ANTHROPOMETRIC CHARACTERISTICS AND SOMATOTYPE OF YOUNG WATER POLO PLAYERS

Antropometrijske karakteristike i somatotip kadeta u vaterpolu

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Summary

The objective of this research was to describe anthropometric characteristics and somatotype of young water polo players involved in two intensity levels of training – seasonal and year-round and compare their differences. Study was conducted on 12 year old water polo players (N=30) from three water polo clubs in Biograd area (seasonal training) and on water polo players (N=29) from two clubs in Split (year-round training). Total of 14 morphological variables necessary for determination of somatotype characteristics were measured. In addition, body mass index (BMI), body fat percentage (BF%) and sum of seven skinfolds (∑7KN) were calculated. The somatotype components of the individual subjects were calculated and water polo players were grouped in one of the 13 somatotype categories. There was a statistically significant difference in all anthropometric variables measured, except in calf skinfold. Higher values of all anthropometric variables, BMI, BF% and ∑7KN were recorded for water polo players from Split. Mean somatotype of water polo players from Biograd area was 2.85-3.39-3.28, while water polo players from Split had a mean somatotype of 3.87-4.46-2.74. Total of 8 out of 13 somatotype categories were recorded for young water polo players from Biograd area, while 9 categories were determined for players in Split. The results of this study indicate that certain level of selection in water polo occurs already at 12 years of age.

Key words: anthropometry, somatotype, water polo

Sažetak

Cilj ovom istraživanju bio je opisati i usporediti antropometrijske karakteristike i somatotip kadeta u vaterpolu uključenih u dva nivoa treniranja – sezonalno i tijekom cijele godine. Istraživanje je provedeno na 12-godišnjim vaterpolistima iz tri kluba s biogradskoga područja (N=30) i dva kluba iz Splita (N=29). Ukupno je mjereno 14 morfoloških varijabla potrebnih za određivanje somatotipskih značajka. Nadalje, izračunani su indeks tjelesne mase, postotak masnog tkiva i suma sedam kožnih nabora. Somatotipske komponente izračunane su za svakoga pojedinog sportaša, i vaterpolisti su grupirani u jednu od 13 somatotipskih kategorija. Zabilježena je statistički značajna razlika u svim antropometrijskim

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varijablama, osim u kožnom naboru potkoljenice. Veće vrijednosti svih antropometrijskih varijabla, te indeksa tjelesne mase, postotka masnog tkiva i sume sedam kožnih nabora zabilježene su kod vaterpolista iz Splita. Srednji somatotip vaterpolista iz Biograda iznosio je 2,85-3,39-3,28, dok je kod vaterpolista iz Splita srednji somatotip iznosio 3,87-4,46-2,74. Ukupno osam od 13 somatotipskih kategorija je zabilježeno kod kadeta iz Biograda, dok je devet kategorija određeno za vaterpoliste iz Splita. Rezultati ovoga istraživanja upućuju na to da se određeni nivo selekcije u vaterpolu odvija već kod dvanaestogodišnjaka.

Ključne riječi: antropometrija, somatotip, vaterpolo.

INTRODUCTION / *Uvod*

In many sport disciplines, start of the training is based on set of different socio-economic criteria rather than morphological and other predisposition of a child for that sport. Seasonal sport schools, if coached and managed correctly, enable sport education of wider general public and have a potential for creating top athletes. In Croatia, water polo is one of the most popular team sports mainly because to the results at international competitions. However, it is interesting to note that national water polo league includes only teams from five cities, while seasonal water polo schools exist during summer in many costal towns and villages.

Identification of specific physical characteristics that may contribute to success in sports as well as the possible structural differences among athletes in different sports is crucial for selection and effective coaching of young athletes (Malousaris et al. 2008). Top athletes are from a morphological stand point relatively homogeneous group, and, depending on a sport, it is possible to define a model that is desirable for an athlete to attain (Mišigoj-Duraković et al. 1995). Besides the analysis of anthropometric characteristics, somatotyping of athletes is one of the most useful methods for describing their morphological characteristics. In somatotyping a body shape is expressed by a three-number rating that represents the components of endomorphy (fatness), mesomorphy (muscular skeleton development) and ectomorphy (linearity) (Carter and Heath, 1990).

