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The peculiarities of motor fitness' classification
model of 6-10 years old girls

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Abstract

Purpose:	The purpose of the research is determination of motor fitness' classification model of 6-10 years old girls.
Material:	in the research 6 years old girls (n=36), 7 years old girls (n=48), 8 years old girls (n=57), 9 years old girls (n=38), 10 years old girls (n=46) participated. Testing program includes commonly known tests.
Results:	With age there happened some changes of coordination and power fitness, endurance, quickness, flexibility indicators. Suggested set of tests could be used for final control of girls' motor fitness.
Conclusions:	In the process of analysis was calculated canonic coefficients of discriminant function (not standardized). These coefficients are multipliers of the set values of variables, which are components of discriminants functions. On the basis of them it is possible to classify girls by the level of motor fitness according to their age.
Keywords:	motor abilities, discriminant analysis, classification model, girls.

Introduction

The problem of motor activity and health strengthening is rather relevant in Ukraine and in Europe. The scientists concentrate attention on innovative approaches to physical education, and also on realization of differentiated approach to physical education of children's and teenagers' [1, 2, 4]. Health improvement and rising of children's and teenagers' workability depends on optimal motor activity, which is ensured by physical education at school. The planning of educational process and integrative physical training of pupils provides the necessary amount of motor activity [11, 3].

The main task of school age children's physical education is teaching of motor actions [4, 17, 30]. The training process is regarded from the following positions: organization and educational management [11, 19, 35]; motivation for motor functioning (the higest level of exercise mastering provoques the large amount of motor activity [32, 21]). In educational process is investigated connection of training efficiency and motor functioning: successful education induces to increase motor activity's amount [14, 15]; cognitive and motor training emphasizes at nesessity to join the mental and motor components of motor fitness [18, 16]. Special attention is paid on influence of motor fitness on study's effectiveness [33, 34, 29] and influence of physical loads on study's effectiveness [22, 28].

One of conditions of schoolchildren's physical education effectiveness is organization of pedagogic control at physical culture lessons [26, 27, 36]. Effectiveness of pedagogic control depends on the presence of object to be controlled and informative value of indicators, which characterize the changes of his/her state [7, 8, 9]. It was found that modeling is an effective method of receiving new information for realization of current and final control on the base of children's and teenagers' testing [6, 13, 23]. Factorial and discriminant analysis is one of methods of statistic modeling. Effectiveness of their application is illustrated by scientific data [5, 31, 24]. The mentioned works witness about demand in searching methodological approaches to solution motor fitness problem and its pedagogical control in schoolchildren.

It should examine the opportunity to use discriminant analysis for study peculiarities of motor fitness of 6–10 years old girls.

The purpose of the research is to determine motor fitness' classification model of 6-10 years old girls.

Material and methods

Participants: in the research 6 years old girls (n=36), 7 years old girls (n=48), 8 years old girls (n=57), 9 years old girls (n=38), 10 years old girls (n=46) participated.

Organization of the research: The following methods of the research were used: analysis of scientific literature, pedagogic testing and methods of mathematical statistic. Discriminant analysis was used as the method of modeling.

In testing program we included commonly known tests [23]. For assessment the girls' motor fitness we registered the results of the following motor tests: static stance on one foot (sec.); walking along segments of hexagon (steps); combined movements of arms, torso and legs (errors); walking along straight line after 5 rotations, deviations (cm); shuttle run 4×9 m (sec.); 30 m run (sec.); frequency of arms' movements (times); catching of falling Dietrich's stick (cm); long jump from the spot (cm); 300 meters' run (sec.); arms' bending and unbending in mixed hanging on rope (times); torso rising in sitting position during 1 minute (times); torso bending from sitting position (cm); index assessment of backbone mobility; index assessment of shoulder joints' mobility.

Statistical analysis: processing of the research material was carried out with the help of IBM SPSS 20 program. Discriminant analysis helped to create prognostic model of belonging to group. This model builds discriminant function (or set of discriminant functions, if they are more than two) in the form of predictors-variables linear combination. It ensures the best groups' distribution.

These functions are built basing on set of observations, belonging to groups of which is known. Further, these functions can be applied to new observations with known predictors-variables and unknown group belonging.

For every canonic discriminant function we calculated own value, dispersion percentage, canonic correlation, Wilks' Lambda, χ- Chi-square.

