

# The Connection Between Certain Morphological Parameters and Results in Goalball Players

Conexión entre Ciertos Parámetros Morfológicos y Resultados en Jugadores de Goalball

Romana Romanov<sup>1</sup>; Bojan Medovic<sup>1</sup>; Dusan Stupar<sup>1</sup>; Tatjana Jezdimirovic<sup>1</sup> & Branislava Garunovic<sup>2</sup>

---

**ROMANOV, R.; MEDOVIC, B.; STUPAR, D; JEZDIMIROVIC, T. & GARUNOVIC, B.** The connection between certain morphological parameters and results in goalball players. *Int. J. Morphol.*, 35(4):1396-1402, 2017.

**SUMMARY:** Certain studies in sports for people with disabilities, also research the morphological characteristics of athletes. However, when it comes to goalball, sport for the people with visual impairments, the focus of researchers is on the population of children and adolescents and the impact of the aforementioned sport on the morphological characteristics that are observed in the process of growth and development. Amongst the population of adults with visual impairment who take part in Goalball, there are almost no studies that deal with the issue of morphological space, especially those that would point towards defining the morphological profile of elite goalball players. The subject of this research are the morphological characteristics of adult goalball players (athletes), and the aim is to determine whether there is a correlation between certain morphological indicators which indicate the status of the body mass of athletes and competition results achieved between goalball teams. The total sample consisted of 22 adult male goalball players, participants of the regional tournament. Morphological space variables, body height, body weight, waist circumference, hip circumference, body fat percentage and muscle tissue percentage were tested and body mass index value as well as the ratio of waist and hip was calculated. Based on the analyzed results, it is concluded that the body height is important in defining the morphological profile of goalball players. In addition to the body height, the indicators pointing to the nutritional status may be taken into account when defining the morphological profile of goalball players (body fat percentage, muscle tissue percentage but also body mass index). Correlation analysis indicated a correlating relationship of the waist and hips with the ranking achievement of the team, which indicates the importance of the body fat distribution in the defining of the morphological profile of goalball players.

**KEY WORDS:** Goalball; Visual impairment; Morphological characteristics.

---

## INTRODUCTION

Participation in competitive activities, especially team sports, provides an opportunity for participants to meet the basic human aspiration for movement, cooperation but also competition. Team sports activities are based on the physical, emotional and cognitive engagement of athletes who aspire to become winners in the game and to outplay opponents. On the bases of so defined success of team sports games, many characteristics of athletes can be distinguished amongst which an important role belongs to their anthropological characteristics (Srhoj *et al.*, 2002). Of anthropological characteristics, morphological characteristics are significantly distinguished, and especially those that can be linked to specific sports requirements.

Morphological characteristics, as the basic indicator of growth, development and differentiation of tissue, as well as their functional maturation, are an important parameter

to be monitored in the training process of athletes. Many studies researched the subject of morphological parameters among athletes in different sports disciplines, with the aim of selecting those characteristics that contribute to the creation of an elite sport profile and superb sports results (Matkovic *et al.*, 2003; de Lima *et al.*, 2007; Holway & Garavaglia, 2009).

Goalball is a team sport designed for people with visual impairments. Like most sports activities for people with disabilities, goalball was first applied for the purpose of rehabilitation of the Second World War veterans with visual impairments. Hanz Lorenzen (Austria) and Sepp Reindl (Germany) defined the rules of the game as early as in 1946, but goalball's world debut was at the Paralympic Games in 1976 (Toronto, Canada). It was in 1978 in Austria that the sport's first world cup took place and it has been in the re-

<sup>1</sup> Faculty of Sport and Tourism, Radnicka 30a, Novi Sad, Educons University, Serbia.

<sup>2</sup> School for the visually impaired «Veljko Ramadanovic», Cara Dusana 143, Zemun, Serbia.

gular program of Paralympic games, as well as European championships since 1980. International Blind Sport Federation (IBSA) is the umbrella organization for all national sport federations for the blind and visually impaired people.