Previous investigations of water polo players in Croatia include studies on structural analysis of positions (Šimenc et al., 1999), creatin supplementation and effects (Sekulić et al., 1999), analysis of anthropometric changes in elite male players (Lozovina and Pavičić, 2004), analysis of load during the game in relation to players position (Lozovina et al. 2003, 2004, 2006, 2007), ventilatory parameters in young players (Hraste, 2004), and injuries in water polo (Seifert et al., 2005; Franić et al., 2007).

However, there are no studies analyzing characteristics of children involved in seasonal water polo schools. Therefore, the objective of this research was to describe anthropometric characteristics and somatotype of young water polo players involved in two intensity levels of training – seasonal and year-round and compare their differences.

MATERIALS AND METHODS / *Materijali i metode*

Study was conducted on water polo players from three water polo clubs in Biograd area (Biograd, Gusar, and Turanj) in July and August 2008 and on water polo players from two clubs in Split (Mornar and Pošk) in September 2008. In Biograd area, a total of 30 children were studied that train water polo only during summer season, while in Split, a total of 29 children that train this sport year around were measured. Measuring was performed by trained and experienced investigators according to the International Biological Program (Weiner and Lourie, 1969).

For the purpose of this study, 14 morphological variables necessary for determination of somatotype characteristics were measured including: body height (cm), body mass (kg), upper arm girth (cm), calf girth (cm), humerus breadth (cm), femur breadth (cm), triceps skinfold (mm), biceps skinfold (mm), subscapular skinfold (mm), abdomen skinfold (mm), supraspinal skinfold (mm), suprailiac skinfold (mm), femur skinfold (mm), and calf skinfold (mm). Anthropometric equipment used included athropometer, weighing scale, small sliding calliper, synthetic length measuring tape and skinfold calliper. Corresponding accuracy were 1 mm, 0.1 kg, 1mm, 1 mm, and 0.2 mm. For skinfolds, three measurements were taken and their mean values were used in the analysis. Values of inter-item correlation coefficients were above 0.99.

In addition, body mass index and body fat percentage were determined. Body mass index (BMI) or Quetelet index was calculated from body height and body mass values using following formula:

BMI = weight (kg)/height (m^2)

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Body fat percentage (BF%) was calculated using body density (BD) according to the following formula (Durnin and Woremesley, 1974):

BD = 1.162 – 0.063 * log Σ4KN,

where Σ4KN = sum of biceps, triceps, subscapular and suprailiac skinfolds

Obtained value was used for calculation of body fat percentage according to Siri (1956):

BF% = (4.95 / BD – 4.5) * 100

For determination of body mass characteristics sum of seven skinfolds (biceps, triceps, subscapular, abdomen, supraspinal, femur and calf) was also calculated.

The somatotype components of the individual subjects were calculated according to the Heath-Carter methods, using the following equations (Carter, 2002):

Endomorphy = -0.7182 + 0.1415(x) - 0.00068(x^2) + 0.0000014(x^3)

- where x = triceps skinfold + subscapularis skinfold + supraspinale skinfold

Mesomorphy = [(0.858 * humerus breadth)
+ (0.601 * femur breadth)
+ (0.188 * corrected arm girth)
+ (0.161 * corrected calf girth)]
- (height * 0.131) + 4.50

- where corrected arm girth = upper arm girth (cm) - triceps skinfold /10 (mm) and corrected calf girth = calf girth (cm) – calf skinfolds/10 (mm).

Ectomorphy:

If HWR ≥ 40.75, then Ectomorphy = 0.732 HWR – 28.58

If HWR < 40.75 and >38.25, then Ectomorphy = 0.463 HWR – 17.63

If HWR ≤ 38.25, then Ectomorphy = 0.1

HRW is height/cube root of weight.

On the basis of obtained results young water polo players were grouped in one of the 13 categories according to two-dimensional somatochart (Carter and Heath, 1990).The somatotype of each subject was plotted on the somatochart. Coordinate values of X and Y were calculated according to Carter and Heath (1990) using following formula: X = ectomorphy – endomorphy, and Y = 2* mesomorphy – (endomorphy + ectomorphy).

