PROFILE OF YOUNG ELITE HANDBALL PLAYERS ACCORDING TO PLAYING POSITIONS

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Abstract:
The aim of this study was to examine the morphological characteristics and functional abilities of the junior men's handball team of Serbia, as well as possible differences between the four positions on the team (goalkeeper, wing players, guards and pivot). In the statistical analysis basic parameters were calculated, and then one factor ANOVA test was conducted and post-hoc analysis of variance. Statistically significant difference ($p < 0.05$) was found in body weight, body height, the amount of fat, percentage share of fat and muscle tissue and muscle-fat ratio in athletes. Wing players are distinguished from most other players in the morphological characteristics of the body. The value of their body height, weight and BMI, muscle mass and subcutaneous fat were significantly lower compared to players in other positions. With high values of body mass and amount of fat and bone tissue, the highest homogeneity of morphological profile was found between the goalkeepers and pivots. Serbian Junior`s significantly lagging behind the functional abilities compared to the handball players of other countries. Morphological differences in the present material indicate differentiation of players due to the specific requirements of individual gaming sites. Problem in body composition is the increased amount of fat from 13.61 ± 5.86% and extremely low maximal aerobic power by 3.53 ± 0.48 l and 39.98 ± 4.62 ml/kg/min. One of the most important task in the further preparation of this handball players is training with to increase maximum oxygen consumption and muscle hypertrophy.

Key words: *anthropometric measures, functional abilities, Body mass- index VO2max., ANOVA*

INTRODUCTION

Numerous external and internal factors affected competitive success. Handball is sport game that belongs to physically most demanding. In addition to numerous contacts, this sports game consists of different movement categories including running, jumping, sprinting, throwing, blocking and pushing (Gorostiaga, Granados, Ibanez, Gonzalez Badillo, & Izquierdo (2006). Except optimal physical shape and technical-tactical (TE-TA) preparedness, successful handball play demand appropriate morphological characteristics. High levels of peak muscle strength and power, and high levels of aerobic abilities are the primary preconditions for successful play in top-level handball (Granados, Izquierdo, Ibañez, Bonnabau, & Gorostiaga (2007).

Morphofunctional characteristics of the players should be in accordance with specific kinesiological requirements (Srhoj, Marinović, & Rogulj (2002). Numerous anthropometric studies on athletes from different sports disciplines, examined the connection between body composition and type of sport. Body composition could significantly effects on the quality of training and competitive activity,

and vice versa, under the influence of training the body composition can be changed. That is why measurement of body composition and functional capabilities, and analyzing their impact on athletic performance is one of the most interesting areas of research (McIntyre, 2005; Tsekouras, Kavoura, Campagna, Kotsis, Syntosi, Papzoglou, Sidossis & (2005); Wittich, Oliveri, Rotemberg & Mautalen (2001).

For high quality planning and programming of sports training, measuring the anthropometric and morfofunctional status of players is necessary. Great importance for optimal design of sports-specific conditioning programs is measuring these characteristics (Granados et al., 2005). For effective implementation of the training process it is essential to know current and targeted anthropometric and morphofunctional characteristics of the players (Srhoj et al., 2002).

According to their team position handball players can be classified as goalkeepers, first lines players - wings and pivots and second line players - backs and central backs (Pezerat-Correia, Valamantos, Francisco, & Santos (2007); Scarbalius, 2003). Time motion analysis showed that handball players perform various movement activities based on their playing position (Cambel, 1985; Šibila, Vuleta, & Pori (2004). During the play, wingers cover the greatest distance in the sprint, while backs make most shots on the goal (Peach et al., 2008; Ohnjec, Vuleta, Milanoviæ, & Gruiæ (2003); Sibila et al., 2004). These differences in motion activities might be the cause of morphofunctional differentiation in team positions.

Complete diagnostic procedure involves the measurement and evaluation of morphological, biochemical, biomechanical, conditioning, psychological and sociological characteristics, as well as specific TE-TA capacity of players. Specific anthropometric characteristics (height, weight, length and width of the palm) are the main criteria for selection of handball players for different positions (Zapartidis, Toganidis, Vareltzis, Christodoulidis, Kororos, Skoufas, (2009); Srhoj et al., 2002).

The goal of this study was to examine: 1) morphological characteristics and functional abilities of the men's junior handball team of Serbia and 2) the possible differences between positions on the team.

METHODS

Anthropometric characteristics and functional abilities were tested on a sample of 32 Serbian national team handball players (mean age 20.43±1.16 years and sport experience 1.89±8.12 years). Distribution of players across playing positions was 4 goalkeepers, 14 backs, 10 wings and 4 pivots.

