

Sport-Specific Morphology Profile: Differences in Anthropometric Characteristics among Elite Soccer and Handball Players

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ABSTRACT

The aim of this study was to obtain the relevant knowledge about significant differences in some anthropometric characteristics of top soccer and handball players. The sample included 41 male subjects divided into two subsamples. The first subsample included 25 subjects, who train in the senior selection in the Football club "Vojvodina" from Novi Sad, while the other subsample included 16 subjects who train in the senior selection in the Handball club "Vrbas" from Vrbas. The variables sample included 20 anthropometric measures that defined longitudinal and transversal dimensionality of skeleton, volume and mass of the body, and subcutaneous adipose tissue. The results were analysed in a statistical procedure marked as a significance testing of two arithmetic means of the independent samples, a t-test at the level of significance of $p < 0.05$. It was concluded, based on these results, that significant differences occur in all variables for evaluation of subcutaneous adipose tissue, except for the skinfold of the upper arm and forearm, and in variables for evaluation of body height, body mass, the minimum circumference of the upper arm and lower leg, and the maximum circumference of the upper arm, forearm, upper leg and lower leg.

Key words: anthropometric characteristics, soccer players, handball players, professional sport

Introduction

Top athletes, engaged in different sports branches, each differ in physical and physiological characteristics. It is expected for a top athlete to represent an expression of potential through heritage, training, nutrition, and sociocultural factors (Bourgeois et al., 2000).

Anthropometry is the method of measuring the human body or the individual body parts, which involves the quantitative definition of the morphological traits, and insight into an objective image of the state of growth of the person tested. Morphological characteristics appear to be great importance for orientation and selection in the most of sport disciplines, given that they are present in the specification equation of almost every sport, morphological dimensions occupy one of the major positions. For a large number of sports disciplines, the morphological structure that affects the sports efficiency the most is already known, although the coefficients of participation of individual morphological dimensions in the specification equation indubitably change due to the development of technique and tactics, and modern achievements in a particular sport. Soccer is a sports game played in the open field, and the training is usually based on the movement, expressed through endurance, which consists of a series of moderate activities, followed by

alternating periods of high intensity, which leads to significant metabolic heat production (Masanovic, 2015).

Role of morphological characteristics or body constitution in sport activities, on one side for specific kinesiological activity type, specific morphology type is necessary for above-average and top result achievement, and on the other side long-term training process, with regards of previous selection, genetical basis and social surroundings (Bala, 2000).

In regards of sport-specific or position-specific morphological profiling of athletes, study conducted by Sporis, Jukic, Ostojic and Milanovic (2009) which results can be used by coaches for improving process of designing training program to maximize the fitness development. According to the study of Matkovic et al. (2003), who investigated a sample of 57 first league players of Croatian soccer league, the players were not significantly different in height and body weight, but showed significant differences in the amount of adipose tissue as well as in the circumference of certain body parts, in relation to normal population.

The aim of this research was a desire to determine whether there is a difference, and the scope of it, in anthropometric characteristics between the top soccer and handball players, and to characterize, as accurately as possible, the morphological characteristics of subjects by measuring the individual body parts.

Methods

The sample included 41 male subjects divided into two subsamples. The first subsample included 25 subjects, who trained in the senior selection in the Football club "Vojvodina" from Novi Sad, which competed in Serbian Super League, while the other subsample included 16 subjects who trained in the senior selection in the Handball club "Vrbas", which competed in Serbian Super League. Criteria for selection of subjects for the sample were as follows: that they have been a part of the first team at the club for at least one year and that they are in good health.

Anthropometric research technique was used for data collection. A total of 20 anthropometric measures were evaluated, that defined the longitudinal and transversal dimensionality of skeleton, volume and body mass, and subcutaneous adipose tissue: body height, body weight, elbow diameter, wrist diameter, knee diameter, ankle joint diameter, minimum circumference of the upper arm, maximum circumference of the upper arm, minimum circumference of the forearm, maximum circumference of the forearm, minimum circumference of the upper leg, maximum circumference of the upper leg, minimum circumference of the lower leg, maximum circumference of the lower leg, skinfold thickness of the upper arm, skinfold thickness of the forearm, skinfold thickness of the thigh, skinfold thickness of the calf, skinfold thickness of the chest and skinfold thickness of the abdomen.

Anthropometric research was conducted according to IBP standards, while respecting the basic rules and principles related to the selection of parameters, standard conditions and measuring techniques, as well as the standard measuring instruments calibrated before measuring.

The measuring was carried out in the middle of the competitive season. The data obtained in the research were analyzed with the statistical program SPSS 10.0, adapted for use on personal computers. The arithmetic means, standard deviation and standard errors of arithmetic means of the anthropometric characteristics were calculated in respondents who are professional soccer players and professional handball players, by testing the differences of arithmetic means of independent samples at a significance level of $p < 0.05$. This analysis was able to answer the question whether there is a difference, and the scope of it, between the anthropometric characteristics of the soccer and handball players, regulars who compete in union divisions.