Prior to the analysis data were tested for normality and homogeneity of variances. When these assumptions were met, t-test was used for comparison of two groups. When these assumptions were violated, non parametric Mann-Whiney U test was used for the analysis. Analysis was performed in Statistica 7.0.

RESULTS / *Rezultati*

Mean age of water polo players involved in seasonal training in Biograd area was 12.06±1.17, while mean age value of young water polo players that train year-round in Split was 12.40±0.77. There was no significant difference in age between these two groups (Z = 1.213, P = 0.225). Results of comparison of anthropometric characteristics between these two groups are presented in table 1. There was a statistically significant difference in all anthropometric variables measured, except in calf skinfold. For all variables measured, water polo players from Split had higher values. It is interesting to note that on average they were 7 cm taller and had 11 kg heavier. The highest difference in skinfolds was determined for the abdominal skinfold. According to the results of analysis there was no statistically significant difference in ectomorph component between two groups, while observed differences in endomorph and mesomorph components were statistically significant. In both groups the highest values were recorded for mesomorph component. Distribution of somatotypes is illustrated in Figure 1 for seasonal water polo players and in Figure 2 for year-round water polo players. In both figures data points are relatively dispersed.

Total of 8 out of 13 somatotype categories were recorded for young water polo players from Biograd area, while 9 categories were determined for players in Split (Table 2). Observed difference in number of categories was due to the category endomorph-ectomoph that was determined for one player from a later group. Among seasonal water polo players dominant somatotype category was mesomorphic ectomorph (30%), followed by endomorphic mesomorph (16.6%), mesomorph-ectomorph (16.6%), and ectomorphic mesomorph (13.3%). The largest number of water polo players that trained year-round were classified in endomorphic mesomorph category (31%), followed by balanced ectomorph (10.4%) category. In seven remaining categories recorded for these water polo players were represented by one or two players.

DISCUSSION / *Rasprava*

Results of this study indicate that there are significant differences in anthropometric characteristics and somatotype of young water polo players involved in seasonal (summer) training process and those involved in year-round training. According to Mišigoj-Duraković et al. (1995) anthropometric characteristics are used for selection of candidates to certain sport or discipline. In urban communities, such as Split, there is a high diversity of sport for children to chose and be selected for, while