The sport is practiced by three players on each team. It is based on the auditory sense to detect the ball in the play (the ball has rattles inside), and it requires good spatial orientation, so that the athlete knows the ball's location in order to intercept it or throw it with his hands in attack and defense moves (Silva, 2008). Golball as a unique game that is not a copy of any existing sport involves a number of blind and visually impaired athletes categorized into sports classes B1, B2 and B3. At the highest level, goalball teams have been competing for four decades, but this sport is not sufficiently highlighted from the perspective of sports science and profession. Observation of the morphological profile of goalball players, the influence of morphological characteristics on certain playing positions and achieved results are not sufficiently studied. The reasons can be numerous, insufficient massiveness of the sport at the national level, a large range of age amongst the players in goalball team, because the players categories are not assigned in accordance with the age (pioneers, cadets, juniors, seniors), but in terms of the type and degree of visual impairment. Goalball players who are still in a period of growth and development (adolescents) as well as adult players in which the period of the musculoskeletal tissue consolidation has occurred can be encountered in the same team and in identifying the morphological characteristics amongst players. All possible influencing factors must be considered (growth and development, the level of physical activity). A number of studies researched morphological characteristics of goalball players in the population of children and adolescents; however there is no enough data for the adult population (Çolak *et al.*, 2004; Karakaya *et al.*, 2009; Caliskan *et al.*, 2011; Scherer *et al.*, 2012). On the other hand, a number of studies show that blind and visually impaired people have a reduced level of daily physical activity that is associated with an increase in body weight (Çolak *et al.*). In addition to the fact that the increase in body mass is associated with health status, it is important to mention that the body composition of athletes is one of the important determinants, upon which training activity program is based (Rexhepi & Brestovci, 2010). Bearing in mind that goalball is a sport that requires agility and strength, the question is whether the excessive body mass appears in the profile of goalball players (competitors) and whether it can be linked to the team's results achieved. In relation to the aforesaid the subject of this research are the morphological characteristics of adult goalball players (athletes), and the aim is to determine whether there is a

correlation between certain morphological indicators which indicate the status of the body mass of athletes and competition results achieved between goalball teams.

## MATERIAL AND METHOD

The research of this transversal study was conducted at the regional goalball tournament where 6 national teams have participated (Hungary (HUN), Serbia (SRB) Montenegro (MNE), Macedonia (MKD), Romania (ROU) and Bosnia and Herzegovina (BIH)). Each team consisted of a minimum of 3 and a maximum of 5 players which have been active athletes for at least 2 years and who have training activities at least three times during the week and of the total duration of 180 min.

The total sample consisted of 22 adult male goalball players, from 24 to 54 years of age, and the effect of growth and development factors on musculoskeletal tissue was completely absent. All tested goalball players (athletes) were categorized into sports classes B1 and B2. Blind athletes were categorized in sport class of sensory impairment of vision B1 while the visually impaired athletes were categorized in sport class of sensory impairment of vision B2 (Cosic *et al.*, 2014). Regardless of the sport class, during the match all athletes were using a blindfold, therefore in this research; the sample was not stratified in relation to the degree of sensory impairment. The overall sample was stratified into 6 subsamples, in relation to the national team affiliation and achieved placement (ranking). Table I shows the distribution of goalball players per team and the team results achieved in the tournament.

Table I Distribution of the sample of respondents.

national team	number of players	score
HUN	3	4
SRB	3	3
MNE	4	1
MKD	5	6
ROU	4	2
BIH	3	5

For the testing of the morphological space, 6 variables were applied and body mass index (BMI) and the ratio of waist and hip circumference (WHR) values were calculated. The World Health Organization (2008) suggests measuring WHR because it additionally points to the distribution of body fat and at the same time the values of the measures of the distribution of WHR are more accurate compared to the measures of skin folds. Acceptable values of the waist and hips ratio for the adult male population range

