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Differences in Anthropometric Characteristics and Body Composition of Water Polo Players in the 2019 World Junior Championship

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Abstract

This research aimed to determine the differences between the junior (U20) water polo players of national teams of Montenegro, and Australia regarding their anthropometric characteristics and body composition. The first sub-sample of the subjects consisted of 18 water polo players of the Montenegrin national team, who occupied the sixth position on the FINA World Men's Junior Water Polo Championship in Kuwait 2019. The second sub-sample consisted of 13 water polo players of the Australian national team, who occupied the eleventh position on the championship. The players were tested at the final preparations just before the World Championship. Anthropometric characteristics were evaluated using a battery of eight tests: body height, body weight, triceps skinfold, biceps skinfold, skinfold of the back, abdominal skinfold, upper-leg skinfold, lower leg skinfold; body composition was evaluated using a battery of three tests: body mass index, fat percentage, and muscle mass. The results of the t-test revealed that the water polo players of the two national teams do not have statistically significant differences in the variables. The results obtained in this research showed average team values for the estimated variables of water polo players of the two national teams (U20) who participated in the World Championship. That can serve as possible model parameters for all teams who want to participate in the U20 water polo World Championship. Differences in classification among water polo players may be related to the motor abilities, as well as technical and tactical parameters, as their anthropometric parameters were found to be similar.

Keywords: _junior water polo players, body composition of water polo players, anthropometric characteristics of water polo players_

Introduction

Water polo is a popular sport worldwide. It is a highly dynamic and fast team game that, with its abundance of movement, is in the category of polystructural sports games. Water polo is a sport characterized by numerous complex and dynamic kinesiological activities, which are then characterized by either cyclical or acyclical movement. It is contact sport (Cecchi et al., 2019), characterized by different swimming intensities, duelling, acceleration and deceleration (Gardasevic et al., 2019; Gardasevic et al., 2020). In water polo, top results can be achieved only within a well-programmed training process. High quality management of the training process depends on knowing the structure of certain anthropological capabilities and water polo players' characteristics, as well as their development. Findings regarding anthropometric characteristics and body composition are crucial for complex sports, such as water polo. The anthropometric space is defined by the longitudinal dimension of the skeleton, the transversal dimensionality of the skeleton, and the mass and volume

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of the body. The purpose of knowing anthropometric characteristics is to improve skills in many sports (Gardasevic et al., 2019; Gardasevic et al., 2019; Masanovic et al., 2018). The anthropometric status of top-level athletes is relatively homogeneous, depending on the sport, and can be defined as a model of athletic achievement (Gardasevic et al., 2020). Research on anthropometric characteristics and body composition among athletes of different sports indicates that athletes of different sports have specific characteristics (Gardasevic et al., 2020; Masanovic, 2018; Masanovic et al., 2021; Arifi et al., 2019; Popovic et al., 2013), mostly because the size of those characteristics contributes a significant percentage of total variance associated with athletic success (Carvajal et al., 2012). Muscle mass improves performance in activities that require muscular strength and endurance, as well as those that require enviable aerobic ability (Rico-Sanz, 1998).

It is well known that water polo in Montenegro and Australia has a long tradition and the best results in international competitions, especially Montenegro. Montenegrins were the junior world champions, and Australians were vice-champions once. Montenegro's junior national team is always top-ranked in Europe and the world.

It was expected that the national teams, especially Montenegrins, would continue with good results on the FINA World Men's Junior (U20) Water Polo Championship in Kuwait 12–20 December 2019, where twenty national teams participated. It is clear that these were the best players in Montenegro and Australia, at age 20, and that they had many years of quality training to qualify to wear a representative cap. It is well known in all sports and, therefore, in water polo that long-term and intensive training is a critical factor that enables athletes to reach and remain at the elite representative level (Gardasevic et al., 2019). Researchers became interested in determining the models of an-

thropometric characteristics and body composition of the water polo players who play for these two national teams in order to determine the differences among them.

This research aimed to determine the anthropometric characteristics and body composition of junior (U20) water polo players of national teams of Montenegro and Australia, who participated on the FINA World Men's Water Polo Championship 2019 in Kuwait. The variables between these water polo players were compared, and the possible differences between them were determined.

Methods
Sample of subjects
A sample of the subjects consists of 31 water polo players, divided into two sub-samples. The first sub-sample of the subjects consisted of 18 water polo players of the national team of Montenegro of an average age of 18.44±0.98, who occupied the sixth position on the championship. The second sub-sample consisted of 13 water polo players of the national team of Australia of an average age of 19.00±0.91, who occupied the eleventh position on the World Men's Junior Championship (Table 1).