Results

The analysis permitted to determine, that statistically confident differences between mean group indicators were observed in the following below tests:

coordination abilities: in tests №№ 1-5 with age there are statistically confident differences in results of testing. Results improves in test № 1 «Static stance on one foot (sec.)» (p < 0,001), test № 2 «Walking along segments of hexagon (steps)» (p < 0,001), test № 4 «Walking along straight line after 5 rotations, deviations (cm)» (p < 0,001), test № 5 «Shuttle run 4×9 m (sec.)» (p < 0,001), test № 3 «Combined movements of arms, torso and legs (errors)» (p < 0,1). The least dynamics of results is observed in test № 3. The exercises of combined movements of arms, torso and legs are difficult for 6–10 year old girls;

quickness: in tests for different demonstration of quickness with age is observed statistically confident dynamics. Results improves in test № 6 «30 m run» (p < 0,001), test № 7 «Frequency of arms' movements» (p < 0,001), test № 8 №21 «Catching of falling Dietrich's stick (cm)» (p < 0,001). The most dynamics of results is observed in test № 6 «30 m run»;

power abilities: in tests № 9 «Long jump from the spot (cm)» (p<0,001), № 11 «Arms' bending and unbending in mixed hanging on rope (times)» (p < 0,001), is observed statistically confident dynamics of results;

endurance: in tests № 10 «300 meters' run» (p < 0,001), № 12 «Torso rising in sitting position during 1 minute (times)» (p < 0,001) is observed statistically confident dynamics of results;

flexibility: in tests №№ 14-15 with age is observed statistically positive confident dynamics of testing results, in test № 13 «Torso bending from sitting position (cm)» dynamics of results isn't statistically confident.

Thus, with age there are differences in indicators of coordination and power fitness, endurance, quickness, flexibility. Suggested set of tests could be used for final control of motor fitness of 6-10 years old girls.

The results of discriminant analysis indicate, that first canonic function explains variation of results by 85,3%, the second – by 8,1%. It witnesses about their high informational potential. Correlation coefficient between calculated values of discriminant function and indicators of belonging to group equal to r=0,831. It witnesses about high prognostic potential of first canonic function. The first canonic function's own value witnesses about successfully selected coefficients in it.

The analysis of canonic functions points that first and second functions have high discriminant potential and meaning in interpretation in respect to general communality (λ=0,216 and statistical significance p=0,001 for all set of canonic functions).

Normalized coefficients of canonic discriminant function give opportunity to define correlation of variables' contribution in function result.

1.   The highest contribution in the first canonic function is provided by the following variables:

Shuttle run 4×9 m – ,552;

Catching of falling Dietrich's stick – ,343;

Walking along segments of hexagon (steps) – -,344;

300 meters' run – ,329;

2. The highest contribution in the second canonic function is provided by the following variables:

Combined movements of arms, torso and legs – -,577;

Long jump from the spot – ,553;

Static stance on one foot – ,522;

Frequency of arms' movements – -,424;

3. The highest contribution in the third canonic function is provided by the following variables:

Shuttle run 4×9 m – ,717;

Index assessment of backbone mobility – ,604;

Frequency of arms' movements – ,488;

4. The highest contribution in the fourth canonic function is provided by the following variables:

Index assessment of shoulder joints' mobility – ,627;

Long jump from the spot – -,615;

Torso rising in sitting position during 1 minute – ,507.

On the basis of results of variables from the first list could classify 6–10 years old girls, from the second list – 7–10 years old girls; from the third list – 8–10 years old girls; from the fourth list – 9–10 years old girls.

It is determined, that maximum discriminant potential have first and second functions. That's why variables from the first and second lists play the main role in classification.

Structural coefficients of canonic discriminant function are correlation coefficients of variables with function. They determine the influence power of independent variables on dependent.

1. The maximum influence power of independent variables on dependent in the fist function have:

Shuttle run 4×9 m (sec.) – ,715;

300 meters' run – ,531;

30 m run – ,477;

Long jump from the spot – -,462;

Catching of falling Dietrich's stick – ,385;

Walking along segments of hexagon (steps) –-,228;

2. The maximum influence power of independent variables on dependent in second function have:

Static stance on one foot – ,363;

Combined movements of arms, torso and legs – -,351;

3. The maximum influence power of independent variables on dependent in third function have:

Frequency of arms' movements – ,384;

Index assessment of backbone mobility – ,377;

Arms' bending and unbending in mixed hanging on rope (times) – -,202;

Torso bending from sitting position – ,135;

4. The maximum influence power of independent variables on dependent in fourth function have:

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Index assessment of shoulder joints' mobility – ,596;

Walking along straight line after 5 rotations, deviations – -,342;

Torso rising in sitting position during 1 minute – ,331.