Measuring anthropometric parameters included body height (BH), body weight (BW), circumferences (upper arm, forearm, thigh, abdomen) and skin fold thickness at six sites (thigh, calves, upper arm, forearm, chest, abdomen), as well as diameters of four joints (elbow, wrist, knee and ankle). BH was measured in a standing position, with shoulders and heels placed along the wall with an accuracy of 0.1 cm (Martin`s anthropometer), and BW was measured using scale accurate to 0.1 kg (Tanita TBF/531, Germany). Circumferences of body segments were measured using anthropometric strip Harpenden © (Holtain Ltd.) and using cephalometer (GPM, Swiss Made, Switzerland). Body mass index (BMI) was calculated based on the ratio of body mass and the square of height (kg/m^2). Skin folds were measured on the dominant side of the body (for left-handed players on the left and for right-handed players on the right side of the body) using SlimGuide © calipper (Creative Health Products, Inc, Plymouth, MI). Based on obtained values of skin fold thickness, circumference and diameters, percentages of fat, muscle and bone tissue were calculated.

Heart rate was measured by using heart rate monitor (Polar S610, Finland). To determine maximal oxygen consumption (VO_2 max) we used a treadmill (Technogym, Italy) maximal-oxygen-consumption test (Bruce protocol). Gas analyzer (Cosmed Quark b2, Rome, Italy) conducted analysis of expired air.

Statistical analysis included the calculation of basic descriptive parameters for anthropometric and functional variables: mean±standard deviation (SD), maximum and minimum values (MIN and MAX). Differences in morphological and functional characteristics of players were obtained using One-way analysis of variance test (ANOVA) while comparisons between different team positions were carried out with post hoc analysis of variance (LSD test) and statistical significance differences of

Table 1. Descriptive statistics and results of ANOVA tests in 32 handball players.

	MEAN±SD	MIN	MAX	F	p
BW (kg)	88.44±8.98	88.00	106.00	3.296	.035
BH (cm)	190.70±5.23	179.50	200.50	4.158	.015
BMI (kg/m^2)	24.33±2.34	20.40	30.04	2.358	.093
BONE TISSUE (%)	16.74±0.99	15.26	18.65	1.428	.256
BONE TISSUE (kg)	14.72±1.30	12.14	17.53	1.689	.192
FAT TISSUE (%)	13.61±5.86	7.76	30.16	6.712	.001
FAT TISSUE (kg)	12.33±6.15	6.22	26.72	6.813	.001
MUSCLE TISSUE (%)	50.44±2.57	43.18	54.47	1.493	.238
MUSCLE TISSUE (kg)	44.59±4.87	35.36	53.02	3.323	.034
VO_2max (lO_2/min)	3.53±0.48	2.68	4.66	.869	.469
VO_2max ($mlO_2/kg/min$)	39.98±4.62	32.65	54.10	.242	.866

Table 2. Post-hoc analyze of variances according to playing positions.

VARIABLES	MEAN ± SD				Significant difference					
	G	W	B	P	G-W	G-B	G-P	W-B	W-P	B-P
BW (kg)	92.05±7.6	82.28±8.1	89.83±8.69	95.41±5.8	*			*	**	
BH (cm)	191.15±2.71	187.08±4.92	193.61±4.38	189.08±5.71				**		
BMI (kg/m^2)	25.17±1.66	23.53±2.40	23.97±2.16	26.74±2.25					*	*
BONE TISSUE (%)	16.20±0.40	17.27±0.89	16.60±0.93	16.45±1.50						
BONE TISSUE (kg)	16.59±4.55	14.17±1.11	14.79±1.27	15.69±1.64						
FAT TISSUE (%)	17.81±3.69	10.49±3.07	12.35±3.98	21.65±9.72	*	*			**	**
FAT TISSUE (kg)	16.59±4.55	8.70±2.96	11.34±4.82	20.58±8.91	*	*			**	**
MUSCLE TISSUE (%)	49.36±2.84	51.00±1.60	51.22±1.64	47.38±4.80					*	**
MUSCLE TISSUE (kg)	45.48±5.14	41.98±4.44	46.01±4.63	45.25±5.72				*		
VO_2max (lO_2/min)	3.55±0.42	3.34±0.51	3.59±0.44	3.76±0.61						
VO_2max - ($mlO_2/kg/min$)	38.49±2.53	40.83±6.53	39.92±2.43	39.58±7.43						

*G = goalkeeper; W = wing; B = back; P = pivot. ** $p < 0.01$; * $p < 0.05$*

Table 3. Comparison of morphological profiles of Serbian and players from other countries.