Results

This section presents the results of centrality and dispersion parameters, as well as the results of t-test for independent samples, classified into tables.

Observing the results, the differences of the centrality and dispersion parameters can be immediately noticed between the top soccer and top handball players when it comes to accumulation of subcutaneous adipose tissue, except the skinfolds of the upper extremities, while for the parameters of longitudinal and transversal skeletal dimensionality, volume and body mass, those differences are not as visible and emphasized as in the parameters for the evaluation of subcutaneous adipose tissue. Soccer players have higher values when it comes to knee diameter, minimum circumference of the upper leg and minimum circumference of the lower leg, while handball players have higher values in all the other variables (Table 1).

Table 1. Descriptive Statistics

	Soccer N=26		Handball N=16	
	AM	S	AM	S
Body height (cm)	182.11	± 6.73	188.16	± 6.14
Body weight (kg)	80.10	± 7.13	86.63	± 7.50
Elbow diameter (mm)	72.71	± 3.38	74.50	± 4.30
Wrist diameter (mm)	58.10	± 3.43	59.09	± 4.42
Knee diameter (mm)	99.33	± 3.77	99.01	± 5.53
Ankle joint diameter (mm)	75.72	± 3.22	76.13	± 2.91
Upper arm circumference (min) (cm)	30.31	± 2.46	33.30	± 2.64
Upper arm circumference (max) (cm)	32.15	± 1.97	35.60	± 2.59
Lower arm circumference (min) (cm)	16.92	± 0.89	19.57	± 7.76
Lower arm circumference (max) (cm)	16.42	± 2.55	28.73	± 1.57
Upper leg circumference (min) (cm)	42.27	± 2.63	40.57	± 2.29
Upper leg circumference (max) (cm)	56.42	± 2.66	58.83	± 3.22
Lower leg circumference (min) (cm)	24.35	± 1.20	23.43	± 1.16
Lower leg circumference (max) (cm)	37.85	± 1.93	39.30	± 2.12
Upper arm skinfold (mm)	4.21	± 1.16	4.75	± 1.00
Lower arm skinfold (mm)	4.84	± .62	5.67	± 1.52
Thigh skinfold (mm)	7.33	± 2.07	10.02	± 3.34
Calf skinfold (mm)	6.14	± 1.53	8.27	± 2.94
Chest skinfold (mm)	6.47	± 1.35	9.15	± 3.45
Abdomen skinfold (mm)	6.34	± 1.38	8.55	± 2.80

Legend: N – number of subjects, AM – arithmetic mean, S – standard deviation

On the basis of the results presented it was determined that the subsamples are significantly different in 12 of 20 anthropometric characteristics (level of significance $p < 0.05$) and in 11 variables (body height, body weight, minimum and maximum circumference of the lower arm, maximum circumference of the forearm, maximum circumference of the upper

leg, maximum circumference of the lower leg, thigh skinfold, calf skinfold, chest skinfold and abdominal skinfold), handball players show significantly higher values while the soccer players show higher values only in one anthropometric characteristic (minimum circumference of the lower leg, Table 2).

Table 2. Independent Samples t-test

	F	t	df	p	MD	SED	Min	Max
Body height	0.66	-2.86	39	0.01	-6.05	2.12	-10.32	-1.77
Body weight	0.01	-2.78	39	0.01	-6.53	2.36	-11.30	-1.77
Elbow diameter	1.45	-1.48	39	0.15	-1.79	1.21	-4.24	0.66
Wrist diameter	0.88	-0.81	39	0.43	-0.99	1.24	-3.50	1.51
Knee diameter	5.62	0.20	21.64	0.85	0.32	1.61	-3.02	3.66
Ankle joint diameter	0.85	-0.41	39	0.68	-0.41	1.01	-2.46	1.63
Upper arm circumference (min)	0.25	-3.65	39	0.00	-2.99	0.82	-4.65	-1.34
Upper arm circumference (max)	1.06	-4.80	39	0.00	-3.45	0.72	-4.90	-1.99
Lower arm circumference (min)	5.23	-1.31	14.21	0.21	-2.64	2.01	-6.95	1.67
Lower arm circumference (max)	0.19	-3.17	39	0.00	-2.31	0.73	-3.78	-0.83
Upper leg circumference (min)	0.68	0.86	39	0.39	0.70	0.82	-0.95	2.35
Upper leg circumference (max)	1.10	-2.70	39	0.01	-2.51	0.93	-4.39	-0.63
Lower leg circumference (min)	0.00	2.38	39	0.02	0.91	0.38	0.14	1.69
Lower leg circumference (max)	0.27	-2.24	39	0.03	-1.45	0.65	-2.77	-0.14
Upper arm skinfold	0.57	-1.53	39	0.14	-0.55	0.36	-1.27	0.18
Lower arm skinfold	12.23	-2.02	16.75	0.06	-0.83	0.41	-1.70	0.04
Thigh skinfold	3.66	-3.19	39	0.00	-2.69	0.84	-4.39	-0.97
Calf skinfold	3.28	-3.06	39	0.00	-2.13	0.70	-3.54	-0.72
Chest skinfold	9.48	-2.90	16.53	0.01	-2.68	0.93	-4.64	-0.72
Abdomen skinfold	9.63	-2.90	18.00	0.01	-2.21	0.77	-3.83	-0.59

