Original Article

Simulation as method of classification of 7-9th form boy pupils' motor fitness

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Abstract:

The purpose of the research is determination of model of classification of 7-9th form boy pupils' motor fitness. *The methods of the research:* for solution of our tasks we used the following methods as analysis of scientific literature, pedagogic testing and methods of mathematical statistic for processing of the obtained results. Discriminant analysis was used as method of simulation. For assessment of functional and motor fitness of 7-9th form boy pupils we registered results of tests of Shtange, Genchi, Serkin and motor tests. In the research 24 boy pupils of 7th form, 34 – of 8th form, and 35 boy pupils of 9th form participated. *Conclusions:* for classification of age specificities of motor and functional fitness of 7-9th form boys discriminant function can be applied. Equations of discriminant function permit to classify correctly 95.8% of grouped data. In classification of functional and motor fitness of 7th form boys the most informative were results in tests No.4 "Shuttle run 4x9 meters, sec." (0.54), № 6 "Chin ups, q-ty of times" (0.495), № 8 "Long jump from the spot, cm", № 3 "Assessment of power parameters of arms' movements, error %" (-.459), №10 "Test Genchi, sec. " (-.448). In classification of functional and motor fitness of 8th and 9th form boys the most informative were results in tests № 5 "Pressing ups in lying position, q-ty of times" and № 2 "Assessment of time parameters of movement, error, sec. "

Key words: discriminant function; classification; simulation; motor fitness; 7-9th form boy pupils.

Introduction

In modern conditions of schoolchildren's reduced motor functioning, low resistance of their organisms to diseases the problem of optimization of children's and teenagers' physical education is especially important. As per results of researches in field of medical/biological and pedagogic sciences physical exercises are the most efficient means for ensuring of not only general but also specialized development of human organism's functions and systems (Baltsevych V.K., 2000; Ilyin P.E., 2003; Krutsevych T.Yu. and Bezverkhnya G.V., 2010; Nosko M.O. et al., 2010; Vink K. et al., 2015; Gulbin J. P. et al., 2013; Yermakova T.S., 2015).

One of conditions of schoolchildren motor fitness's rising is organization of pedagogic control both at lessons of physical culture (Khudolii O.M. and Zabora A.V., 2001; Ivashchenko O.V. and Cieśllicka M. et al., 2014; Ivashchenko O.V. and Muszkieta R. et al., 2014; Cieśllicka M. and Napierała M., 2009; Pedersen S., 2014), and in conditions of sport training (Khudolii O.M. and Shlemin A.M., 1988; Khudolii O.M. and Iermakov S.S., 2011; Khudolii O.M. and Ivashchenko O.V., 2013; Cieśllicka M. et al., 2012; Cieśllicka Mirosława and Słowiński Mariusz, 2012; Dmitruk K. et al., 2008; Logan S.W. et al., 2014). The procedure of pedagogic control is classification of current state of motor and functional fitness, on which taking decisions in process of children and teenagers' physical education's monitoring depends.

So, classification of motor fitness state has practical significance for taking decisions in process of physical education's monitoring as well as for working out of effective physical training programs for children and teenagers.

In researches of Khudolii O.M., Iermakov S.S. (2011), Khudolii O.M., Ivashchenko O.V. (2013) there were developed conceptual approaches to simulation of training process and development of children's and teenagers' motor abilities. There were analyzed models of motor skills' development, which can be used for current summarizing control of children's and teenagers' fitness. By the data of Khudolii O.M., Ivashchenko O.V. (2013), Ivashchenko O.V., Muszkieta R. et al., (2014), Ivashchenko O.V., Cieśllicka M. et al., (2014) current control over children's and teenagers' motor fitness can be realized on the base of analysis of discriminant function.

However, in available scientific literature insufficient attention is paid to application of simulation methods for classification of children's and teenagers' motor and functional fitness.

Material and methods

The purpose of the research is to determine model of classification of 7-9th form boys' motor fitness.

The methods of the research: for solution of our tasks we used the following methods as analysis of scientific literature, pedagogic testing and methods of mathematical statistic for processing of the obtained results. Discriminant analysis was used as method of simulation.

For assessment of functional and motor fitness of 7-9th form boy pupils we registered results of tests of Stange, Genchi, Serkin and motor tests. In the research 24 boy pupils of 7th form, 34 – of 8th form, and 35 boy pupils of 9th form participated. The study protocol was approved by the Ethical Committee of H.S. Skovoroda Kharkiv National Pedagogical University. In addition, children and their parents or legal guardians were fully informed about all the features of the study, and a signed informed-consent document was obtained from all the parents.