		YEARS	BODY HEIGHT	BODY WEIGHT	BODY FAT (%)	MUSCLE MASS (%)	VO_2 max (mlO_2/kg/min)
	Serbian U20	20.41±1.10	190.70±5.23	88.44±8.98	13.61±5.86	50.44±2.57	39.98±4.62
(Hassan et al. 2007)	England	20±2.0	174.2±5.4	77.5±11.5	13.4±5.4	47.8±8.0	-
	China	25.0±3.0	190.0±7.4	85.4±10.0	9.6±2.8	54.5±8.8	-
	Japan	26.0±2.0	185.4±6.7	80.6±3.9	9.2±2.0	49.0±5.9	-
	Korea	25.0±2.0	184.6±5.3	85.4±8.7	11.2±2.7	54.7±6.8	-
	Kuwait	26.0±3.0	181.6±5.0	87.6±10.3	12.9±4.3	55.3±10.5	-
	Saudi Arabia	25.0±3.0	182.1±7.0	75.8±8.1	10.3±2.8	46.0±6.0	-
(Granados et al. 2005)	Spain national team	31.0±3	188.7±8	95.2±13	13.8±2	-	-
	Spain third league	22.2±4	183.8±7	82.4±10	11.6±3	-	
(Rannou et al 2001)	France first league	22.7±0.6	177.0±1.4	74.0±2.0	13.2±0.9	-	57.7±3.1
	France national team	23.9±1.2	190.0±1.2	79.4±0.8	12.0±0.4	-	58.7±0.9

$p<0.05$. All data were analyzed using SPSS software (15.0, SPSS, Chicago, IL).

RESULTS

The results of the basic descriptive analysis of morphological and functional characteristics (variables) for all players, as well as the parameters of ANOVA test are shown in Table 1. Statistically significant difference ($p<0.05$) was found in BW, BH, body fat mass and percentage of fat and muscle tissue.

The differences between positions in the team were obtained using post-hoc analysis of variance (LSD test) (Table 2). The results show that wingers differ from other players according to the morphological characteristics of the body. The value of their BW, BH and BMI, muscle mass and fat tissue mass were significant lower compared to other players. In comparison between wingers and pivots, statistically significant difference was found in BW ($p=0.009$) and the amount and percentage of body fat ($p<0.001$). In comparison to the backs, wingers showed statistically significant difference in BH ($p=0.002$). Pivots had the highest BW (95.41kg), with the highest BMI (26.74kg/m^2), and compared to the backs had statistically significantly more body fat ($p=0.002$). The greatest muscle tissue mass had backs (46.01kg or 51.22%), significantly higher compared to the pivots ($p=0.007$), in relation to overall body mass.

The largest homogeneity of morphological profiles were recorded between the goalkeepers and pivots. Goalkeepers are relatively high, with high levels of body mass and subcutaneous fat tissue. It is interesting that they had the greatest amount of bone tissue (14.18kg), but the smallest percentage contribution in relation to BW (17.27%). Significant differences in amount of bone tissue were not found among the players ($p>0.05$). In addition, comparison of the cardiovascular functional capabilities showed that there was not statistically significant differences between players ($p>0.05$), although the highest VO_2 max in absolute values had pivots (3.76lO_2/min) and in relative values had wingers (40.83mlO_2/kg/min).

DISCUSSION

Knowledge about morphofunctional status of handball players allows us insight into the factors that affect the playing performance. The results of previous studies showed that body composition might affect the determination of specific playing position (Hassan, Rahaman, Cable, & Reilly

(2007; Srhoj et al., 2002). In this study, morphological characteristics of wing players were different from most other players.

The comparison of morphological profiles of Serbian and handball players from other countries are shown in Table 3. The results showed that the Serbian handball players had significantly higher values of BH (1.90±0.05m) and BW (88.44±8.98kg) compared to English and Asian players (Hassan et al. 2007). Compared with the handball players from Asian countries, the Serbian juniors had the highest percentage of body fat (13.61±5.86%). The percentage of muscle mass in Serbian players was higher than Saudi Arabia and Japanese players, but significantly lower compared to players from China, Korea and Kuwait.

