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Research article

ANTHROPOMETRIC AND MOTOR CHARACTERISTICS OF YOUNG HANDBALL PLAYERS USED IN EARLY SELECTION

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Abstract. *This paper deals with recognizing the indicators significant for early selection in handball. The sample consisted of 311 selected young players (175 males and 136 females), of the ages of between 12 and 16, who had trained handball for a minimum of 3 years. They have been tested by assemblies of young representative selections of the Handball Federation of Vojvodina. Three anthropometric variables were applied (Mass, Height, BMI), 8 tests of the Eurofit battery for the evaluation of motor abilities, and 3 tests with a ball that contained basic technical elements of handball. A factorial analysis for both genders was conducted individually, in order to establish model characteristics of young handball male and female athletes. For the subsample of girls, where three qualitatively different groups existed (the national, regional and club level), a canonical analysis was also conducted. Both subsamples resulted in a bi-component structure. With boys, the first component was formed from general motor skills, and the second from physical dimensionality. With girls, both components were similarly saturated, but they had reversed hierarchy (the first factor was formed from anthropometric, and the second from motor skills variables). A boy and a girl that are distinguished from their peers by a higher physical strength and larger physical constitution were used as the typical model of beginner handball players. In the sub-sample of girls, two canonical factors were gained, but neither was significantly discriminable. The Eurofit battery of tests did not prove to be discriminatory enough in the selection of young handball players.*

Key words: *handball, sports selection, motor skills, physical characteristics*

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INTRODUCTION

More and more attention is being devoted to discovering early talent in sports. Although numerous research indicates that early selection has many harmful influences on the biological and psychological development of children (Malina, 2010; Burgess, & Naughton, 2010; Moesch, Elbe, Hauge, & Wikman, 2011), the desire for top sports results ignores the drawbacks. More and more parents engage their children in serious specialized training from the age of 5-6, which is supported by many coaches. As this phenomenon is difficult to prevent, it is very important to establish as reliable criteria as possible for the objective discovery of children's sports talent and therefore, decrease the possibility of time spent in vain due to misguidance. This paper deals with certain issues regarding early selection in handball. It is a sport of high physical demands and can expose a young individual to numerous risks from sports injuries (Moller, Attermann, Myklebust, & Wedderkopp, 2012; Myklebust, Hasslan, Bahr, & Steffen, 2013; Jovanovski-Dašić, & Vujović, 2011). In recent years, The European Handball Federation has been organizing a larger number of sports camps where, apart from learning and perfecting handball technique and tactics, various tests of psycho-physical abilities of young handball players are also being conducted. Numerous national associations organize similar camps for the selected young players based on this model. Most often, this is a gathering of boys and girls where clubs send their talented players. True, there are many camps where the commercial interest of the organizer prevails, which is why due to prioritizing quantity, true talents are often not recognized, or they do not have the opportunity to be detected.

In this research, one assembly of selected young handball players of both genders was used, organized by the handball federations of Serbia and Vojvodina. In an isolated space, suitable conditions were created to conduct standardized test procedures, and eliminate numerous parasitical factors that are present in the usual work conditions in clubs.

METHODS

Study design

This is an empirical research of a transversal nature. It was realized during a gathering of young representative selections in Temerin, Crvenka, Ruma and Novi Sad, in November 2015, where selected young players of both genders participated. Regular and part-time members of pioneer and cadet representative selections were tested, as were the talented children sent by the clubs on their own initiative. Each participant was measured for their basic anthropometric dimensions (Height and Mass), which were used to calculate body mass index (BMI). During the days required for the testing, an evaluation of their motor skills was conducted. Eleven tests were applied, 8 of which come from the Eurofit battery and are used for the evaluation of general motor skills, while 3 were hypothetically designed to test specific handball abilities. With the aim to establish the model characteristics (anthropometric and motor) of young selected handball players, a factor analysis was conducted on the gathered data, for both genders individually, while for the subsample of girls, where three qualitatively different groups were identified in advance, a canonical analysis was also conducted.