from 0.85 to 0.90 (<0.85 excellent; 0.85-0.90 good), and not acceptable are those which are larger than 0, 90 (0.90-0,95 medium; 0,95-1,00,high and > 1 extreme). In addition, World Health organization states Body Mass Index as a best evaluation tool for discerning nutritional state and defining and classifying obesity (Vlaski & Katanic, 2010). BMI values that are <18.5 categorize people in the group of undernourished people, from 18.5-24.9 categorize as persons with an ideal body weight, from 25 to 29.9 is the group of overweight people, from 30-34.9 mildly obese people, in the group where the index is from 35 to 39.9 are people who are severely obese, while people who have values greater than 40 are amongst the extremely obese. The 6 variables used to evaluate the morphologically space are: body height (BH), body weight (BW), waist circumference (WC), hips circumference (HC), the measures of assessment of body composition and fat percentage (% FAT) and the muscle tissue percentage (% MCT). For the morphological space variables evaluated, the following instruments were applied: stadiometer (SECA stadiometer 217) for estimating BH, centimeter tape (Baseline® Measurement Tapes) used to measure the WC and HC, and bioimpedance (Tanita BC-545) to determine the BW and for the assessment of body composition (% FAT% and %MCT).

The criterion for assessing the performance of the team in the tournament and the earned placement of the team (TEAM) is defined on the basis of the official results following the end of the regional tournament. The measurement results were analyzed by the procedure of descriptive and comparative statistics. For each subsample in relation to the evaluated variables, the basic central and dispersion parameters were calculated: arithmetic mean, standard deviation, maximum and minimum values. The correlation between certain morphological dimensions and the achieved results of the team was analyzed by inferential statistical procedure, using Persons coefficient. By using the Mann Whitney-U test, difference between the results of teams was analyzed, and in relation to all the evaluated variables (level of significance  $p < 0,05$ ). All the data were analyzed by statistical package SPSS version 14.0.

## RESULTS AND DISCUSSION

Tables II and III provide the values of the morphological space variables evaluated in goalball players, at the level of the entire sample, in relation to the team affiliation. The average values for each tested variable are presented in the aforesaid tables.

In Table III on the basis of nominal values for the variable ITM, a difference between the teams in relation to the classification of the index according to the degree of nutrition can be discerned. In the same table for variable WHR which was used to assess the value of the relation between waist and hips circumference, an acceptable value is noticed only amongst players of one team, while the other teams' players' values are unacceptable and thus pointing to the bad distribution of body fat.

In relation to the teams' results achieved in the tournament, Table IV shows the value of correlation between the teams' achieved placement (ranking) in the tournament and certain variables of morphological indicators. It can be seen that a complete or strong correlation with the achieved

Table II. Descriptive indicators of anthropometric characteristics and body composition at the level of the entire sample.

Variables	N	Min.	Max.	AM	SD
TV	22	1,47	1,90	1,74	,11
TM	22	65,60	110,70	85,89	12,80
ITM	22	18,96	35,53	28,59	4,86
%FAT	22	8,50	33,80	24,45	6,83
%MCT	22	33,50	47,90	40,20	3,63
OS	22	76,00	116,50	96,65	10,92
OK	22	88,60	122,00	102,86	8,33
WHR	22	,79	1,05	,93	,07

Table III. Average values of the indicators of anthropometric characteristics and body composition in relation to the team affiliation.

TEAM	Variables								
	age	BH	BW	BMI	%FAT	%MCT	WC	HC	WHR
BIH(5)	49.67	1.73	89.70	29.87*	28.57	37.73	104.67	104.47	1.00
SRB(3)	33.00	1.81	77.70	23.74	16.33	43.20	87.17	97.50	0.89 <sup>+</sup>
MKD(6)	38.60	1.62	86.24	32.94**	26.94	39.74	99.70	102.72	0.97
MNE(1)	29.50	1.82	98.03	29.89*	26.98	39.58	101.13	112.50	0.90
ROU(2)	38.50	1.72	88.73	29.91*	27.45	39.20	99.50	103.63	0.96
HUN(4)	30.33	1.81	69.77	21.47	16.93	42.67	83.33	93.00	0.90

\*-overweight; \*\*-mildly obese; +-acceptable value.

Table IV. Correlation between certain variables and achieved teams' results in the tournament.