Results

Results of discriminant analysis are given in tables 1-6.

First canonical function explains variation of results by 84,2 %, the second –15.8 %, that witness about their high informational character (see table 1).

Table 1

Canonical discriminants function. Eigenvalue				
Function	Eigenvalue	% of explained variance	Cumulative%	Canonical correlation
1	6.906	84.2	84.2	.935
2	1.293	15.8	100.0	.751

Table 2

Canonical discriminant function. Wilks' lambda				
Check functions	Wilks' lambda	Chi-square	Degrees of freedom	p
from 1 to 2	.055	252.067	22	.000
2	.436	72.182	10	.000

In table 2 we can see material of analysis of canonical functions. In the upper line values there are $\lambda=0.055$ and statistical significance $p=0.0001$ for all set of canonical functions; in the lower line there are data after excluding of first function. The first and second functions have high discriminant ability and value in interpretation in respect to general aggregate.

In table 3 we provide normalized coefficients of canonical discriminant function, which permit to determine correlation of variables' contribution in result of function. Variables No. 4 "Shuttle run 4x9 meters, sec. (0.54), No.6 "Chin ups, q-ty of times (0.495), No.8 "Long jump from the spot, cm." (-0.462), No.3 "Assessment of power parameters of arms' movements, error %" (-.459), No. 10 "Test Genchi, sec." (-.448) make the highest contribution in first canonical function: the higher is the value of these variables the higher is the function's value. The above mentioned proves that it is possible to classify age distinctions of 7-9th form boys on the base of functional, coordination and power fitness's testing. The first function permits to separate 7th form boys from 8th and 9th boys basing on the mentioned indicators.

Variables No.5 "Pressing ups in lying position, q-ty of times" (0.796), No.8 "Long jump from the spot, cm" (0.453) make the highest contribution in second canonical function: the higher is the value of these variables the higher is the function's value. The second function permits to separate 8th form boys from 9th form boys basing on the mentioned indicators.

The above mentioned proves that in classification of 7-9th boys' motor and functional fitness level of coordination and power abilities plays leading role.

Table 3. Normalized coefficients of canonical discriminant function

№ of test	Description of test	Functions	
		1	2
1	Jumps with "increment", q-ty of times	.277	.065
2	"Assessment of time parameters of movement, error, sec.	.296	-.296
3	Assessment of power parameters of arms' movements, error %	-.459	.254
4	Shuttle run 4x9 meters, sec.	.540	-.006
5	Pressing ups in lying position, q-ty of times	.140	.796
6	Chin ups, q-ty of times	.495	.347
7	Hanging on bent arms, sec.	-.123	-.108
8	Long jump from the spot, cm.	-.462	.453
9	Stange's test, sec.	.096	.118
10	Genchi's test, sec.	-.448	-.340
11	Serkin's test, sec.	.185	.162

In table 4 we provide structural coefficients of canonical discriminant function, which are coefficients of variables' correlation with function. The provided coefficients, like in factorial analysis, permit to interpret canonical function, to determine influence of independent variables on dependent; in our case on level of 7-9th boys' motor and functional fitness. In *first canonical function* coordination and speed-power fitness are the most important. So, in classification of seventh form boys as well as of eighth and ninth form boys' indicators of coordination and speed-power fitness take leading place. In *second canonical function*, which separates 8th form boys from 9th form boys the most important are indicators of relative strength (test No.5 "Pressing ups in lying position, q-ty of times" and control over movements by time (test No.2 "Assessment of time parameters of movement, error, sec.")).

Table 4. Structural coefficients of canonical discriminant function

Ранг	№ of test (variables)	Description of test	Functions	
			1	2
1	4	Shuttle run 4x9 meters, sec.	.446	.001
2	8	Long jump from the spot, cm.	-.439	.295
3	3	Assessment of power parameters of arms' movements, error %	-.344	.205
4	6	Chin ups, q-ty of times	.312	.289
5	1	Jumps with "increment", q-ty of times	.276	-.002
6	10	Genchi's test, sec.	-.227	-.169
7	11	Serkin's test, sec.	-.221	-.040
8	7	Hanging on bent arms, sec.	-.193	-.086
9	5	Pressing ups in lying position, q-ty of times	.207	.690
10	2	Assessment of time parameters of movement, error, sec.	.198	-.324
11	9	Stange's test, sec.	-.044	.077

In table 5 we give results of classification of groups; 95.8 % of output grouped observations were classified correctly. Thus, canonical discriminant function can be used for classification of age specificities of 7-9th form boys' motor and functional fitness.