Variables and instruments

The following tests used to evaluate general motor abilities were from the Eurofit battery (Council of Europe, 1993; Oja, & Tuxworth, 1995):

- *Flamingo Balance test* – single leg balance test,
- *Plate Tapping* – tests speed of limb movement,
- *Sit-and-Reach* – flexibility test (using 15cm at the level of the feet),
- *Standing Long Jump* – measures explosive leg power,
- *Handgrip Test* – measures static arm strength,
- *Sit-Ups in 30 seconds* – measures trunk strength,
- *Bent Arm Hang* – muscular endurance/functional strength and
- *10 x 5 meter Shuttle Run* – measures running speed and agility.

To evaluate specific motor skills significant for handball, three tests were used that contain basic elements of the technique:

- Goal Shooting (Mikić, 2000) – The participant performs a jump kick from a distance of 9 m, trying to hit the set corner of the handball goal. The participant has 4 handball balls at their disposal, which are used to aim at the corners of the goal in the following order: 1. Upper left, 2. Upper right, 3. Lower right, and 4. Lower left. Hitting the upper corners carries 2, and the lower corners 1 point. The result of the test is a sum of the achieved points by using all four balls.
- Passing the Ball (Čavala, & Katić, 2010) – The participant throws a ball at a wall that is 3 meters away with their stronger and weaker hand, interchangeably. Catching is conducted with both hands. The result of the test is the number of executed throws, namely the number of contacts of the ball with the wall.
- Slalom with the Ball (Lidor, Falk, Cohen, Segal, & Lander, 2005) – The participant guides the ball with one hand between 5 stalks that are set in a straight line, with the distance between them being 3 m. The starting line is marked on the floor and is 3 meters away from the first stalk. The participant sets off on the mark of the measurer. When they reach the final stalk, the participant goes around the stalk and executes guiding the ball in the opposite direction. The result of the test is the time that passes from the starting mark of the measurer to crossing the starting line with both feet. Measurement precision is 0.1 s.

Sample of the participants

The research included 311 participants (175 males and 136 females) of the ages between 12 and 16. They are selected young players from the clubs on the territory of AP Vojvodina, who had played handball for the minimum of 3 years and whom the coaches valued to be prospect players. The research adhered to ethical standards, so the participants were all aware of the reasons of testing, and they agreed that the results of their analysis should be published.

The subsample of boys was rather homogenous and was treated as a unique statistical set. The subsample of girls, apart from the prospective club players, contained regular and occasional members of pioneer and cadet national selections. This enabled the extraction of three qualitatively different groups among the girls: players at the national level (N=8), players at the regional level (N=36) and club players (N=92). Such structure allowed a proper discriminative analysis to be conducted on the subsample of girls.

Data processing

Basic descriptive statistical parameters were calculated for all variables of the research: Mean, Std. Deviation, Std. Error, Minimum and Maximum. To test the significance of the differences between the arithmetic means of the three different qualitative groups in the subsample of girls, the One Way ANOVA was used. To determine the latent structure in the entire system of the 14 analyzed variables, a factor analysis was applied (Principal Components Analysis – PCA), with a Direct Oblimin rotation method. The factor analysis was realized separately for the boys and for the girls. Since in the subsample of girls three qualitative stratum existed (the national, regional and club level), a Discriminant Analysis was also conducted on this subsample. It was used to define the canonical factors, which additionally tested the predictive value of the applied test battery.

All the gathered data were processed using Portable IBM SPSS v.19 application. All conclusions were realized at the 0.05 (Sig.≤ ,05) level of significance.

RESULTS

Descriptive indicators

Descriptive statistical parameters indicated a high homogeny of the boys and the girls in terms of anthropometric dimensions (Table 1). In both subsamples, relatively low indicators of variability were attained in both subsamples (Std. Deviation and Std. Error). The average anthropometric values (Mean) indicated that the participants were somewhat lower and heavier compared to their non-selected peers from the standard school population (Rakic, Bozic-Krstic, & Pavlica, 2011; Rakić, Božić-Krstić, & Pavlica, 2008).