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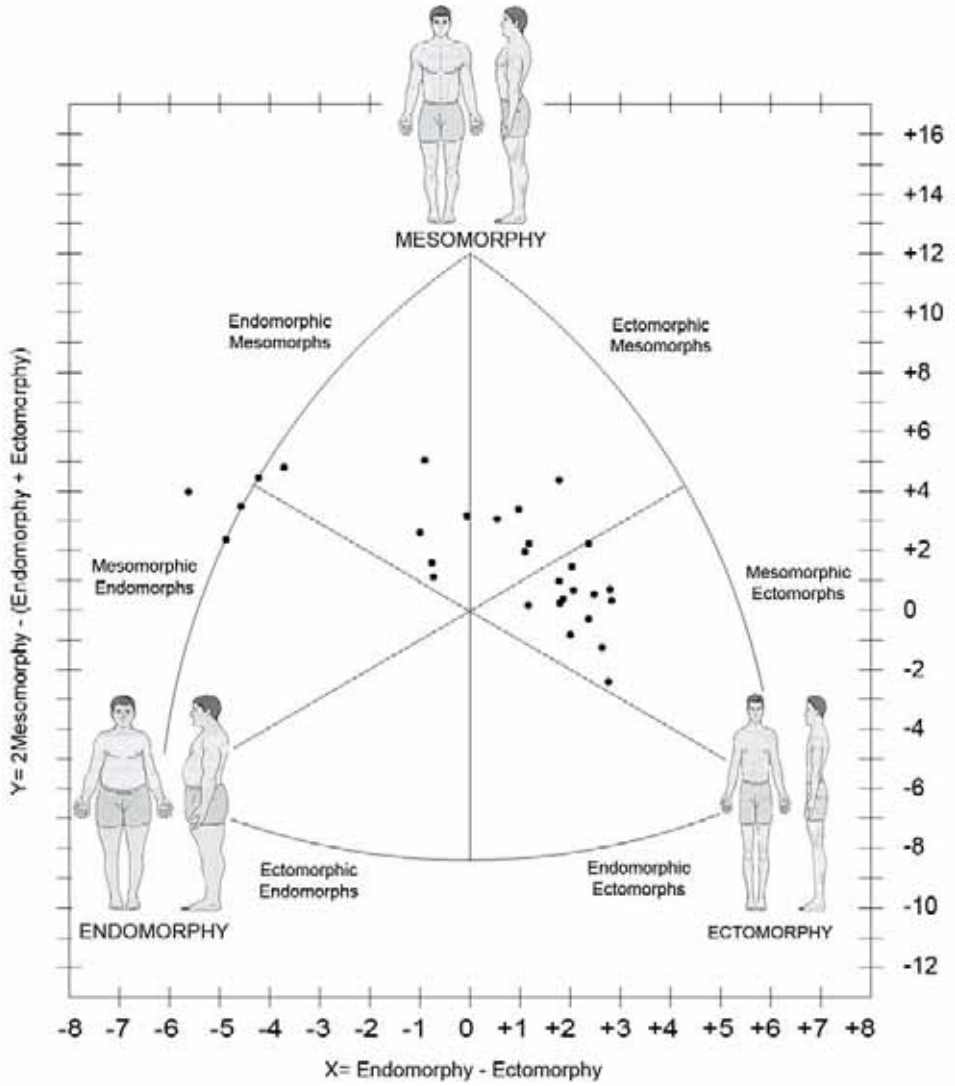

Figure 1. Somatochart of water polo players involed in seasonal training proces
Slika 1. Somatokarta vaterpolskih igrača koji treniraju sezonalno

in smaller communities, such as Biograd area in our case, selection of available sports as well as children for training is often limited. This has impact on profile of children involved in certain sport, causing formation of more heterogeneous group in smaller communities as opposed to selected group in communities with more sport disciplines. In both investigated groups children have been training water polo for two to three season/ years. According to our data this period is long enough for beginning of the selection process.

According to data from World Health Organisation (2007) on child growth standards, mean height of 12 year old boys is 150 cm, while their mean body mass index is 17.6 kg/m^2. Unfortunately this data base does not contain data on weight for children older than 10 years. Mean height of 12 year old boys from Saskatchewan (Canada) was 147.4 cm, their mean mass was 38.0 kg (Carter et al., 1997). Water polo players measured for the purposes of this study had a higher body mass index and were taller than values reported in these studies. According to referent values of body mass in relation to body height (Findak et al., 1996), relationship between these two variables is excellent for water polo players from Split, and above average for water polo players from Split.

In relation to somatotype components, in both groups investigated in this study the highest values were recorded for the mesomorphic component. This was also a dominant component in Olympic class water polo players for which Carter (1984) recorded a mean somatotype of 2.9-5.3-2.3. Differences in mean somatotypes obtained in this study and that obtained for