TEAM	Variables							
	BH	BM	BMI	%FAR	%MCT	WC	HC	WHR
(BIH) 5	1.73	89.70	29.87	28.57	37.73	104.67	104.47	1.00
(SRB) 3	1.81	77.70	23.74	16.33	43.20	87.17	97.50	0.89
(MKD) 6	1.62	86.24	32.94	26.94	39.74	99.70	102.72	0.97
(MNE) 1	1.82	98.03	29.89	26.98	39.58	101.13	112.50	0.90
(ROU) 2	1.72	88.73	29.91	27.45	39.20	99.50	103.63	0.96
(HUN) 4	1.81	69.77	21.47	16.93	42.67	83.33	93.00	0.90
R	0.66	-0.34	0.16	0.04	-0.10	0.03	-0.41	0.54

teams' placement was not discerned for any tested indicators. Medium-strong correlation between the achieved results and the variables tested, can be discerned for the body height and the ratio of the hips and waist circumference variables.

By using the Mann Whitney-U test the difference between the teams' (TEAM) placement was analyzed, in relation to the evaluated variables (Table V). It is observed that in relation to the placement of the teams, statistically significant differences appear in a number of morphological space variables tested.

Many authors suggest that a satisfactory level of physical activity and participation in sports provides many benefits to the health of people with visual impairments. In addition to a better fitness status and health benefits, people with visual impairments also develop self-confidence, they build social skills and they better integrate themselves into

their surroundings (Ponchillia *et al.*, 2002). However, studies exploring the level of physical activity, body composition and perception of quality of life in people with impaired sight, state that in this population in all age periods there is a decrease in the level of physical activity that is associated with high value levels of indicators of body composition and overweight (obesity) (acc: Holbrook *et al.*, 2009). On the other hand, when it comes to the goalball player morphological profile there are insufficient studies especially for the population of adults with visual impairment (Scherer *et al.*). Therefore, the results of this study will be discussed in accordance with the data that are available and a study that has explored the subject of goalball players morphological characteristics from the city of Florianopolis (Portugal) in relation to the goalball players, members of the Portuguese Paralympic Team. In addition, the results of this study were discussed in accordance with the set aim of the study.

Table V. The differences identified (Mann Whitney-U test) in the test variable among the teams, and in relation to the results achieved by the team at the tournament.

differences between TEAM variables	p values of variables tested							
	BH	BW	BMI	%FAT	%MCT	WC	HC	WHR
MNE(1)/ROU(2)	.248	.248	.773	.773	.564	.772	.248	.375
MNE(1)/SRB(3)	.719	.077	.157	<b>.034</b>	.157	.289	<b>.034</b>	1.00
MNE(1)/HUN(4)	.724	<b>.034</b>	<b>.034</b>	.289	.480	<b>.034</b>	<b>.034</b>	.721
MNE(1)/BIH(5)	.289	.289	1.00	.480	.157	.289	.212	<b>.048</b>
MNE(1)/MKD(6)	<b>.050</b>	.221	.221	.806	1.00	.711	.221	.219
ROU(2)/SRB(3)	.157	.289	.157	.034	.157	.285	.212	.289
ROU(2)/HUN(4)	.108	<b>.034</b>	<b>.034</b>	.289	.480	.074	<b>.050</b>	.289
ROU(2)/BIH(5)	.724	1.00	.480	.480	.157	.285	1.00	.471
ROU(2)/MKD(6)	.268	.712	.086	.806	.624	.459	.902	.806
SRB(3)/HUN(4)	.827	.827	.513	.827	.513	.658	.077	.827
SRB(3)/BIH(5)	<b>.050</b>	.513	.127	<b>.050</b>	<b>.050</b>	<b>.050</b>	<b>.050</b>	.275
SRB(3)/MKD(6)	<b>.025</b>	.180	<b>.025</b>	.053	.180	.294	.180	.297
HUN(4)/BIH(5)	.184	<b>.050</b>	<b>.050</b>	.127	.513	<b>.050</b>	<b>.050</b>	<b>.050</b>
HUN(4)/MKD(6)	.053	.053	<b>.025</b>	.180	.456	.051	.180	.174
BIH(5)/MKD(6)	.180	.655	.101	.549	.456	.177	.881	.297

Based on the descriptive analysis of the anthropometric characteristics of goalball players in this study (Tables II & III), both at the level of the entire sample, and at the level of the subsample which is defined by the players' national affiliation, the increased values for body mass index, overweightness and obesity can be discerned in goalball players.