As expected, in almost all the variables statistically significant differences between boys and girls were recorded (Table 2 and 3). In 13 of the total 14 tests, these differences were statistically significant. A significant difference only lacked in the Plate Tapping test. The boys achieved better results in all the tests related to manifesting strength, speed and agility, as in all the tests of specific motor skills that contained elements of handball technique. The girls showed better results in the field of balance and flexibility.

Table 1 Descriptives for Anthropometry

Variables	Gender	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Body Height (m)	Male	1.73	0.133	0.010	1.41	1.99
	Female	1.67	0.088	0.008	1.39	1.85
Body Mass (kg)	Male	64.05	16.917	1.279	28	110
	Female	57.63	11.691	1.002	28	93
BMI (kg/m^2)	Male	20.99	3.578	0.270	13.69	32.41
	Female	20.38	2.884	0.247	13.85	29.35

Table 2 Descriptives for general motor skills

Variables	Gender	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Flamingo balance test (s)	Male	7.28	5.174	0.391	1.98	35
	Female	11.73	10.696	.917	1.53	55.40
Plate Tapping (No)	Male	12.53	3.954	0.299	5.32	28.65
	Female	12.34	2.110	0.181	6.85	19.16
Sit-and-Reach (cm)	Male	19.14	8.832	0.668	0	38
	Female	25.50	6.419	.550	4	40
Standing Long Jump (m)	Male	1.91	0.320	2.418	114	265
	Female	1.67	0.227	1.947	34	215
Handgrip test (kp)	Male	40.07	9.675	0.731	17	54
	Female	33.01	7.173	.615	15	51
Sit-Ups in 30 seconds (No)	Male	28.29	5.026	0.380	18	44
	Female	24.36	4.073	.349	12	36
Bent Arm Hang (s)	Male	16.71	12.564	0.950	0	53.42
	Female	10.94	9.006	0.772	0	46
10x5 meter Shuttle Run (s)	Male	19.08	3.158	0.239	10.12	32.5
	Female	19.77	2.418	0.207	2.13	28.24

Table 3 Descriptives for specific motor skills.

Variables	Gender	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Goal Shooting (points)	Male	1.81	1.600	0.121	0	6
	Female	1.30	1.963	0.168	0	19
Passing the Ball (mark)	Male	21.94	4.676	0.353	9	32
	Female	19.20	2.794	0.240	10	26
Slalom with a Ball (s)	Male	9.34	1.374	0.104	1.61	13.80
	Female	10.81	1.627	0.139	7.87	21

Outcomes of factor analysis

With the aim of determining the latent structure in the entire system of 14 analyzed variables (3 anthropometric, 8 Eurofit battery tests and 3 tests of specific motor skills), a factor analysis was applied. Before conducting PCA, data suitability for factor analysis was evaluated. By examining the correlational matrixes in both subsamples (boys and girls), many coefficients of a 0.3 value and more were recorded. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) in boys was 0.801, which exceeds the recommended value of 0.6 (Kaiser, 1970, 1974). With girls, however, KMO was somewhat lower than the recommended theoretical value, and was 0.582. In both subsamples, Bartlett's test of sphericity (Bartlett, 1954) reached statistical significance (with boys Chi-square = 1976.569; Sig.=.000; with girls Chi-Square = 1005.831; Sig.=.000). All of this indicated factorability of correlational matrixes.

Main component analysis, attained after the Oblimin rotation, detected the presence of three components in the subsample of boys, and four components in the subsample of girls with Eiegen values over one. The attained Scree plots, however, indicated break off points in both subsamples after the second component (Image 1 and 2). Based on Kattel's criteria (1966), it was decided to keep only two components with boys and girls. This was

supported by the results of a parallel two-component analysis (Watkins, 2000), whose characteristic values exceed the suitable threshold gained using an equally large matrix of random numbers (14 variables x 175 participants for boys, 14 variables x 136 participants for girls respectively). Therefore, in boys and girls a bi-factor structure was accepted in the space covered by 14 variables. This bi-factor solution accounted for 59.809% of the total variance in the subsample of boys, or 41.73% of the variance in the subsample of girls. The contribution of the first component in the subsample of boys was 44.244% and the second 15.565%. In the subsample of girls, the contribution of the first component was 22.871% and the second 18.86%. Some of the 14 variables gave significant factorial weight to both extracted components. In such cases, items with lower correlation coefficients were eliminated from the final matrix patterns.

