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Diagnostic Validity of the Tests
for Assessing and Monitoring Football-Playing Abilities in Boys

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Abstract
The system of 22 variables in total (12 morphological and 10 specific morphological ones) was applied to the sample that included 105 boys, aged 10, with the aim of determining diagnostic (factor) validity of the battery of tests for assessing and monitoring football-playing abilities in boys. Applying the factor analysis (direct oblimin, Kaiser I[3]1.00), in morphological and specific motor space two latent variables for each of them were isolated. The first morphological latent variable is defined using the variables for the assessment of body voluminosity and subcutaneous adipose tissue, while the other is defined by variables for the assessment of skeleton longitudinality and transversality. The first latent variable in specific motor space can be interpreted as a variable for assessing precision in hitting the target and a ball handling, while the other can be interpreted as a variable for the assessment of the speed of guiding the ball, the ball kick strength and the speed of curvilinear motion/running. Diagnostic validity of the battery of the tests for assessing and monitoring morphological characteristics and specific motor football-playing abilities in boys was determined applying the factor procedure by means of parallel projection matrix (matrix A), which is consisted of 5 morphological variables (body mass, body height, shinbone circumference, thigh skinfold, calf skinfold) and 5 specific motor variables (propelling the ball towards a goal through dribbling (running with the ball close to one's feet) - with a foot, guiding the ball around the semicircle, guiding the ball in random directions, heading a ball over a long distance, striking a rolling ball (without settling it first) against the wall – with a foot).

Key words: **football, boys, morphological characteristics, specific motor abilities, diagnostic validity**.

Sažetak
Na uzorku 105 dečaka, uzrasta od 10 godina, bio je primenjen sistem od ukupno 22 varijable (12 morfoloških i 10 specifično motoričkih), sa ciljem da se utvrdi dijagnostička (faktorska) valjanost baterije testova za procenu i praćenje dečaka za fudbal. Primenom faktorske analize (direktan oblimin, Kaiser I[3]1.00), u morfološkom i specifično motoričkom prostoru izolovane su po dve latentne varijable. Prvu morfološku latentnu varijablu definišu varijable za procenu voluminoznosti tela i potkožnog masnog tkiva, a drugu za procenu longitudinalnosti i transverzalnosti skeleta. Prva latentna varijabla u specifično motoričkom prostoru se može interpretirati kao varijabla procene preciznosti u pogađanju cilja i baratanja loptom, a druga kao varijabla za procenu brzine vođenja lopte, snage udarca po lopti i brzine krivolinijskog trčanja. Dijagnostička valjanost baterije testova za procenu i praćenje morfoloških karakteristika, i specifično motoričkih sposobnosti dečaka za fudbal utvrđena je faktorskim postupkom pomoću matrice paralelnih projekcija (A - matrice), a nju sačinjavaju 5 morfoloških (telesna masa, telesna visina, obim potkolenice, kožni nabor natlolenice i kožni nabor potkolenice) i 5 specifično motoričkih varijabli (gađanje cilja iz vođenja – nogom, vođenje lopte po polukrugu, vođenje lopte promenom pravca kretanja, udarac po lopti glavom u dalj i udarci kotrljajućih lopti u zid – nogom .

Ključne reči: **fudbal, dečaci, morfološke karakteristike, specifične motoričke sposobnosti, dijagnostička valjanost**

Introduction

The increasing pace of advancement in football requires modern approaches, concepts, forms, contents and procedures in work with young football players. In order to achieve the desired effects in the process of training and competition of the young, it is necessary to start with timely and well-founded guidance and selection according to a desirable condition that had been modeled in advance (a complexity model, specification equation) in football, and secondly, according to meaningful diagnosing, planning, programming and effects controlling of the implemented training process (Radosav, 1984; Molnar, 2003; Švraka, 2003; Joksimović, 2005).

So far numerous practical experiences and scientific researches (Kurelić, Momirović, Stojanović, Radojević, & Viskić-Štalec, 1975; Gredelj, Metikoš, Hošek, & Momirović, 1975; Malacko, & Popović, 2001) have shown that a well-programmed training process can efficiently and successfully transform the status of both children and young people.

Only with a well-founded and meaningful training process can personality structure be developed and guided towards a desired goal, under condition of retrieving reliable feedback information on the condition and changes in primary anthropological characteristics resulting from adequately applied training devices, methods and loads.