Table 5. Results of classification of groups

	Form	Prognosticated belonging to group			Total
		7.00	8.00	9.00	
Frequency	7.00	24	0	0	24
	8.00	0	34	1	35
	9.00	0	3	33	36
	7.00	100.0	.0	.0	100.0
%	8.00	.0	97.1	2.9	100.0
	9.00	.0	8.3	91.7	100.0

Table 6. Functions in the groups' centroids

Form	Function	
	1	2
7 form	4.404	.271
8 form	-1.062	-1.391
9 form	-1.903	1.172

In table 6 we provide coordinates of centroids for three groups. They permit to interpret canonical functions in respect to their role in differentiating of forms by motor fitness of junior forms' schoolchildren. At positive pole of the *first function* there are centroids for seventh form, on negative pole – centroids for eighth and ninth forms. At positive pole of the *second function* there are centroids of seventh and ninth forms; on negative pole – centroids for 8th form. So, in motor fitness of 7-9th forms power and coordination abilities engage leading place.

Diagram, shown in fig.1, illustrates density of objects inside every form and expressive borderline between forms. It permits to say that classification of 7th form boys as well as 8th and 9th forms' boys is possible on the base of mentioned set of tests.

Canonical discriminant functions

Fig.1. Canonical discriminant functions. Diagram of results of 7-9th forms' boys' classification by level of motor and functional fitness

Discussion

In works devoted to physical education and sports discriminant function is used for classification of pupils by motivation for sport's practicing (Milić M. et al., 2011; Sigal N.S. et al., 2009), by motor functioning (Gert-Jan de Bruijn, Benjamin Gardner, 2011; Dmitriev S.V., 2010), for classification of groups into sportsmen and not sportsmen (Lulzim I., 2013), for determination of 9-12 years old children's physical condition's dynamic under influence of fitness programs (Dorita du Toit et al., 2011).

Geoffrey D. Broadhead and Gabie E. Church (1982) point at possibility of discriminant analysis's usage for classification of 4-12 years old children's motor functioning, depending on its scope; equations of discriminant function permit to classify correctly 93% of grouped data. Titarenko A.A. (2010), Mrozkowiak M. (2014) also points at possibility to classify junior forms' girls by level of motor fitness with the help of motor tests' set.

The purpose of discriminant analysis is determination of coefficients of discriminant function in order to maximally correctly classify pupils by groups by their values. Discriminant analysis permits to solve two groups of problems:

- Answer the question with what confidence it is possible to divide one form from other by the set of offered variables; which of these variables render the most substantial influence on distinguishing of forms;
- Classify objects on the base of discriminant function, i.e. to answer the question to what form object belongs on the base of discriminant variables.

In experiment we established that by the set of offered variables it is possible to statistically confidently ($p < 0.001$) separate 7th form boys from 8th and 9th form. Distinguishing of forms is the most substantially influenced by results of tests № 4 "Shuttle run 4x9 meters, sec." (0.54), № 6 "Chin ups, q-ty of times" (0.495), № 8 "Long jump from the spot, cm." (-0.462), № 3 "Assessment of power parameters of arms' movements, error %" (-.459), №10 "Genchi's test, sec." (-.448). For distinguishing of 8th and 9th forms the set of informative variables shortens and includes results of tests № 5 "Pressing ups in lying position, q-ty of times" and №.2 "Assessment of time parameters of movement, error, sec.".

So, for summarizing pedagogic control of motor and functional fitness of 7th form boys the first discriminant function with accent on the most informative variables can be used. If results, shown by 7th form boys are classified as similar to results of 8th form boys we can say that physical education is effective. For summarizing pedagogic control of motor and functional fitness of 8th form pupils the benchmark is results of 9th form boys with accent on the most informative indicators of discriminant function.

Conclusions

Discriminant function can be used for classification of age specificities of 7-9th form boys' motor and functional fitness. Equations of discriminant function permit to correctly classify 95.8% of grouped data. In classification of motor and functional fitness of 7th form boys the most informative are results in tests № 4 "Shuttle run 4x9 meters, sec." (0.54), № 6 "Chin ups, q-ty of times" (0.495), № 8 "Long jump from the spot, cm." (-0.462), № 3 "Assessment of power parameters of arms' movements, error %" (-.459), №10 "Genchi's test, sec." (-.448).

In classification of motor and functional fitness of 8th and 9th forms boys the most informative are results in tests № 5 “ Pressing ups in lying position, q-ty of times” and № 2 “ Assessment of time parameters of movement, error, sec.”.

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