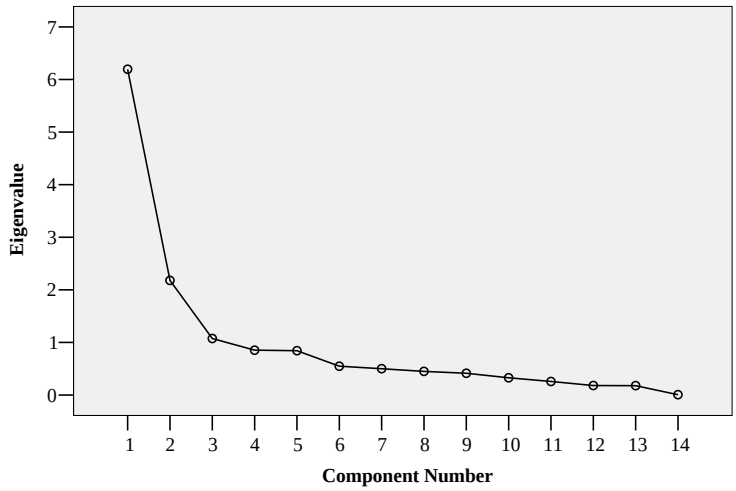

Fig. 1 Scree Plot for the male subsample

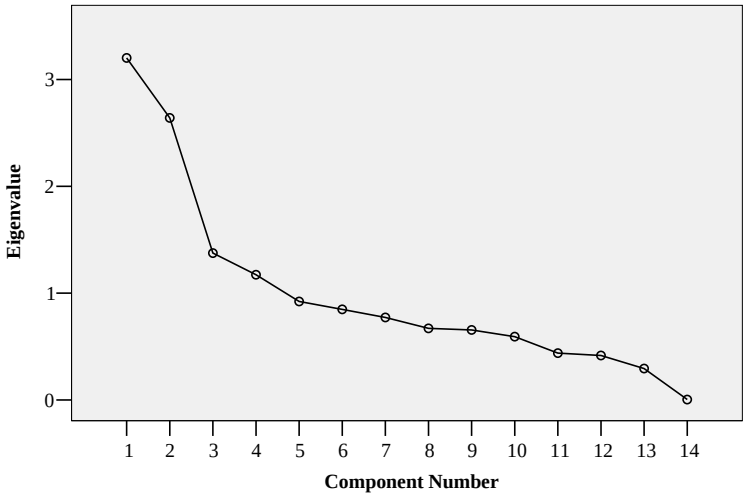

Fig. 2 Scree Plot for the female subsample

The extracted factors in both subsamples had very similar saturation and were marked with the same names – General motor skills and General physical dimensionality. However, in the different samples the factors changed places. The position of the first component, which explained the largest part of the general variability, was occupied by general motor skills in boys, while in girls it was occupied by General physical dimensionality.

Model characteristics of boys

The frame matrix gained for the subsample of boys indicates that the first factor is most saturated with the results gained on the tests: the Standing Long Jump, 10x5 meter Shuttle Run, Bent Arm Hang, Passing the Ball, Sit-Ups in 30 seconds, Slalom with the Ball, Plate Tapping and Sit-and-Reach (Table 4). Considering that 6 of the 8 tests in total predominantly saturated the first hierarchal component were aimed at evaluating the general motor skills, the first factor was named – General motor skills. The two remaining tests (Passing the Ball and Slalom with a Ball) were used in this research as potential indicators of specific abilities (specific handball motor skills), but the factor analysis did not justify their hypothetical intent. The results show that both tests where a ball was used indicated more strongly quality in general rather than specific motor skills. The third hypothetical test for the evaluation of specific motor skills, Goal Shooting, had the lowest commonality and showed the lowest connection with both factor components (Table 4).