In these tables, increase of the values of fat tissue percentage are identified, which is not in accordance with the recommendations of the American College of Sports Medicine (ACSM, 2013) for the given age and sex. These above mentioned values are in direct relation with insufficient values obtained for the muscle mass percentage at the level of the entire sample and at the level of subsamples in goalball players affiliated with national teams. These identified values of the respondents in this study may be interpreted in two ways.

Specifically, general type of obesity is more present in the population of blind and visually impaired people than the typical population (persons who have no visual impairment) (Çolak *et al.*; Holbrook *et al.*), but seeing how the respondents are active athletes who train three times a week, the present overweightness could be explained by the insufficient level of activity, or inadequate training programs in terms of conditioning of the athletes, and / or inadequate nutritional habits. However, it can be noted that goalball players of the Serbian national team have optimum values for all herein mentioned anthropometric variables that assess body composition, body mass index and calculate the ratio of waist and hips circumferences. Since this team has achieved a good result (second place), we find that the optimal values of the tested variables are desirable when defining the morphological profile of goalball players.

In relation to the study of Scherer *et al.* who have tested the differences in morphological profile of Florianopolis goalball players and members of the Paralympic goalball team of Portugal, the respondents of this study have significantly higher body mass indexes, while excluding goalball players of Serbia (SRB) and Hungary (HUN) national teams. Goalball players SRB have reached an average BMI of 23.74 kg/m<sup>2</sup>, HUN have reached a value of 21.47 kg/m<sup>2</sup>, and in their values they are closer to the profile of Paralympic goalball players of the team of Portugal (23.66 kg/m<sup>2</sup>). BMI values of other teams in this study, are significantly higher, and that reflects the profile of a player with increased nutritional status and players who are obese as defined in the national team of goalball players of Macedonia (MKD, the players have reached the value of 32.94 kg/m<sup>2</sup>). Although there is no statistically

significant correlation between the realized placements and the BMI values of goalball players according to affiliation with national teams, high nominal values in goalball players of MKD team could be brought into connection with the placement of this team (last place) precisely because goalball is a sport that requires agility and strength. It should also be noted that the body height can be an important clue in defining morphological profile of goalball players. This is indicated by the body height values identified in the players of the first-ranked team (MNE, 1.82 m), which are closest to the body height values of the players of the Portuguese Paralympic goalball team (1.86 m). This is also confirmed by the results of body height of goalball players who have qualified for the last place on the regional tournament, BH of MKD players is 1.62 m.

Based on the analysis used to identify correlations between placements per team and tested variables, it can be seen that there is no complete or a strong correlation for any indicators of the morphological profile. However, a medium strong correlation, discerned for the variables used to evaluate body height and ratio of waist and hips circumferences, may be taken into consideration.

Global players when playing defense are protecting the goal, length of 9 meters, which means that each player in order to effectively defend has to cover an area of 3 meters. It is noticeable that the team that has achieved a better result, their players has a higher body height value than the players in teams that have achieved lower results in the tournament. Length of body segments, the upper extremities are positively correlated with body height (Jarzem & Gledhill, 1993) and in goalball when playing defense and preventing the entry of the ball into the goal, it is very important that players use primarily their arms range and torso movements in order to defend a larger area of the goal. In this study the tested variables which are associated with the body weight and body composition indicators (body fat percentage, muscle tissue percentage), as well as the calculated body mass index could not have been brought into correlation with the results achieved by the teams in the tournament. However, there is a medium strong correlation for the distribution of adipose tissue variable and achievements of the teams in the tournament. In teams that have achieved better results, the values of the variable WHR were lower than the values of the teams who have made weaker placement in the tournament. Possible logical explanation for the mentioned values, and realized difference, should be sought in the mode of play and the characteristic distribution of adipose tissue typical in the male population (in the upper body), hence the lower values of WHR provide more effective defense and attack.