For these reasons, it is of utmost importance that we are familiar with the morphological status and development of basic motor abilities that sports results chiefly depend on and which, furthermore, need constant development, control and correction in order to achieve the best effects in the shortest time (Doder, 2002; Malacko, & Rađo, 2004; Malacko, & Doder, 2008).

According to a modern classification of sports activities, the way the football is played today belongs to the group of polistructural activities of complex nature. From a biomechanical standpoint, the game of football is defined by complex motor structure comprised of different cyclic and acyclic movements. Quick and sudden situational changes are quite common in the game, which requires quick and sudden reactions from the players in order to achieve a desired effect. In these complex circumstances the players are required to exhibit maximum concentration, oversight and time/spatial orientation, situational reasoning and other an-

thropological features and motor abilities. Physiological load imposed on football players during a practice and competition is particularly big, due to high intensity that must be kept constant for a longer period of time, i.e. as long as the game lasts. Football requires high aerobic and anaerobic abilities, which increases the complexity of modern training technology. A modern way of playing obliges the player to perfectly master the technique elements. The overall aim of the game is to ensure victory over the opponent by scoring most goals. Apart from this basic aim, during the game a number of smaller attack/defense problems are solved, which all have the function of achieving the basic aim. Football as a collective game offers certain possibilities for the development of positive moral/voluntary traits and emotions, but they need to be systematically formed through a pedagogical process, especially in the case of young players.

The aim of this research is to determine diagnostic (factor) validity of the battery of the tests used for assessing and monitoring morphological characteristics and more specifically motor abilities football-playing abilities in boys in order to be able to create most rational procedures for optimal modeling, diagnosing, planning, programming and controlling a training process during the continual selection and training process.

Methods

Participants

The total of 105 boys, aged 10, was recruited from the school of football in Novi Sad (Serbia) and subject to the 22-variables system, 12 morphologic and 10 specific motor variables.

Instruments

For the assessment of morphologic characteristic the following measures were applied: *longitudinal skeleton dimensionality* – 1. body height (BODHEI), 2. – leg length (LEGLEN), - 3. foot length (FOOLEN), *transversal skeleton dimensionality* – 4. pelvic width (PELWID), 5. knee diameter (KNEDIA), 6. ankle diameter (ANKDIA) – 7. body mass (BODMAS), 8. femur circumference (FEMCIR) 9. shinbone circumference (SHICIR) and *hypodermic adipose tissue* – 10. abdominal skinfold (ABDSKI), 11. thigh skinfold (THISKI) and 12. calf skinfold (CALSKI).
For the assessment of specific motor abilities the following tests were applied: *for assessing the accuracy of hitting the target* - 1. propelling the ball towards a target in a vertical position– with a foot (PVTFOO) – 2. propelling the ball towards a goal through dribbling (running with the ball close to one's feet) - with a foot (PGDFOO), f*or ball-handling assessment* – 3. striking a rolling ball (without settling it first) against the wall – with your foot (KIRBAW) 4. kicking the ball after it bounces off the ground and striking it against the wall – with your foot (STWBOG), *for assessing the speed of guiding the ball* 5. guiding the ball around the semicircle (GUBASE), 6. guiding the ball in random directions (GUBRDI), for assessing a ball kick force 7. kicking the ball over a long distance (KIBLDI), 8. heading a ball over a long distance (HEBLDI), for assessing curvilinear motion – 9. running around the semicircle (RUNSEC), and 10. running in random directions (RUNRDI).

Procedure

For every applied variable the following central and dispersion parameters were calculated: arithmetic mean (M), standard deviation (S), standard error of arithmetic mean (Se), minimum value (min) and maximum value (max). The normality of variables distribution was tested using the skewness (Sk) and the kurtosis (Ku).
The analysis of the relation between the applied manifest variables for all two types of space (morphological and specific motor skills space) was conducted using intercorrelation matrix of manifest variables.

Determining the structure of morphological characteristics and specific motor abilities was performed by means of factor analysis (direct oblimin), whereas the criterion 1.00 (Kaiser $\lambda \geq 1.00$) was applied for the extraction of characteristic roots. Communalities were calculated (h^2) for all the applied variables in order to obtain their basic information values.

The latent variable structure was calculated using a composition matrix (matrix A) which contains parallel projections (coordinates) of the variables onto the factors, structure matrix (matrix F) which contains orthogonal projections of the variables onto the factors, i.e. correlation of variables and factors, as well as factor intercorrelation matrix (matrix M). The data were processed by means of a statistical software package SPSS 10.0 for Windows.