The pattern matrix, determined for boys, indicated that the second hierarchal component was most saturated with the results of three anthropometric dimensions: BMI, Body Mass and Height, which is why the second factor was named – General physical dimensionality. The fourth variable that had a significant contribution in forming the second factor in the subsample of boys was handgrip strength (Table 4).

Model characteristics of girls

The pattern matrix, determined for the girls, indicated that the first hierarchical component was most saturated with results from the three anthropometric dimensions: Body Mass, BMI and Body Height. This is why the first factor in girls was titled- General body dimensionality. As in the second factor in the case of the boys, the fourth variable with a significant contribution in forming the first factor in the subsample of the girls was the Handgrip test (Table 5). By inspecting the correlational matrix, very high correlation coefficients calculated between handgrip strength and all three anthropometric dimensions were once again noticed.

The pattern matrix attained for the subsample of girls indicates that he second factor was most saturated by the results attained in the tests: Sit-Ups in 30 seconds, Bent Arm Hang, Plate Tapping, Standing Long Jump, 10x5 meter Shuttle Run, Slalom with Ball, Passing the Ball and Goal Shooting (Table 5). Considering that 5 of the 8 tests in total that predominantly saturated the second hierarchal component were intended to evaluate general motor skills, the second factor in the subsample of girls was titled – General motor skills. The factor analysis did not confirm the hypothetical role of the three tests containing a ball even in the subsample of girls (Passing the Ball, Slalom with the Ball and Goal Shooting). It was expected of these tests to determine the level of specific handball abilities. The results show that all three tests with a ball gave more information regarding the quality of general rather than specific motor skills. The two tests from the Eurofit battery, the Flamingo balance test and Sit-and-Reach, had very low commonalities

and were not significantly linked with either of the two extracted factor components. This indicates very low predictive values of these two motor tasks, hypothetically intended to evaluate the balance and the flexibility of the participants.

Table 4 Results of the factor analysis with 14 variables tested on the subsample of boys

Variable	Pattern matrix		Structure matrix		Commonalities
	Factor 1	Factor 2	Factor 1	Factor 2	
Standing Long Jump	**.889**	-.092	.881	-.012	.784
10x5 meter Shuttle Run	**-.826**	.133	-.814	.059	.680
Bent Arm Hang	**.826**	-.363	.759	-.291	.707
Passing the Ball	**.792**	.077	.833	.151	.699
Sit-Ups in 30 seconds	**.760**	-.091	.752	-.023	.573
Slalom with a Ball	**-.680**	.372	-.647	.310	.555
Plate Tapping	**-.621**	-.111	-.631	-.167	.410
Sit-and-Reach	**.502**	.261	.525	.306	.343
Goal Shooting	-.064	-.009	-.064	-.015	.004
BMI	.155	**.879**	.234	.893	.822
Body Mass	.515	**.776**	.585	.822	.939
Body Height	.420	**.756**	.488	.794	.806
Handgrip test	.441	**.743**	.508	.783	.807
Flamingo balance test	.146	-.251	.205	-.329	.244
KMO Measure of Sampling Adequacy = .801		Bartlett's Test of Sphericity = 1976.569		*Sig.*= .000	

Table 5 Results of the factor analysis with 14 variables tested on the subsample of girls

Variable	Pattern matrix		Structure matrix		Commonalities
	Factor 1	Factor 2	Factor 1	Factor 2	
Body Mass	**.970**	.026	.972	.074	.945
BMI	**.865**	-.065	.861	-.022	.746
Body Height	**.764**	.177	.773	.215	.629
Handgrip test	**.634**	.456	.656	.488	.638
Flamingo balance test	-.298	.135	-.392	-.392	.172
Sit-Ups in 30 seconds	.069	**.617**	.099	.099	.389
Bent Arm Hang	-.439	**.603**	-.409	-.409	.530
Plate Tapping	-.041	**-.584**	-.070	-.070	.345
Standing Long Jump	-.115	**.578**	-.086	.572	.340
10x5 meter Shuttle Run	.130	**-.548**	.102	-.542	.310
Slalom with the Ball	.002	**-.545**	-.025	-.545	.297
Passing the Ball	.056	**.467**	.080	.470	.224
Goal Shooting	.042	**.439**	.064	.441	.196
Sit-and-Reach	.135	.246	.147	.253	.082
KMO Measure of Sampling Adequacy = .589		Bartlett's Test of Sphericity = 1005.831		*Sig.*= .000	