The difference between the tested variables and realized placements of the teams was analyzed by Mann Whitney-U test (Table V). It may be discerned that there is no statistically significant difference in any of the tested variables between the two best-placed teams in the tournament (MNE and SRB), as well as between two teams that have achieved the lowest placements in the tournament (BIH and MKD). If we look at the number of variables tested and the rankings of the teams, the highest number of statistically significant differences noted is for the variable where the body mass index was calculated, which is consistent with the data from the descriptive analysis and it shows that in this study, body mass index is an important indicator of the morphological profile of goalball players. In addition to the statistically significant values of BMI, values for the hips circumference variable can be mentioned, but this data by itself has no significance, because in the calculated ratio of the waist and hip circumferences, a statistically significant difference, of small values, can be identified only between the first placed and fifth placed teams and the fourth placed and the team that has won the last place (sixth) in the tournament. Taking into account the analyzed data, it can be discerned that in relation to the placement of the team, the value of body mass index has a bigger influence than the distribution of adipose tissue value.

## CONCLUSION

As the lack of studies concerning the morphological profile of goalball players in the adult population is evident, this study has a practical contribution in terms of publishing some of the indicators of the morphological space and their connection with the realized placement of goalball teams (6 international teams) at the regional tournament. The authors of this study are aware of the limitations, because in addition to the morphological characteristics of goalball players, important factors for achieving the best placement can be correlated with the hearing of goalball players and the extent of their technical and tactical preparedness. However, based on analyzed results, it may be concluded that the body height is important in defining morphological profile of goalball players. In addition to the body height, the indicators pointing to the nutritional status may be taken into account when defining the morphological profile of goalball players and those are body fat percentage value, muscle tissue percentage value and body mass index value. Correlation analysis indicated a connection between the ratio of waist and hips circumference with the achieved placement of the teams, which indicates the importance of the distribution of adipose tissue in defining the morphological profile of goalball player.

**ROMANOV, R.; MEDOVIC, B.; STUPAR, D.; JEZDIMIROVIC, T. & GARUNOVIC, B.** La conexión entre ciertos parámetros morfológicos y resultados en jugadores de goalball. *Int. J. Morphol.*, 35(4):1396-1402, 2017.

**RESUMEN:** En ciertos estudios sobre deportes para personas con discapacidad también se investigan las características morfológicas de dichos atletas. Sin embargo, cuando se trata de goalball, el deporte para las personas con discapacidad visual, el foco de los investigadores se centra en la población de niños y adolescentes y el impacto del deporte mencionado sobre las características morfológicas que se observan en el proceso de crecimiento y desarrollo. Entre la población de adultos con discapacidad visual que participan en goalball, existen escasos estudios que aborden el tema del espacio morfológico, especialmente aquellos que apuntaran hacia la definición del perfil morfológico de los jugadores de élite de goalball. El objetivo de esta investigación consistió en determinar las características morfológicas de los jugadores adultos y si existe una correlación entre ciertos indicadores morfológicos del estado de la masa corporal de los atletas y los resultados de competencia entre los equipos de goalball. La muestra total consistió en 22 jugadores adultos de goalball, participantes de un torneo regional. Se analizaron las variables espaciales morfológicas, altura, peso corporal, circunferencia de cintura, circunferencia de cadera, porcentaje de grasa corporal y porcentaje de tejido muscular y se calculó el índice de masa corporal así como la relación cintura/cadera. En base a los resultados analizados, concluimos que la altura es importante para definir el perfil morfológico de los jugadores de goalball. Además de la altura, se debe tener en cuenta los indicadores que apuntan al estado nutricional, al definir el perfil morfológico de los jugadores de goalball (porcentaje de grasa corporal, porcentaje de tejido muscular, pero también el índice de masa corporal). El análisis de correlación indicó una correlación entre la cintura y cadera con la clasificación de los equipos, lo que indica la importancia de la distribución de grasa corporal en la definición del perfil morfológico de los jugadores de goalball.