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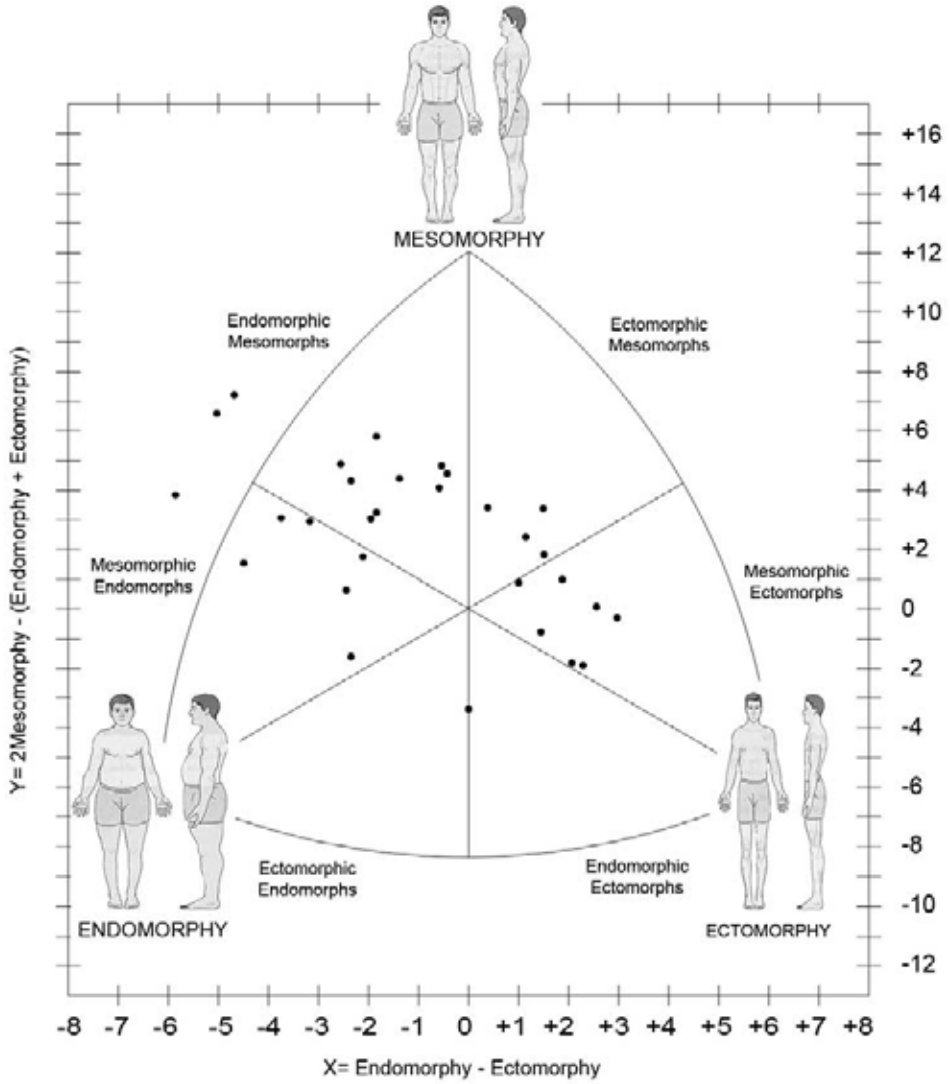

Figure 2. Somatochart of water polo players involed in year-round training process
Slika 2. Somatokarta vaterpolskih igrača koji treniraju tijekom cijele godine

water polo players at Olympic Games can be attributed to differences in age as well as to a selection that occurs through training process.

Several previous studies, including Carter et al. (1997) recognized that individual somatotype changes over time. Biggest change in general population of boys was recorded for ectomorph component that increased from 1.6 in 7 year old boys to 3.7 in 16 year old. In the same period mesomorph component increased from 3.6 to 4.0 and endomorphic decreased from 2.9 to 2.5. Taking this into account, results obtained in this study indicate that water polo players from Split with mean somatotype of 3.9-4.5-2.7 have higher possibilities to attain somatotype values recorded by Carter (1984) for Olympic level water polo players, than water polo players from Biograd that had mean somatotype of 2.9-3.4-3.3.

Previous studies investigated somatotype characteristics of boys in their early teens in relation to different parameters and results of several of these studies are presented in Table 3. Certain differences were observed between them and values recorded in this study. However, it is not possible to statistically analyse these differences so we can not interpret weather or not they are significant.

Results of this study contribute to understanding of anthropometric and somatotype characteristics of children from different communities involved in different intensities of water polo training. They also indicate that certain level of selection occurs already at 12 years of age. Future study analysing control group of children not involved in sport activities in two different types of communities should be conducted.

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Table 1. Antrophometric and somatotopic characteristics of water polo players involved in seasonal (N=30) and year-round (N=29) training (x±st.dev - mean±standard deviation, t - results of t-test on parametric data, Z – results of Mann-Whitney U test on non parametric data, p - associated probability values, NS – not signifiant).