Discriminative analysis in the subsample of girls

Considering that in the case of the girls there were three qualitative stratums (players of the national, regional and the club level), a Discriminant Analysis was also conducted on this subsample. This procedure enabled the testing of predictive value of the extracted canonical factors and a better overview of the criteria significant for the early selection of young female handball players. Two canonical factors were extracted, which confirmed

the justifiability of the application of the two-component model in the previous factor analysis. The first canonical (hierarchal) factor participated with 66.5% in explaining the total system variance containing 14 applied variables. Even though the values of Wilks' Lambda were rather high, the realized significance levels exceeded the theoretical limit (Sig.>0.05) and indicated the lack of significant discrimination of both canonical functions (Table 6).

These statistical indicators created an objective doubt in the predicative values of the Eurofit battery of tests. All things considering, the applied tests are not sufficiently discriminative for early selection in handball. By individually analyzing each of the 14 applied tests, for which the Univariate ANOVA was used, statistically significant discrimination was determined for only 5 tests, two of which are anthropometric dimensions (Table 7). Only three tests from the Eurofit battery have proven to be discriminative for the three different qualitative groups (national, regional and club level) – the Handgrip test (Sig.=.003), Sit-Ups in 30 seconds (Sig.=.010) and Sit-and-Reach (Sig.=.003). With the remaining motor skill tests the realized levels of significance were far above the theoretical border value (Sig.>.05). This did not allow for the canonical factor (Function 1) to be pronounced statistically discriminative.

Table 6 Summary of the Canonical Discriminant Functions for the female subsample

Statistic parameter	Function 1	Function 2
Eigenvalue	0.230	0.116
% of Variance	66.5%	33.5%
Canonical Correlation	0.432	0.322
Wilks' Lambda	0.729	0.896
Sig.	0.066	0.384

Table 7 Discriminative analysis for the 14 applied variables in the subsample of girls

Variables	Republic level	Provincial level	Club level	Wilks' Lambda	**F**	Sig.
Body Height (m)	1.72	1.69	1.66	.955	3.106*	**.048**
Body Mass (kg)	65.13	59.83	56.11	.955	3.157*	**.046**
BMI (kg/m^2)	21.8676	20.72	20.12	.975	1.686	.189
Flamingo balance test (s)	8.61	10.74	12.39	.990	.668	.515
Plate Tapping (No)	11.41	12.29	12.44	.987	.893	.412
Sit-and-Reach (cm)	28.88	23.08	26.15	.939	4.337*	**.015**
Standing Long Jump (m)	1.60	1.70	1.66	.989	.766	.467
Handgrip test (kp)	37.88	35.44	31.64	.917	6.002*	**.003**
Sit-Ups in 30 seconds (No)	24.75	26.06	23.66	.933	4.754*	**.010**
Bent Arm Hang (s)	13.75	10.28	10.96	.993	.481	.619
10x5 meter Shuttle Run (s)	18.75	19.47	19.98	.980	1.360	.260
Goal Shooting (points)	1.75	0.94	1.40	.986	.913	.404
Passing the Ball (mark)	19.64	19.67	18.98	.987	.887	.414
Slalom with the Ball (s)	11.15	10.47	10.91	.984	1.110	.333

Of the three anthropometric dimensions, only the body mass index (BMI) did not prove to be sufficiently statistically discriminant (Sig.=.189). This data corroborates earlier observations regarding whether male and female handball players are persons that

stand out from the average due to larger general body dimensions. Namely, in the more quality stratums, significantly higher general averages of body height and mass were recorded, while in terms of their physical composition, the stratums did not significantly differ amongst themselves.