Players of the Montenegrin and Australian national teams were tested at the final joint preparations in Niksic (Montenegro), one week before the World Championship. Because they were in the final pre-championship preparations, the final list of players was not formed (possibility of injuries or illness are why there is often a surplus of players), and the number of players tested was different among teams. All participants signed the consent form approved by the Institutional Review Board of the University of Montenegro, which was in accordance with the Declaration of Helsinki as amended by the World Medical Association Declaration of Helsinki (World Medical Association, 2013).

Table 1. Final rankings (20 December 2019) at the FINA World Men's Junior Water Polo Championship in Kuwait 2019

National teams	Place
Greece	1
Serbia	2
Italy	3
Croatia	4
Spain	5
Montenegro	**6**
USA	7
Japan	8
Hungary	9
Canada	10
Australia	**11**
New Zealand	12
Russia	13
South Africa	14
Egypt	15
China	16
Brazil	17
Uzbekistan	18
Iran	19
Kuwait	20

Sample of variables

Anthropometric research has been carried out with respect to the basic rules and principles related to the selection of measuring instruments and measurement techniques, standardized in accordance with the International Biological Program guidelines. For this study, eight anthropometric measures were taken: body height, body weight, triceps skinfold, biceps skinfold, skinfold of the back, abdominal skinfold, upper leg skinfold and lower leg skinfold, as well as three body composition assessment variables: body mass index, fat percentage and muscle mass. An anthropometer, calliper, and measuring tape were used for anthropometric measurements. To evaluate the body composition and body weight, a Tanita body fat scale (model BC-418MA) was used. The scale is based on the indirect measurement of the body composition; a safe electrical signal is transmitted through the body via electrodes located in the standalone unit. The Tanita Scale enables athletes to closely monitor their body weight, body mass index, fat percentage, fat mass, muscle mass, and bone mass;

it also provides a segmental analysis of arms and legs.

Statistical analysis

The data obtained through the research were processed using descriptive and comparative statistical procedures. For each variable, central and dispersion parameters have been processed. The significance of the differences between the water polo players of the two national teams in the anthropometric characteristics and variables for assessing body composition was determined using a t-test, with statistical significance of $p < 0.05$ using IBM SPSS Statistics 20.0

Results

In Tables 2 and 3, basic descriptive statistical parameters of variables of anthropometric characteristics and body composition of the Montenegrin and Australian water polo players are shown. First, the central and dispersion parameters of the variables of the water polo players of Montenegro were analysed (Table 2).

Table 2. Central and dispersion parameters of variables for the assessment of anthropometric characteristics and body composition of Montenegrin Water polo players (N=18)

Variables	Min	Max	Mean±SD	Skewness	Kurtosis
body height	178.0	201.3	189.60±6.90	.173	-.802
body weight	67.1	117.5	88.69±11.72	-.012	-.550
triceps skinfold	4.3	12.4	7.85±2.38	.566	1.004
biceps skinfold	3.2	9.6	6.35±1.86	.444	-1.092
skinfold of the back	7.8	18.1	12.11±3.31	-.061	-.962
abdominal skinfold	5.8	31.4	16.01±7.45	.312	-.778
upper leg skinfold	6.8	23.0	13.21±4.25	.604	-.682
lower leg skinfold	5.2	16.5	9.96±3.54	.805	.088
body mass index	20.3	29.0	24.59±2.20	.499	-.928
fat percentage	5.5	22.5	13.13±4.39	.048	.170
muscle mass	34.4	54.6	43.47±4.75	.234	-.362

Legend: Min - minimum result; Max - maximum result; SD – standard deviation

Based on the central and dispersion parameters, and the values of the skewness and the kurtosis, it can be noted that all the variables are within the normal distribution boundaries. Generally, according to all statistical parameters, it can be concluded that this is a good selection of Montenegrin water polo players U20,

that there is a normal distribution in almost all variables, and that the results that prevail are superior to the arithmetic mean, which is not statistically significant because not too large a span between the results of analysed variables is to be expected regarding water polo national team members.

Table 3. Central and dispersion parameters of variables for the assessment of anthropometric characteristics and body composition of Australian water polo players (N=13)

Variables	Min	Max	Mean±SD	Skewness	Kurtosis
body height	182.5	202.0	191.27±5.5173	.286	-.176
body weight	73.3	102.6	89.06±8.1556	-.391	.006
triceps skinfold	4.8	17.0	8.88±3.2046	1.249	2.545
biceps skinfold	3.6	17.9	7.04±3.8675	1.419	1.361
skinfold of the back	7.8	16.0	11.73±3.5436	.626	-.852
abdominal skinfold	4.0	34.6	13.50±8.2407	1.557	2.801
upper leg skinfold	7.4	19.0	11.79±4.1570	.895	-.735
lower leg skinfold	4.0	14.8	9.462±3.4973	.077	-.974
body mass index	21.5	28.5	24.35±1.9797	.867	.372
fat percentage	6.8	20.9	11.31±4.0305	1.241	1.601
muscle mass	38.2	48.2	44.61±3.2602	-1.117	.554

Based on the central and dispersion parameters of the Australian water polo players (Table 3), it can be stated that the values all the variables are very similar to those of the Montenegrin water polo players.