Tablica 1. Antropometrijske i somatotipske značajke vaterpolista koji treniraju sezonski (N=30) i tijekom cijele godine (N=29) (x±st.dev – srednja vrijednost±standardna devijacija, t - rezultati t testa na parametarskim podatcima, Z – rezultati Mann-Whitney U testa na neparametarskim podatcima, p – vjerojatnost, NS – razlike nisu značajne).

Variable	Seasonal (x±st.dev)	Year-round (x±st.dev)	Test results	P
Height (cm)	156,36±11,05	163,37±8,43	t = 3,022	0,004
Weight (kg)	48,42±13,02	59,96±11,00	t = 2,911	0,005
Upper arm girth (cm)	25,00±3,05	26,88±2,77	t = 2,877	0,006
Calf girth (cm)	32,16±3,48	33,92±2,67	t = 2,161	0,035
Humerus breadth (cm)	6,08±0,50	6,46±0,36	Z = -3,124	0,002
Femur breadth (cm)	8,34±0,47	9,68±0,41	t = 7,071	<0,001
Triceps skinfold (mm)	12,11±4,67	14,45±4,19	t = 2,081	0,042
Biceps skinfold (mm)	7,11±2,66	8,84±3,34	Z= 2,070	0,038
Subscapular skinfold (mm)	8,11±3,71	9,92±4,53	Z = 2,730	0,006
Abdomen skinfold (mm)	13,34±7,49	20,27±8,19	t = 3,515	0,001
Supraspinale skinfold (mm)	8,98±5,35	14,51±7,18	Z = 3,586	<0,001
Suprailiac skinfold (mm)	12,50±7,38	18,40±8,41	Z = 2,911	0,004
Femur skinfold (mm)	16,34±6,02	21,88±7,11	t = 3,171	0,002
Calf skinfold (mm)	12,85±6,22	14,81±5,03	t =1,562	NS
BMI (kg/m²)	19,51±3,19	21,20±2,86	t = 2,347	0,022
BF%	15,54±4,65	18,81±4,65	t = 2,817	0,007
∑7KN	78,09±34,06	102,78±36,19	Z= 2,835	0,005
Endomorph	2,85±1,33	3,87±1,39	Z = 3,123	0,002
Mesomorph	3,39±0,75	4,46±1,04	t = 2,265	0,027
Ectomorph	3,28±1,33	2,74±1,27	t = 1,576	NS

Table 2. Somatotype chategories of young water polo players

Tablica 2. Somatotipske kategorije mladih vaterpolista

SOMATOTYPE CATEGORIES	Seasonal (n=30)	Year-round (n=29)
Central	0	0
Balanced endomorph	0	0
Mesomorphic endomorph	3	2
Mesomorph-endomorph	2	2
Endomorphic mesomorph	5	9
Balanced mesomorph	1	2
Ectomorphic mesomorph	4	2
Mesomorph-ectomorph	5	2
Mesomorphic ectomorph	9	2
Balanced ectomorph	1	3
Endomorphic ectomorph	0	0
Endomorph-ectomorph	0	1
Ektomorphic endomorph	0	0

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Table 3. Mean somatotype values of 12 year old boys obtained in this study and studies conducted by other authors

Tablica 3. Srednje vrijednosti somatotipa dvanaestogodišnjih dječaka prema rezultatima ovog istraživanja i istraživanja drugih autora

AUTHOR	Location	Age	Mean somatotype	Note
This study	Biograd (Croatia)	12	2,9-3,4-3,3	Sesonal water polo
This study	Split (Croatia)	12.4	3,9-4,5-2,7	Year-round water polo
Uljević (2006)	Split (Croatia)	12	2,8-4,2-3,7	Optimist sailors
Carter (1984)	Saskatchewan (Canada)	12	2,7-3,7-3,1	General population
Ji and Hosawa (1996)	China	12	2,3-4,1-3,7	General population
Katzmarzyk et al, (1998)	Québec, (Canada)	9-12	2,2-4,2-3,5	General population
Bell (1993)	United Kingdom	12-15	2,4-3,4-4,7	Sedentary children
Bell (1993)	United Kingdom	12-15	2,3-3,9-4,0	Active children

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