Legend: F – value of Levene’s test of equality of variances, t – value of t-test, df – number of degrees of freedom, p – significance of two-tailed testing of arithmetic mean difference, MD – arithmetic mean difference, SED – standard error of difference, Min – the level of lower difference interval, Max – level of upper difference interval

Discussion

On the basis of the data obtained in this study was found that there are significant differences in certain anthropometric characteristics between soccer players and handball players in the highest rank of competition. Results relating to measures of the skeleton longitudinality and subcutaneous adipose tissue showed significantly higher values for handball players. Also, the measuring results of the volume and body mass showed higher values for handball players, while only one variable (min. lower leg circumference) shows significant difference, where the soccer players had higher values.

Being a professional athlete requires a high level of preparation which, in addition to motor and functional abilities, must be supported by morphological characteristics that should correspond, through the perfect harmony, based on sport structure, rank of the competition and the specifics of the player position, which differ within almost every sport branch.

The aim of this research was a desire to determine whether there is a difference, and the scope of it, in anthropometric characteristics between the top soccer and handball players, and to characterize, as accurately as possible, the morphological characteristics of subjects by measuring the individual body parts.

Given the structure of the movement in soccer and handball, higher values of lower extremities circumferences, and lower level of skin folds were expected for soccer players, as a result of specific strength training and higher training load on the lower extremities compared to handball players, for which the largest training load involves upper extremities and shoulder area. Still, fsoccer players had higher values only for minimal circumference of lower leg, as confirmed by the study of Smajić, Ujsasi, Djukic and Kapidzic (2015). They had similar results in their research, for the same sports, but for female subjects where in all measured variables handball player had significantly higher values, and soccer players had significantly higher value only in 1 variable (circumference of lower leg). It appear that differences in muscular activity of different regions

of body, could influence these changes in morphological domain, but not concluded in what amount and proportion between endogenous and exogenous factors.

Regarding the anthropometric characteristics of handball players, similar values were acquired by Srhoj, Marinovic and Rogulj (2002). They determined the characteristic morphological profile of top rank handball players, presenting clearer picture for coaches in possible morphological selection demands where cluster analysis revealed homogeneity between certain positions (more at wings and pivots, less at backs and goalkeepers). The research results of Stanković, Malacko and Doder (2009) partially coincide with the results of this research in terms of longitudinal and transversal dimensionality of skeleton and voluminosity and body mass. It was concluded, by comparing handball, basketball and soccer players, that similar differences were present in height and subcutaneous adipose tissue, in where handball players had higher values in comparison to soccer players. Results relating to the circumferences of the upper extremities also coincide, however, lower leg circumference in the aforementioned study was lower for soccer players, which can be marked as partial non-matching of these two studies.

Higher values observed in body height of handball players can be related to the selection of athletes for the forementioned sport, which is dominated by athletes who are taller and more massive and corpulent, because of the need of the sport itself for technical and tactical elements (jump shot, block, etc.) to be performed with maximum efficiency. These requirements can be recognized in sports like basketball and volleyball (Prahovic & Protic, 2007; Stanković, Malacko, & Doder, 2009; Rexhepi & Brestovci, 2010). Nevertheless, female subjects had also being studied by Bayios, Bergele, Apostolidis, Noutsos and Kas-kolou (2006) with significant differences found between sports, level of competition and specific player position. On the other hand, soccer is characterized as aerobic-anaerobic type of sport, with high load sprints, turns, and jumps but with much lesser amount of contact between players so force impact in contact duels are more often and intence in handball which may also in-

fluence team tactic in favor of particular player morphology type (wings are shortest, pivots tallest and haviest, goalkeeper oldest with most fat but no difference between lactate and max hart rate) concluded by Sporis, Vuleta, Vuleta and Milanovic (2010). It is known that soccer players do not differ significantly from the general population in body height and body weight, but have significantly lower levels of fat components and significantly higher values for muscle circumference (Matkovic et al., 2003).

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soccer players appears to have great interest for some authors (Di Salvo et al., 2007; I. Joksimovic, A. Joksimovic, & S. Joksimovic, 2008; Gorostiaga et al., 2009; Jovanovic, Sporis, & Milanovic, 2011) with interest of finding best morphology type for particular sport, competition level or player position. Quantification and comparison of anthropometrics should support coaches with better understanding specific demands of certain sport where particular morphology type of athlete, combined with motor and functional abilities, should express it's full potential.

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