By the value of the skewness, it can be observed that in the variables of the triceps skinfold, biceps skinfold, abdominal skinfold, and fat percentage there was a slight inclination on the side of the lower results, which is beneficial for athless because subcutaneous fat is a disruptive factor. In the case of muscle mass is opposite. There was a slight inclination on the side of the better results. The values of the kurtosis of variables of the biceps skinfold and fat percentage form a slight leptokurtic curve, while two variables of the triceps skinfold and abdominal skinfold, form a significant leptokurtic curve.

To determine whether there are statistically significant differences in the analysed variables in the Montenegrin and Australian water polo players, participants of World Championship 2019 in Kuwait, the statistical procedure t-test (Table 4) was applied.

Table 4. T-test values between of variables of water polo players of Montenegrin national team (N=18) and of Australian national team (N=15)

Variables	National team	Mean±SD	Mean Diff.	t-test	Sig.
body height	Montenegro	189.60±6.90	-1.67	-.721	.477
	Australia	191.27±5.52			
body weight	Montenegro	88.69±11.72	-0.37	-.099	.922
	Australia	89.06±8.15			
triceps skinfold	Montenegro	7.85±2.38	-1.03	-1.034	.310
	Australia	8.88±3.20			
biceps skinfold	Montenegro	6.35±1.86	-0.69	-.660	.514
	Australia	7.04±3.87			
skinfold of the back	Montenegro	12.11±3.31	0.38	.307	.761
	Australia	11.73±3.54			
abdominal skinfold	Montenegro	16.01±7.45	2.51	.883	.384
	Australia	13.50±8.24			
upper leg skinfold	Montenegro	13.21±4.25	1.42	.922	.364
	Australia	11.79±4.16			
lower leg skinfold	Montenegro	9.96±3.54	0.50	.385	.703
	Australia	9.46±3.49			
body mass index	Montenegro	24.59±2.20	0.24	.316	.754
	Australia	24.35±1.98			
fat percentage	Montenegro	13.13±4.39	1.82	1.173	.250
	Australia	11.31±4.03			
muscle mass	Montenegro	43.47±4.75	-1.14	-.747	.461
	Australia	44.61±3.26			

Based on the t-test results (Table 4), it can be stated that the values of all the variables are very similar to all water polo players of these two countries. There were no significant differences in variables among the water polo players of the two national teams.

Discussion

This study aimed to determine the difference in the anthropometric characteristics and body composition of the junior (U20) water polo players of the Montenegrin national team, who occupied the sixth position, and the water polo players of the Australian national team, who occupied the eleventh position at the FINA World Water Polo Championship in Kuwait, 12–20 December 2019. The results were obtained using a battery of eight tests regarding anthropometric characteristics and three tests regarding body composition. By examining the basic descriptive statistical parameters, we have analysed the best selected junior age water polo players from these countries. Similar results in their research were obtained by Kondric, Uljevic, Gabrilo, Kontić, and Sekulić (2012). They found some lower body height 186.92 cm, and lower body weight 84.31 kg, in the sample of the 110 best world water polo players, in comparison to water polo players from our research, but it was at the age of 18 years, when growth and development are not finished. Having that in mind, we can say that those of U20 reached similar results as water polo players who were the subject of this research. When we compare water polo players of these two national teams with some other athletes, for example, football players of the same age (Gardasevic & Bjelica, 2020), we can observe differences in anthropometric characteristics and body composition, which speaks in favour of the specificity of each sport in terms of new variables. It can be noted that the water polo players are taller and have a lower body weight than U19 football players in Montenegro (body height=179.01 cm; body weight=69.58 kg) in Bosnia and Hercegovina (body height=180.99 cm; body weight=73.65 kg) or in Kosovo (body height=178.15 cm; body weight=70.34 kg) (Gardasevic & Bjelica, 2020). A difference in fat percentage is also observed; with football players in Montenegro it is 9.88%, in Bosnia and Hercegovina 9.65%, and in Kosovo it is 8.66% (Gardasevic and Bjelica, 2020). These are

lower values in comparison to water polo players of two national teams. However, muscle mass is more dominant with water polo players, and it is in average 8-9 kg on a higher level than it is with football players from the two mentioned countries from the research of Gardasevic and Bjelica (2020).

It can be observed that the water polo players of the Montenegrin and Australian national teams are of the approximately similar mean values of all the variables analysed, which is not surprising because these are two national teams of the same age, from countries where water polo is popular and where water polo coaches are highly skilled. If we analyse the final achievements at the championship, then we could say that the absence of these differences is a surprise. Nevertheless, a final result at some competition is affected by many other things, such as physical preparation, technical and tactical preparation psychological preparation, that fact that all players are without injuries and penalties, than good timing of form in the championship, and similar factors.