Compared with the results of research conducted by Granados et al. (2005), Serbian handball players are morphologically very similar to the players from third Spanish handball league. In relation to the other elite handball players (Spanish team), Serbian players did not differ in the BH (1.88±0.08m with respect to 1.90±0.05m) and body fat percentage (13.8±2% compared to 13.6±5.8%), but their BW was about 6.7kg lower. Considering the U20 category and significantly smaller training experience, lower BW of Serbian handball players is expected. However, the same amount of fat mass with less total body mass, indicate a smaller proportion of lean body mass in Serbian players. Changes in body composition by increasing muscle and reducing fat body mass could be made by systematic training process and optimizing nutrition.

According to the positions in the team, the Serbian guards are significantly different from the Asian in BH (1.93±0.04m compared to 1.85±0.04m) and BW (89.8±8.7kg compared to 82.5±5.0kg). There was no statistically significant difference in the percentage of muscle mass and adipose tissue. Serbian pivots, had a higher percentage of body fat (21.6±9.7% compared to 10.8±3.3%) and lower percentage of muscle mass (47.9±4.8% compared to 53.8±7.7%) compared to Asian pivots (Hassan et al., 2007).

Serbian U20 team was significantly heavier compared to the French national team (88.4kg compared to 79.4kg). The percentage of fat tissue in Serbian handball players is higher than the percentage of French national team and first division players, and significantly higher in comparison to power or endurance athletes. In addition, Serbian juniors are significantly below the functional abilities of the French players. Players from French national team and first division with oxygen consumption of 58.7mlO_2/kg/min or 57.7mlO_2/kg/min respectively, had significantly higher VO_2 max compared to 39.98 mlO_2/kg/min in Serbian players.

Even athletes trained by the type of sprint had significantly higher oxygen consumption (60.2mlO_2/kg/min) (Rannou et al. 2001). The lower values of oxygen consumption in both absolute and relative terms partially might be a result of higher body fat mass that is certainly unnecessary ballast for the heart muscle.

CONCLUSION

Morphological characteristics of Serbia national U20 team partly indicate quite favorable body composition: BH=1.90±0.05m, BW=88.44±8.98kg, BMI=24.33±2.34kg/m^2 and the percentage of muscle tissue of 50.44±2.57%. Problem in body composition is the increased amount of fat tissue (13.61±5.86%). Considering the age of 20.43±1.16 years and sports experience of about 8 years, adequate training process in the aerobic zone and adequate diet could result in reducing body fat percentage at an appropriate level. Body composition could be changed throughout increasing the amount of muscle mass by introduction of strength training for muscle hypertrophy.

Indicator of cardiovascular system functional status, expressed in maximum oxygen consumption in absolute or relative units, indicate an extremely low value of 3.53±0.48lO_2/min and 39.98±4.62mlO_2/kg/min. One of the major tasks in further preparation of the handball players is increasing their VO_2 max.

The analyzing of morphological characteristics and functional abilities, suggests a need for continuous monitoring of certain morphological parameters (some of them are BH, BW, the percentage of fat and muscle tissue) and functional capacity (VO2 max, respiratory coefficient), biochemical status (anaerobic threshold, anaerobic capacity). The individualization of the training process to the needs of each individual, indicate the importance of cooperation between medical team and a coach.

Knowledge about morphofunctional status, allow efficient determination of the objectives and proper planning and programming training according to the individual needs of players.

REFERENCES

Cambel, K. (1985). An assessment of the movement requirements of elite team handball athletes. *Sports Medicine,* (3),23-30.

Gorostiaga, E.M., Granados, C., Ibanez, J., Gonzalez Badillo, J.J.,& Izquierdo, M. (2006). Effects of an Entire Season on Physical Fitness Changes in Elite Male Handball Players. *MedicineSciencies Sports Exercise, 38*(2), 357-366.

Granados, C., Izquierdo, M., Ibañez, J., Bonnabau, H., & Gorostiaga, E.M (2005). Differences in Physical Fitness and Throwing Velocity Among Elite and Amateur Male Handball Players. *International Journal Sports Medicine, 26* (3), 225-232.

Granados, C., Izquierdo, M., Ibañez, J., Bonnabau, H., & Gorostiaga, E.M. (2007). Differences in Physical Fitness and Throwing Velocity Among Elite and Amateur Female Handball Players. *International Journal Sports Medicine, 28*(10), 860-867.

Hassan, A.A., Rahaman, J.A., Cable, N.T., & Reilly, T. (2007). Anthropometric profile of elite male handball players in Asia. *Biology of Sport, 24*(1), 3-12.

Luig, P., Manchado-Lopez, C., Perse, M., Kristan, M., Schander, I., Zimmermann, M., Henke, T., & Platen, P. (2008). Motion characteristics according to playing position in international men's team handball. *13th Annual Congress of the European College of Sports Science. Book of abstract*, (p. 255). Portugal: Estoril.

