample (Muñoz et al., 2020), there are evident differences in the circumference of the thigh where the circumference of our runner is 2-3 cm higher. The identical result is related to the circumference of the upper arm, where the circumference is larger by 1.5-2 cm and occupies the 85th percentile division. Subcutaneous adipose tissue is also in 90% of similar studies less in our sample and significantly participate in the saturation of the total ballast mass of runners in defining the total body composition. The total sum of 8 skin folds (45.4mm) is 10mm lower than the results (Wan Nudri, Ismail, & Zawiak, 1996; Billat et al., 2001; Muñoz, et al. (2020) on the scale of the 10-50 percentile which is an indicator of good anthropometric structure. Compared with the results of Kenney and Hodgson (1985), Sidhu et al., (1990), Deason, Powers, Lawyer, Ayers and Stuart (1991); Brandon and Boileau (1992); Billat et al., (2003); Billat, Lepretre, Heugas and Koralsztein (2004), Maldonado-Martin, Mujika and Padilla (2004), Oguri et al., (2004), Vernillo et al., (2013), Arazi, Mirzaei and Nobari (2015) our runner is taller (on average 7-8cm) and heavier (4-5kg) with a lower percentage of body fat (6.3%) compared to previous studies, which defines a good height-to-weight ratio and which is in line with the findings of some studies (Lucia et al., 2006).

The body fat of our B&H runner is also represented in a low percentage and in relation to previous research results as well as according to the tabular values it records a healthy level (coefficient 1.) The percentage of water in muscles is about 68% which is an indicator of good hydration and muscle function. Muscle mass accounts for close to 60 kg (89.50%) of total body weight and with a bone mass of 3.2 kg is higher compared to previous results (Wan Nudri, Ismail, & Zawiak, 1996; Lee, Wang, Heo, Ross, Janssen, & Heymsfield 2000). The basal metabolism of the athlete is 1826 kCal, while the daily consumption is 7640 kCal, and together with all the parameters of physical status, it defines the metabolic age of 12 years, which is 11 years less than his biological age. It is an indicator of good shape and health condition of an athlete in general.

Analysis of segmental body status defines a greater presence of muscle mass in the torso (32.2 kg), then almost uniform caudal extremities (left leg 9.9 kg-right leg 10.2 kg) and cranial extremities (left arm 3.7 kg-right arm 3.7 kg). Out of a total of 6.3% of body fat, the smallest percentage is topographically occupied by the trunk region (5%), slightly higher for caudal extremities (left leg 7.9% - right leg 7.6%) and cranial extremities (left arm 7.7 % - right hand 6.6%). An inverse relationship between muscle mass and fat percentage by segments is noticeable, especially in the trunk area, and then in the extremities. In this case, it was confirmed that the segment of the body that has higher muscle mass has consequently a lower percentage of fat. The results of our study support the results of Oguri et al. (2004); Arrese and Ostariz (2006) which define the relationship between muscle mass and adipose tissue in the body, and the negative relationship between skin fold thickness and motor performance, because it is low relative fat is favorable in mechanical and metabolic terms (Vučetić, Matković, & Sentija, 2008)

Given the functional parameters of our sample (defined in the method of work) VO_2max=69.56ml/kg/min and %HRmax=81.51bmp, it can be said that these results are in line with most results of top athletes, and what is affected by age, anthropometric characteristics and body composition (McArdle, Katch, & Katch, 1996). According to the valid norms of B&H, the athlete belongs to the Superior category because VO_2max is>55ml/kg/min, which was confirmed in an earlier research (Pavlović, Mihajlović, Radulović, & Gutić, 2021). The importance of monitoring the state of hydration of the organism and the replenishment of essential electrolytes also contributes to the distribution of the results of current measurements, especially body composition, which is in line with the findings of the study by Southard and Pugh (2004). According to Joyner and Coyle (2008) the aerobic component of the energy system with body composition and appropriate morphological profile is a key element for good performance in long distance races. Also, exercise-oriented exercise physiology seeks models for better training control, based on periodic individual assessments that can improve physical performance and aerobic strength (Bosquet, Léger, & Legros, 2002). In this study, a lower percentage of subcutaneous fat was confirmed, compared to similar studies of this type. According to Pavlović et al., (2021) energy power and economy of work are the main parameters of racing performance, they are in direct correlation with the morphological and physiological profile of athletes, muscle characteristics and degree of training. The economy of work is directly related to the biomechanical profile of the athlete and mainly depends on the anthropometric characteristics and their structure as well as the adopted movement patterns. Variations in energy consumption are also achieved by changes in the way of running and body dimensions such as height and weight, the percentage of fat and muscle tissue in the body. In our study, the percentage of fat is quite low (6.3%) with higher muscle mass participating with close to 90% of the total body weight of runners. Also, a high percentage of water in the muscles (67.9%) is a guarantee of good hydration of the body of our athlete, while the body weight of runners is a crucial success factor, which raises questions about the BMI of runners, i.e. weight-height ratio which records significant differences depending on sport or discipline (Bayios et al., 2006; Gabbett, & Georgieff, 2007; Ziv, & Lidor, 2009) defining an important factor influencing sports performance and as such is of great interest to athletes and coaches (Malina, 2007).

4. CONCLUSION

The results of this study will help to understand the importance of anthropometric characteristics and body composition of runners on medium and long distances which will be a guide for trainers to adjust the training process with the help of physique data. The study defines reference values for anthropometric characteristics and body composition of B&H runner U.G. on medium and long lanes. It provides normative data that could help coaches identify future talents of young middle and long distance runners. The results presented in this way can be used as a standard reference, but they should be interpreted with caution in the context of individual characteristics and needs. Comparing the results with similar research, our athlete had a slightly bigger height (181), body weight (67 kg), muscle mass (59.6 kg), water percentage (67.9%) but also a significantly lower percentage of fat (6.3%). in relation to the results of other researchers as a whole and segmentally, which is adequate to the elite sample of runners.

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