Results

The tables 1, 2 and show the results of the central and dispersive statistical parameters of morphological and specific motor variables, as well as their discrimination. In case of the skewness (Sk) analysis, variables with normal (symmetric) distribution were given in bold, which means the result ranges from 0-1.00.
Analyzing the Table 1, we see that in almost all of the applied morphological variables: (BODHEI), (LEGLEN), (FOOLEN), (PELWID), (KNEDIA), (ANKDIA), (BODMAS), (FEMCIR), (SHICIR), (THISKI), (CALSKI) distributions are normal because they do not exceed the value of 1.00, while the negative distribution is found only in the case of (ABDSKI) variable, its asymmetry being expressed in the positive direction, which means that a number of the examinees demonstrated considerably lower values.

Table 1. *Central and dispersion parameters of morphologic variables*

Variables	M	S	Se	min	max	Sk	Ku
BODHEI	137.22	6.26	.61	116.90	150.40	**-.09**	.31
LEGLEN	78.12	4.63	.45	66.80	88.30	**-.06**	-.52
FOOLEN	20.57	1.20	.11	16.00	23.50	**-.17**	1.59
PELWID	21.81	1.71	.16	16.90	25.90	**.10**	.40
KNEDIA	6.16	.45	.04	4.80	8.20	**.49**	2.90
ANKDIA	8.42	.55	.05	6.60	9.90	**-.01**	.98
BODMAS	31.76	4.98	.48	18.50	46.00	**.54**	.47
FEMCIR	38.71	4.33	.42	25.70	53.50	**.40**	1.39
SHICIR	28.14	2.22	.21	21.00	35.00	**.21**	.87
ABDSKI	6.37	3.82	.37	3.00	25.00	2.63	8.37
THISKI	11.93	4.04	.39	4.00	23.00	**.61**	.40
CALSKI	11.47	3.65	.35	5.60	23.00	**.60**	.08

Legend: *M - arithmetic mean, S - standard deviation, Se - standard mistake of arithmetic mean, min, max - minimal and maximal result, Sk - skewness, Ku – kurtosis.*

Analyzing the Table 2, only the (PGDFOO) variable has abnormal distribution, while in case of all other variables distributions are within normal range

***Table 2**. Central and dispersion parameters of specific motor variables*

***Legend:** M - arithmetic mean, S - standard deviation, Se - standard mistake of arithmetic mean, min, max - minimal and maximal result, Sk - skewness, Ku – kurtosis.*

Variables	M	S	Se	min	max	Sk	Ku
PVTFOO	2.99	1.67	.16	0.00	7.00	**.27**	-.31
PGDFOO	6.15	2.26	.22	3.00	15.00	1.12	2.23
KIRBAW	12.50	2.84	.27	6.00	24.00	**.73**	2.05
STWBOG	24.01	3.46	.33	14.00	33.00	**-.17**	.13
GUBASE	20.42	2.16	.21	16.50	25.79	**.54**	-.29
GUBRDI	13.48	1.98	.19	9.65	20.00	**.47**	.47
KIBLDI	4.91	1.12	.11	2.30	7.80	**-.07**	-.16
HEBLDI	16.65	4.46	.43	6.50	29.50	**.43**	.19
RUNSEC	9.52	.88	.08	7.97	12.53	**.96**	1.71
RUNRDI	13.98	1.01	.09	9.87	16.82	**-.33**	2.19

Based on the matrix, the variables intercorrelations in the area of morphological characteristics (Table 3) of young football players have rather homogenous structure which mainly includes statistically significant correlation coefficients. A high positive correlation is noted within the segment of longitudinal skeleton dimensionality which ranges between .69 and .87. Variables for assessing the longitudinal skeleton dimensionality are more related to the variables of transversal skeleton dimensionality and body voluminosity.