McIntyre, M.C. (2005). A comparison of the physiological profiles of elite Gaelic footballers, hurdlers, and soccer players. British Journal of Sports Medicine, 39, 437-439.

Ohnjec, K., Vuleta, D., Milanoviæ, D., & Gruiæ, I. (2003). Performance indicators of teams at the 2003 world handball championship for women in Croatia. *Kinesiology, 40*(1), 69-79.

Pezerat-Correia, P., Valamantos, M., Francisco, A., & Santos, P. (2007). Influence of position roles on upper limb force parameters in young male handball players. *Medicine & Science in Sports & Exercise., 39* (Suppl. 5), 216.

Rannou, F., Prioux, J., Zouhal, H., Gratas-Delemarche, A., & Delemarche, P. (2001). Psychological profile of handball players. *Journal of Sports Medicine and Physcal Fitness,* 41, 349-353.

Scarbalius, A. (2003). *Optimization of training high-peak performance handball athletes*. Vilnius: Pedagogical University.

Srhoj, V., Marinoviæ, M., & Rogulj, N. (2002). Position Specific Morphological Charac-teristics of Top-Level Male Handball Players. *Collegium Antropologicum. 26*(1), 219–227.

Tsekouras, Y.E., Kavoura, S.A., Campagna. A., Kotsis, Y.P., Syntosi, S.S., Papzoglou, K., & Sidossis, L.S. (2005). The antropometrical and physiological characteristics of elite water polo players. *European Journal of Applied Physiology* (95), 35-41.

Wittich, A., Oliveri, M.B., Rotemberg, E., & Mautalen, C. (2001). Body composition of professional football (soccer) players determined by dual X-ray absorptiometry. *Journal of. Clinical Densitometry, 4*(1), 51-55.

Zapartidis, I., Toganidis, T., Vareltzis, I., Christodoulidis, T., Kororos, C., & Skoufas, P. (2009). Profile of young female handball players by playing position. *Serbian Journal of Sports Sciences. 3*(2), 53-60.

Šibila, M., Vuleta, D., & Pori, P. (2004). Position related differences in volume and intensity of large scale cyclic movements of male players in handball. *Kinesiology, 36*(1): 58-68.

ПРОФИЛОТ НА МЛАДИ ЕЛИТНИ РАКОМЕТАРИ СПОРЕД ПОЗИЦИИТЕ ВО ТИМОТ

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(Оригинален научен труд)

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Апстракт:

Целта на истражувањето беше да се утврдат морфолошките карактеристики и функционалните способности на младинската машка ракометна репрезентација на Србија, како и можните разлики меѓу четиритe позициив тимот (голмани, крилни играчи, бекови и пивотмени). Во рамките на статистичката обработка на добиените подтоци од истражувањето, пресметани се основните дескриптивни параметри, а потаое е применета еднофакторска Анализа на варијансата (АНОВА) и posthoc анализа на варијансата. Статистички значајна разлика ($p < 0.05$), е утврдена во телесната маса, телесната височина, количината на масното ткиво, процентуалното учество на масното ткиво и мускулното ткиво во однос на спортистите. Крилните играчи во однос на повеќето други играчи се разликуваа во морфолошките карактеристики. Вредностите на нивната телесна височина, телесната маса и Body mass- индексот (БМИ), масата на мускулното и поткожното масно ткиво беа пониски во однос на ракометарите од другите играчки позиции. Со високи вредности на масата на телот и количината на масното и коскеното ткиво, утврдена е највисока хомогеност на морфолошкиот профил кај голманите и пивотмените. Младите ракометари на репрезентацијата на Србија, имаат значително пониски функционални способности во однос на ракометарите од другите земји. Присутните разлики во морфолошката градба, укажуваат на диференцираност и селектираност на играчите со оглед на специфичните барања на одделните играчки места. Во телесната композиција на играчите, посебен проблем претставува зголеменото масно ткиво кое изнесувше 13.61±5.86%, како и исклучителните ниски вредности на максималната аеробна моќ од 3.53±0.48 лит., односно 39.98±4.62 мл/кг/мин. Една од најбитните задачи во по натамошната кондициска подготовка кај овие ракометари е спроведувањето тренингот за зголемување на максималната потрошувачка на кислородот и мускулната маса.

Клучни зборови: *антропометриски мерки, функционални способности, Body mass-indeks ,VO2max., АНОВА*