**PALABRAS CLAVE: Goalball; Deficiencia visual; Características morfológicas.**

## REFERENCES

- American College of Sports Medicine (ACSM). *ACSM's Guidelines for Exercise Testing and Prescription*. Philadelphia, Wolters Kluwer Lippincott Williams & Wilkins Health, 2013.
- Caliskan, E.; Pehlivan, A.; Erzeybek, M. S.; Kayapınar, F. C.; Agopyan, A.; Yuksel, S. & Dane, S. Body mass index and percent body fat in goalball and movement education in male and female children with severe visual impairment. *Neurol. Psychiat. Brain Res.*, 17(2):39-41, 2011.
- Çolak, T.; Bamaç, B.; Aydin, M.; Meriç, B. & Özbek, A. Physical fitness levels of blind and visually impaired goalball team players. *Isokinet. Exerc. Sci.*, 12(4):247-52, 2004.
- Cosic, M.; Kasum, G.; Radovanovic, S. & Koprivica, V. Characteristics of the balance of people with impaired sense of vision. *Phys. Cult. J. Sport Sci. Phys. Educ.*, 20:81-101, 2014.
- de Lima, L. R. A.; Sigwalt, A. R.; Rech, C. R. & Petroski, E. L. Somatotipo e composição corporal de atletas feminino de pólo aquático do Brasil. *Rev. Educ. Fís. UEM*, 18(2):191-8, 2007.

- Holbrook, E. A.; Caputo, J. L.; Perry, T. L.; Fuller, D. K. & Morgan, D. W. Physical activity, body composition, and perceived quality of life of adults with visual impairments. *J. Vis. Impair. Blind.*, 103(1):17-29, 2009.
- Holway, F. E. & Garavaglia R. Kinanthropometry of Group I rugby players in Buenos Aires, Argentina. *J. Sports Sci.*, 27(11):1211-20, 2009.
- Jarzem, P. F. & Gledhill, R. B. Predicting height from arm measurements. *J. Pediatr. Orthop.*, 13(6):761-5, 1993.
- Karakaya, I. C.; Aki, E. & Ergun, N. Physical fitness of visually impaired adolescent goalball players. *Percept. Mot. Skills*, 108(1):129-36, 2009.
- Matkovic, B. R.; Misigoj-Durakovic, M.; Matkovic, B.; Jankovic, S.; Ruzic, L.; Leko, G. & Kondric, M. Morphological differences of elite Croatian soccer players according to the team position. *Coll. Antropol.*, 27 Suppl. 1:167-74, 2003.
- Ponchillia, P. E.; Strause, B. & Ponchillia, S. V. Athletes with visual impairment: Attributes and sports participation. *J. Vis. Impair. Blind.*, 96(4):267-72, 2002.
- Rexhepi, A. M. & Brestovci, B. The differences in body volume and skinfold thickness between basketball players and footballers. *Int. J. Morphol.*, 28(4):1069-74, 2010.
- Scherer, R. L.; Karasiak, F. C.; da Silva, S. G. & Petroski, E. L. Morphological profile of goalball athletes. *Eur. J. Hum. Mov.*, 28:1-13, 2012.
- Silva, G. C. P. *Tempo de Reação e a Eficiência do Jogador de Goalball na Intercepção/ Defesa do Lançamento/Ataque*. Dissertação do Programa Associado de Pós-Graduação em Educação Física. Maringá, UEM/UEL, 2008.
- Srhoj, V.; Marinovic, M. & Rogulj, N. Position specific morphological characteristics of top-level male handball players. *Coll. Antropol.*, 26(1):219-27, 2002.
- Vlas'ki, J. & Katanic', D. Health and social importance of the epidemic of obesity in adolescents in Serbia. *Med. Glas.*, 15(34):43-6, 2010.
- World Health Organization (WHO). *Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation*. Geneva, World Health Organization, 2008.

Corresponding author:  
Romana Romanov  
Educons University  
Faculty of Sport and Tourism  
TIMS, Radnicka str. 30 A, 21000  
Novi Sad  
SERBIA

E-mail: romana.romanov@tims.edu.rs

Received: 15-06-2017

Accepted: 11-09-2017