Analyzing the intercorrelation matrix of specific motor variables (Table4) the relationship was found to be the strongest between the variables: *for assessing the speed of guiding the ball,* guiding the ball around the semicircle (GUBASE), and guiding the ball in random directions (GUBRDI), on the one hand and, on the other, the variables for assessing *curvilinear motion* - running around the semicircle (RUNSEC), and running in random directions (RUNRDI). The variable 'propelling the ball towards a goal through dribbling - with a foot' (PGDFOO) has its strongest relationship with the variable 'kicking the ball over a long distance (KIBLDI)'

***Table 3**. Correlation of morphological variables*

Variables	1	2	3	4	5	6	7	8	9	10	11
BODHEI											
LEGLEN	**.87**										
FOOLEN	**.82**	**.69**									
PELWID	**.63**	**.47**	**.60**								
KNEDIA	**.56**	**.55**	**.54**	**.29**							
ANKDIA	**.72**	**.66**	**.65**	**.65**	**.66**						
BODMAS	**.76**	**.63**	**.66**	**.86**	**.51**	**.81**					
FEMCIR	**.62**	**.53**	**.52**	**.70**	**.60**	**.74**	**.85**				
SHICIR	**.63**	**.53**	**.60**	**.79**	**.46**	**.80**	**.92**	**.82**			
ABDSKI	**.35**	.17	.18	.69	**.16**	**.41**	**.69**	**.63**	**.62**		
THISKI	**.50**	**.36**	**.38**	**.67**	**.26**	**.54**	**.73**	**.69**	**.68**	**.70**	
CALSKI	**.46**	**.32**	**.33**	**.67**	**.22**	**.56**	**.73**	**.66**	**.69**	**.67**	**.88**

$p_{.05} = .138$ $p_{.01} = .181$

***Table 4.** Correlation of specific motor variables*

Variables	1	2	3	4	5	6	7	8	9
PVTFOO									
PGDFOO	**.32**								
KIRBAW	**.21**	**.21**							
STWBOG	**.36**	**.33**	**.37**						
GUBASE	**-.35**	**-.24**	**-.32**	**-.44**					
GUBRDI	**-.40**	**-.34**	**-.42**	**-.46**	**.67**				
KIBLDI	**.24**	**.05**	**.23**	**.28**	**-.46**	**-.45**			
HEBLDI	**.18**	**.29**	**.30**	**.38**	**-.47**	**-.46**	**.49**		
RUNSEC	**-.35**	**-.11**	**-.31**	**-.23**	**.52**	**.54**	**-.32**	**-.15**	
RUNRDI	-.18	**-.20**	-.25	-.32	**.52**	.43	**-.34**	**-.40**	.36

$p_{.05} = .138$ $p_{.01} = .181$

Factorizing the intercorrelation matrix (Table5) of the variables and applying the Kaiser Criterion (1.00) in morphological space two characteristic roots were obtained that account for 78.8% of common variance (CUM %), whereas an individual contribution to the explanation in case of the first latent variable totals 63.9%, and in case of the other 15.0%.

Table 5. *The structure of morphological latent variables*

	λ	%	Cum %
1.	7.67	63.9	63.9
2.	1.79	15.0	78.8

As far as specific motor space is concerned, (Table 6) just as it was the case with morphological space, two characteristic roots were obtained here as well, accounting for 52.8 % of the common variance (CUM %), whereas an individual contribution to the explanation in case of the first latent variable totals 41.6 %, and in case of the other 11.2 %.

Table 6. *The structure of specific motor latent variables*

	λ	%	Cum %
1.	4.16	41.6	41.6
2.	1.12	11.2	52.8

The interpretation of the structure of morphological and specific motor latent variables was carried out by means of composition matrix (matrix A), which contains parallel projections , that is vector coordinates length in a coordinate system.
The first latent variable (Lv-1) in morphological space (Table7) can be interpreted as body voluminosity and subcutaneous adipose tissue, whereas the other one (Lv-2) could be interpreted as skeleton longitudinality and transversality. Communality values of individual morphological variables (h2) have high values and range between .60 and .94, which means that the explained parts of the variable vectors are satisfactory, in other words manifest variables were measured with no significant errors. Based on the intercorrelation matrix it is evident that there is a statistically significant correlation between isolated morphological latent variables at the level of .47 ($R_{Lv\text{-}1\ Lv\text{-}2}$).