U20 water polo players have years of training experience and spend many hours in the pool each week. The t-test results displayed that the water polo players of Montenegrin and Australian national team do not differ significantly in the analysed variables. For all variables, some values are higher for water polo players of the Montenegrin national team (skinfold of the back, abdominal skinfold, upper leg skinfold, lower leg skinfold and body mass index) and some for those of the Australian national team (body height, body weight, triceps skinfold, biceps skinfold, fat percentage and muscle mass), although, insignificantly for statistics. All of the abovementioned indicates that water polo players of the Montenegrin and Australian national team have similar anthropometric parameters and body compositions. All of these players have long-term training before significant competitions, and they are all among best water polo players in the world level, so it is not surprising that there are no differences in anthropometric characteristics and body composition between them. Due to their lifestyle (constant training and sports nutrition), all top athletes take care of body composition; this is confirmed in the research of Melchiorri et al. (2018), which found no differences in body weight and body composition in 13 water polo players after a three-month training programme for the Olympic Games. Using the system of bioelectrical impedance for high-level athletes involved in long and intense training periods helps to evaluate the effects of training and to prevent any decrease in the performance level of body composition (Melchiorri et al., 2018).

Given that the concentration of the best water polo players U20 is at World Championship in Kuwait 2019, the assumption is that the mean values of the analysed variables of two national teams' water polo players should be the model values for all such clubs in the world. Of course, it is clear that these are the team average values of analysed variables, and that the different positions which water polo players cover as well as their differences in stated variables in relation to these positions were not taken into consideration.

Based on the results obtained in this research, before the start of the World Championship, it could not be assumed which national team would achieve a better placement. The Kuwait Championships showed that they were the national teams in which the nuances decided the final standings. For example, the Montenegrin national team in the quarter-finals lost with one goal difference to the Serbian national team in the last minute of the game, and thus lost their chance for the medal fight. In the finals, the Serbian national team lost to the Greek national team by a small result and thus won a silver medal. After the defeat of the Serbian national team, the Montenegrin national team fought for 5th to 8th place (winning 6th place). All this confirms that these are the best water polo players in the world under the age of 20, many of whom already play for the senior national teams.

All water polo players of the two national teams had similar levels of subcutaneous adipose tissue. Different authors state the importance of body fat as a positive fact in water polo (Platanou, 2005; Peric et al., 2012); however, in other studies, it is not confirmed (Vila et al., 2018), and many researchers have demonstrated that it is a disruptive factor for athletes (Masanovic, 2019; Milanovic & Vuleta, 2013). Also, in previous studies of water polo players of this age, subcutaneous adipose tissue has been shown to be a disruptive factor in defence (Milanovic, & Vuleta, 2013). It is well known that a low fat percentage is desirable for high physical performance in all sports. Although not every body composition characteristic is expected to play a role in optimal performance in professional sport, lower levels of body fat (that are specific to each player) are desirable for optimal performance, as body mass must be moved against gravity (Rienzi et al., 2000; Gil et al., 2007).

All the water polo players of the Montenegrin and Australian national teams had similar muscle mass values; water polo is a strenuous sport that takes place in water and requires significant muscle mass. Body height is important for swimming. The Montenegrin nation is among the tallest in Europe and the world with an average body height of male of 183.2 cm (Gardasevic et al., 2017), and Montenegrin water polo players in this study are 189.6 cm tall, which speaks in favour of the importance of body height for water polo. Long arms are important for kicks and defence; however, there were no statistically significant differences between the water polo players of the two national teams, which is perhaps surprising, considering that the Montenegrin national team dropped out in the quarter-final of the competition, and the Australian national team did not qualify for the quarter-final of the World U20 Championship. The reason for the different placement may be found in the different levels of technical and tactical preparation, and functional and psychological preparation between water polo players of the two teams. Physical preparation at such championships is essential because it is done every day, and we have not analysed it. Experience in playing deciding matches at this level of competition can be the reason for different placement. The Montenegrin team has more experience than the Australian team does.

The national water polo associations of Montenegro and Australia should turn to other research studies and check the functional-motoric status, psychological preparation as well as tactical training of their players, and analyse whether there are differences at water polo players that influenced the result at this world championship, and whether there is room for improvement. The values obtained in this research can be useful for coaches of these national teams to compare their players with others and prepare their work in a way that enables the reduction of adverse parameters and raises the beneficial ones to a higher level. That will surely make their water polo players even better and more successful. The results obtained in this research can serve as model parameters for the estimated variables for water polo players (U20) of all clubs in Montenegro and Australia, because the players that have been analysed were the best and the most successful water polo players in their countries, and participants in the World Championship in Kuwait 2019.

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