The analysis of correlation coefficients determines, that for 6–10 years old girls is significant the complex development of motor abilities; for 7–10 years old girls the attention is paid on development of coordination abilities; for 8–10 years old girls – on quickness, power and flexibility; for 9–10 years old girls – on flexibility, motor coordination and power endurance.

In table №1 the canonic (unnormalized) coefficients of discriminant function are given, which are multipliers of the set values discriminant functions. On the basis of comparison of obtained data with function's centrodes (table №2) it is possible to classify each particular case. The results of classification are given in table №3. 59,8%

of output group observations were classified correctly. It made possible to claim that classification of 6–10 years old girls is possible according to suggested set of tests.

Discussion

The obtained results supplement the data about methodological approaches to the pedagogical control of motor abilities development [37, 35]. The results extend opportunities of modeling in the process of new information's receiving about dynamics of motor abilities development of children [37, 29]. The effective use of factorial and discriminant analysis in determination of motor fitness structure of children and teenagers is proved [10, 20, 25]. The received data is important for estimation of primary school age readiness to study motor fitness. They complete data about influence of motor fitness' development level on study's effectiveness [12, 35]. They

Table 1. Unnormalized coefficients of canonic discriminant function. 6–10 years old girls

Test title	Age				
	6	7	8	9	10
Static stance on one foot (sec.)	-,003	,081	-,007	,022	-,003
Walking along segments of hexagon (steps)	-,154	-,019	,008	,002	-,154
Combined movements of arms, torso and legs (errors)	,057	-,189	-,029	,059	,057
Walking along straight line after 5 rotations, deviations (cm)	,000	,001	-,004	-,005	,000
Shuttle run 4×9 m (sec.)	,500	,364	,649	-,071	,500
30 m run (sec.)	,366	,202	-,342	,007	,366
Frequency of arms' movements (times)	-,017	-,040	,046	-,002	-,017
Catching of falling Dietrich's stick (cm)	,047	-,016	,017	,015	,047
Long jump from the spot (cm)	,002	,030	,013	-,033	,002
300 meters' run (sec.)	,019	-,015	-,023	-,006	,019
Arms' bending and unbending in mixed hanging on rope (times)	-,005	-,013	-,047	,018	-,005
Torso rising in sitting position during 1 minute (times)	-,013	,019	,005	,055	-,013
Torso bending from sitting position (cm)	,010	-,019	,058	,040	,010
Index assessment of backbone mobility	,015	-,036	,080	-,004	,015
Index assessment of shoulder joints' mobility	,392	,705	-,190	1,760	,392
(Constant)	-13,463	-6,996	-9,522	-,255	-13,463

Table 2. Functions in groups' centrodes. 6–10 years old girls

Girls' age	Function			
	1	2	3	4
6 years	2,843	,501	,173	,054
7 years	,632	-,575	-,481	,083
8 years	-,239	-,132	,139	-,277
9 years	-1,085	-,293	,610	,191
10 years	-1,697	,611	-,306	,050

Table 3. Results of groups' classification. 6–10 years old girls

Index	Girls' age	Predicted belonging to group					Total
		6 years	7 years	8 years	9 years	10 years	
Frequency	6 years	30	6	0	0	0	36
	7 years	4	27	15	1	1	48
	8 years	4	9	28	7	8	56
	9 years	0	1	13	15	9	38
	10 years	0	0	4	8	34	46
%	6 years	83,3	16,7	,0	,0	,0	100,0
	7 years	8,3	56,3	31,3	2,1	2,1	100,0
	8 years	7,1	16,1	50,0	12,5	14,3	100,0
	9 years	,0	2,6	34,2	39,5	23,7	100,0
	10 years	,0	,0	8,7	17,4	73,9	100,0

also point at necessity of power abilities development [20, 25].

In the process of analysis was calculated canonic coefficients of discriminant function (not standardized). These coefficients are multipliers of the set values of discriminant functions. On this base it is possible to classify girls by the level of motor fitness according to their age and it is of practical significance.

Conclusions

So, discriminant analysis permitted to answer the question: how confidently it is possible to separate one form from other by set of offered variables; which of variables influence most significantly on separation of forms; to which form object belongs on the base of discriminant variables' values.

The suggested set of tests could be used for final control of motor fitness of 6-10 years old girls.

On the basis of canonic coefficients of discriminant function is possible to classify pupils by the level of motor fitness according to the girls' age, which has practical importance for effective development of physical training programs of primary school age children.

Conflict of interests

The author declares that there is no conflict of interests.

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