The first canonic-discriminative factor (Function 1) was formed from five movement tasks (Sit-Ups in 30 seconds, Sit-and-Reach, and three tests performed with a handball ball). The second canonical factor (Function 2) was formed from the remaining 9 tests amongst which the most influential ones were the Handgrip test and three anthropometric dimensions (Table 8).

Table 8 Results of the discriminant analysis with 14 variables tested on the subsample of girls

Variables	Structure Matrix		Standardized Canonical Discriminant Function Coefficients	
	Function 1	Function 2	Function 1	Function 2
Sit-Ups in 30 seconds	-.553*	.102	-.552	-.021
Sit-and-Reach	.461*	.377	.581	.387
Slalom with the Ball	.250*	.143	.177	.346
Passing the Ball	-.223*	.127	.086	.297
Goal Shooting	.217*	.160	.282	.042
Handgrip test	-.492	.547*	-.545	.422
Body Mass	-.285	.499*	-.304	3.479
Body Height	-.330	.432*	.035	-1.508
BMI	-.179	.394*	.318	-2.426
Plate Tapping	.056	-.331*	-.152	-.149
10x5 meter Shuttle Run	.188	-.326*	.132	-.239
Bent Arm Hang	.075	.227*	.211	.403
Flamingo balance test	.136	-.223*	.043	-.254
Standing Long Jump	-.169	-.207*	-.101	-.611

DISCUSSION

Descriptive statistical parameters indicated a high homogeny of both subsamples, which was the first indication that certain latent features exist in the anthropometric and motor features of the participants that influenced primary selection. Anthropometric dimensions and general motor abilities in both genders are above the averages published in previous research conducted on a standard school population (Vlajković, Macanović, Arsić, Jocić, Milovanović, & Arsić, 2015; Pelemiš, Pelemiš, Rankić, & Jovanović, 2013; Bolanča, Čavala, & Rogulj, 2010). Those provided clear indications for defining model characteristics of young handball players. The results of the factor analysis gave mathematical confirmation to this claim. It turned out that a boy and a girl who stood out from their peers with higher general physical strength and a bigger physical constitution were recognized as the typical models of handball players.

The hierarchal structure of factorial matrixes of boys and girls showed significant differences. True, the extracted factors had very similar saturation in both subsamples and were marked with same names, but they had different hierarchal positions. One factor was predominantly saturated with variables of general motor skills, while body dimensions had

the highest influence on the formation of the second factor. The factors in different samples switched their hierarchal positions. The first factor, which explained the largest portion of the total variability in the boys and was titled General motor skills, had the status of the second hierarchal component in the girls. At the same time, the second hierarchal factor from the subsample of boys, marked as General physical dimensionality, took the position of the first component in the subsample of the girls. The primary significance of the physical dimensions for the girls was confirmed by the results of the discriminant analysis, since they were recorded as significant predictors for explaining the differences between players of different competitive levels. Precisely the players from the highest quality group (members of the national team) were characterized by highest physical height and body mass.

The pattern matrix, determined for boys and girls, showed that apart from the three anthropometric dimensions (BMI, Body Mass and Height), the Handgrip test also had a significant contribution in forming the factors of general physical dimensionality. This data is not surprising at all, as previous research studies have proven that absolute strength is most dependent on body mass (Jarić, 2002; Jarić, Radosavljević, & Johansson, 2002; Jarić, 2003; Marković, & Jarić, 2004 and 2005; Kim, 2011). By examining the correlation matrix, very high correlation coefficients were noticed calculated between the handgrip strength and all three anthropometric dimensions, which contributes to the explanation of factor saturation of general physical dimensionality by the Handgrip test, and undoubtedly confirms the findings of previous research.