Table 7. *The structure of morphological variables*

Variables	Lv-1	Lv-2	h^2
BODHEI	.53	**.90**	.84
LEGLEN	.37	**.88**	.78
FOOLEN	.41	**.87**	.76
PELWID	**.85**	.59	.77
KNEDIA	.29	**.77**	.60
ANKDIA	.66	**.84**	.79
BODMAS	**.88**	.76	.94
FEMCIR	**.81**	.68	.78
SHICIR	**.85**	.69	.83
ABDSKI	**.86**	.22	.78
THISKI	**89**	.41	.80
CALSKI	**89**	.37	.80

RF1F2= .47

Legend: Lv-1 = first latent variable, **Lv-2** = second latent variable, **h^2** = communalitaties of variables

The first latent variable (Lv-1) in specific motor space (Table 8) can be interpreted as a variable for assessing the accuracy of hitting the target and ball handling, whereas the other one (Lv-2) could be interpreted as a variable for assessing the speed of guiding the ball, the ball kick force and curvilinear motion (curvilinear running mode). Communality values of individual morphological variables (h^2) have low values and range between .32 and .70. Based on the intercorrelation matrix it is evident that there is a statistically significant correlation between isolated morphological latent variables at the level of .40 ($R_{Lv\text{-}1\ Lv\text{-}2}$).

Table 8. *The structure of specific motor variables*

Variables	Lv-1	Lv-2	h^2
PVTFOO	.37	**.65**	.44
PGDFOO	.17	**.82**	.70
KIRBAW	.47	.47	.32
STWBOG	.50	**.68**	.52
GUBASE	**-.87**	-.42	.69
GUBRDI	**-.79**	-.56	.69
KIBLDI	**.73**	.11	.57
HEBLDI	**.64**	.39	.43
RUNSEC	**-.66**	-.26	.43
RUNRDI	**-.68**	-.26	.47

RF1F2= .40

Legend: Lv-1 = first latent variable, **Lv-2** = second latent variable, **h^2** = communalitaties of variables

Discussion

Football, as an organized competitive sport, requires organized highly training technology that includes optimal methods, means and loads within the scope of macro-, mezo- and micro-cycles. Considering everything that has been said so far, it is perfectly clear that football as the top sport requires exquisite abilities in players, high training technology adjusted to each player in particular. Thus, particular emphasis is placed on an individual approach throughout practice, irrespective of the fact that this is a collective sport. All this, naturally, requires that a special attention is paid to a timely selection of "gifted" boys, systematic and professional work with the categories of young players and a special education and professional training system for the football staff.
The conducted research showed that in case of morphological variables only the measures of subcutaneous adipose tissue deviate considerably from the normal distribution, with the positive measures of distribution asymmetry indicating that young football players have a small amount of abdominal adipose tissue, which is of great importance for that age and that sport.
The conducted research showed that in case of specific motor variables only the variable – 'propelling the ball towards a goal through dribbling - with a foot' deviates considerably from the normal distribution.
Based on the matrix, the variables intercorrelations in the area of morphological characteristics of young football players have rather homogenous structure which mainly includes statistically significant correlation coefficients. A high positive correlation is

noted within the segment of longitudinal skeleton dimensionality which ranges between .69 and .87. Variables for assessing the longitudinal skeleton dimensionality are more related to the variables of transversal skeleton dimensionality and body voluminosity. These results are consistent with the researches conducted by Doder (1998) and Doder (2000).

Finally, it is worth pointing out that the examined young football players at that age, are on the one hand, characterized based on their body constitution where the age and development factors predominate (Doder D, Savić, & Doder R., 2007). Individual values of subcutaneous adipose tissue are not elevated and, on the other hand, there is a statistically significant correlation between morphological and basic motor latent variables.

Analyzing the intercorrelation matrix of specific motor variables the relationship was found to be the strongest between the variables: for assessing the speed of guiding the ball, guiding the ball around the semicircle (GUBASE), and guiding the ball in random directions (GUBRDI), on the one hand and, on the other, the variables for assessing curvilinear motion - running around the semicircle (RUNSEC), and running in random directions (RUNRDI). The variable 'propelling the ball towards a goal through dribbling - with a foot' (PGDFOO) has its strongest relationship with the variable 'kicking the ball over a long distance (KIBLDI)'.

Diagnostic validity of the battery of tests designed for assessing and monitoring morphological characteristics, basic and specific motor, football-playing abilities in boys was determined through the factor procedure using the parallel projection matrix (matrix A), which is comprised of 5 morphological variables: body mass, body height, shinbone circumference, thigh skinfold and calf skinfold; and 5 specific motor variables: propelling the ball towards a goal through dribbling (running with the ball close to one's feet) - with a foot (PGDFOO), guiding the ball around the semicircle, guiding the ball in random directions heading a ball over a long distance, striking a rolling ball (without settling it first) against the wall – with one's foot.

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