Three tests that contained elements of handball technique were amongst the items that formed the first canonical factor in the subsample of girls. They were hypothetically intended to evaluate specific motor skills (Slalom with the Ball, Passing the Ball and Goal shooting). True, the coefficients of the canonical correlation were less than 0.3 on all three tests with a ball, and they had a far small influence on forming Function 1 than other tests of general motor skills. Even though this canonical factor did not prove to be significantly discriminative, its realized level of significance did not exceed the theoretical border value by much (Sig.=0.66). This can be interpreted as an indication that the quality of performance of handball elements does have a role in discriminating between various qualitative strati (national, regional and club level). The statistical confirmation of the discriminatory nature of specific motor skills with a ball was probably lacking because only basic technical elements of handball that are a part of the beginner training were applied. If the participants were required to perform somewhat more complex technical elements, discrimination of the first canonical factor would probably increase. This hypothesis would be justifiably tested in future research studies.

Most statistical indicators created objective doubt in the predictive values of tests from the Eurofit battery. All things considering, the applied tests were not sufficiently discriminative for early selection in handball. True, these conclusions can be made only based on the results attained in the subsample of girls, which represents the main limitation of the study. Significant differences were stablished for only 5 variables using variance analysis, 2 of which were anthropometric. Only three tests from the Eurofit battery have proven to be significant for explaining the differences between girls of various player levels (Handgrip test, Sit-Ups in 30 seconds and Sit-and Reach). This points to the need to check the metric characteristics of some more suitable tests that probably have a larger discriminative potential for the selection of young handball players in future studies.

CONCLUSION

Based on the obtained results, it can be concluded that there are two main model characteristics of young handball players – quality of general motor skills and the size of basic physical dimensions. Not a single physical or motor skill variable stands out either with boys or with girls, but a boy and a girl that stand out from the average with a higher general physical strength and larger physical constitution are recognized as the typical models of handball players. General motor skills have proven to be more significant among boys, while with girls the first hierarchal component was formed from physical dimensions. Amongst the indicators of general motor skills, those abilities that are characterized by engaging large muscle groups are predominant. Apart from the anthropometric variables, the formation of the factors of general physical dimensionality was significantly influenced by handgrip strength, which, in previous studies, was determined to depend the most on body mass. Most tests from the Eurofit battery did not prove to be discriminatory enough for early selection in handball, which points to the need to find some other suitable tests with better metric characteristics.

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ANTROPOMETRIJSKE I MOTORIČKE KARAKTERISTIKE MLADIH RUKOMETAŠA U FUNKCIJI RANE SELEKCIJE

Rad se bavi prepoznavanjem indikatora značajnih za ranu selekciju u rukometu. Uzorak je sastavljen od 311 selektiranih mladih igrača (175 dečaka i 136 devojčica) uzrasta između 12 i 16 godina koji su rukomet trenirali minimalno 3 godine. Oni su testirani na okupljanjima mladih reprezentativnih selekcija Rukometnog saveza Vojvodine. Primenjene su 3 antropometrijske varijable (telesna visina, telesna težina, BMI), 8 testova Eurofit baterije za procenu opšte motorike i 3 testa sa loptom koji su sadržali osnovne tehničke elemente rukometa. Sa ciljem da se utvrde modelne karakteristike mladih rukometaša i rukometašica sprovedena je faktorska analiza posebno za oba pola. Za subuzorak devojčica, u kojem su postojale tri kvalitativno različite grupe (republički, pokrajinski i klupski nivo) urađena je i kananonička analiza. U oba subuzorka dobijena je dvokomponentna struktura. Kod dečaka prvu komponentu su formirale opšte motoričke sposobnosti, a drugu telesne dimenzionalnosti. Kod devojčica su obe komponente bile slično saturirane, ali su imale obrnutu hijerarhiju (prvi faktor su formirale antropometrijske, a drugu motoričke varijable). Kao tipičan model rukometaša početnika prepoznati su dečak i devojčica koji se od svojih vršnjaka izdvajaju većom opštom telesnom snagom i krupnijom telesnom konstitucijom. U subuzorku devojčica dobijena su dva kanonička faktora, ali ni jedan nije imao signifikantnu diskriminativnost. Testovi Eurofit baterije nisu se pokazali dovoljno diskriminativnim u selekciji mladih rukometaša.

Ključne reči: *rukomet, sportska selekcija, motoričke sposobnosti, telesne karakteristike*