

Discriminant analysis as method of pedagogic control of 9-11 forms girls' functional and motor fitness

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Abstract:

The purpose of the research is determination of classification model of senior forms' pupils' motor and functional fitness. Material and methods: for assessment of functional and motor fitness of 9-11 forms' girls results of Shtange's, Genchi's, Serkin's tests and other motor tests were registered. In the research girls of 9th form (n=24), 10th form (n=21) and 11th form (n=26) participated. Results: Normalized coefficients of canonic discriminant function permit to determine correlations of variables' contribution in result of function. The highest contribution in canonic function 1 belongs to variables 3 (pressing ups in lying position), 4 (chin ups) and 7 (Shtange's test): the higher the values of these variables are the greater is function's value. The highest contribution in canonic function 2 belongs to variables 1 (jumps with "additions"), 8 (Genchi's test) and 5 (hanging on bent arms): the higher the values of these variables are the greater is function's value. The first function explains variation of results by 96.9%, the second – by 3.1%. The above said witnesses about possibility to classify age distinctions of 9-11 forms' girls on the basis of testing of their functional, powers and coordination fitness. Structural coefficients of canonic discriminant function witness that it is most closely connected with variables 9 (Serkin's test), & (Shtange's test) and 6 (long jump from the spot): so noticeable difference between 9-11 forms' girls was registered in Serkin's test, Shtange's test and in speed power indicators. *Conclusions:* for finalizing pedagogic control of 9-11 forms' girls' motor and functional fitness first discriminant function with accent on the most informative variables can be used.

Key words: discriminant function; pedagogic control; classification; simulation; motor fitness; girls.

Introduction

Human health is formed in infant and adolescent's age. As per scientific data, recent years schoolchildren's health has significantly been worsening (Baltsevych, 2000; Ilyin, 2003; Iermakov, Apanasenko, Bondarenko, Prasol, 2010; Krutsevych, Bezverkhnya, 2010; Zajcev, Iermakov, Prusik, 2011; Stankiewicz, Cieslicka, 2012). In Target complex program "Physical education – health of nation" it is noted that in Ukraine there is extremely unsatisfactory situation with health of population, especially children and adolescents. Nearly 90% of pupils have health abnormalities, over 50% - unsatisfactory physical fitness.

One of conditions of increasing of schoolchildren's motor fitness is organization of pedagogic control at physical culture lessons (Khudolii, Zabora, 2001; Shiian, Papusha, 2005; Krutsevych et al., 2010) and at sport trainings (Khudolii, Iermakov, 2011; Lotfali, Navid, Mostafa, Ali, 2013; Khudolii, Ivashchenko, 2013, 2014). The procedure of pedagogic control implies classification of current state of motor and functional fitness, on which taking decisions in control of children's and adolescents' physical education depend.

In researches by Khudolii et al. (2011, 2013, 2014) models of motor skills' developments are regarded, which can be used for current and finalizing control of children's and adolescents' fitness. In the researches, fulfilled by topic 13.04 (Simulation of children's and adolescents' motor skills' training process; 2013-2014; (state registration number 0113U002102) specific features of 7-8 forms' girls' (Khudolii et al., 2014), 8-9 forms' girls' (Ivashchenko, Karpunec, Krinin, 2014) motor fitness were outlined. It was determined that canonic discriminant function can be used for assessment and prognostication of dynamic of secondary forms' girls' functional and motor fitness. In works by Ivashchenko and Shepelenko (2014), Ivashchenko, Pashkevich, Krinin (2014), Ivashchenko and Khudolii (2014) peculiarities of dynamic of 8-9th and 9-11th forms' boys' motor fitness were described. It was found that for determination of informative indicators for every form factorial analysis can be used. For estimation of motor fitness's dynamic – discriminant analysis can be used.

However in available scientific literature insufficient attention is paid to possibility of discriminant analysis usage as method of pedagogic control over children's and adolescents' motor and functional fitness. That is why solution of problem of assessment and detection of senior pupils' functional and motor fitness is still an important task.

The purpose of the work is to determine methodological approaches to pedagogic control over senior forms' girls' motor and functional fitness.

Material & methods

When planning of the research we used conceptual approaches to development of scientific researches' programs in physical education and sports (Ashmarin, 1978; Krutsevych, 1985; Filin, Rovnij, 1992; Cieslicka, 2012; Khudolii et al., 2014; Adashevskiy, Iermakov, Korzh, Muszkieta, Prusik, Cieslicka, 2014).

Testing program included commonly known tests (Liakh, 2000; Sergiienko, 2001): jumps with "additions" (quantity of jumps in the previously set corridor), shuttle run 4x9 m (sec.), pressing ups in lying position (times), chin ups (times), hanging on bent arms (sec.), long jump from the spot (cm).

For assessment of functional state we used tests of Shtange, Serkin, Genchi (Dubrovskij, 2005; Shiian et al., 2005). In the research girls of 9th form (n=24), 10th form (n=21) and 11th form (n=26) 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 the researches are given in tables 1-3.

Analysis shows that in results of testing of 9-11th forms' girls there are statistically confident differences in functional fitness of respiratory and blood circulation systems as well as in coordination and power fitness. By functional fitness the girls are assessed as healthy but not trained (see table 1).

Analysis also witnesses in results of testing of 9-11th forms' girls there are statistically confident differences (in tests 1-3 and 6-9) (p<0.05:0.001). By functional state of respiratory and blood circulation systems 11th form's girls are assessed as healthy but not trained (see table 1).

Statistically confident differences between 10th and 11th forms girls are observed in tests, which characterize functional, coordination and power fitness (p<0.001). 10th form's girls have better fitness by results of tests' battery (p<0.001). Besides, they have better indicators of static strength, motor coordination and functional state of respiratory and blood circulation systems (see table 1).

Table 1. Results of comparative analysis of motor and functional fitness of 9th and 10th, 9th and 11th, 10th and 11th forms' girls

№	Test	9 th form (n=24)		10 th form (n=21)		11 th form (n=26)		Confidence of differences					
		x	s	x	s	x	s	Between 9 and 10 form		Between 9 and 11 form		Between 10 and 11 form	
								t	p	t	p	t	p
1	Jumps with "additions" (times)	1.78	.97	4.45	.82	3.68	1.01	-	<0.001	-	<0.001	-	<0.001
2	Shuttle run 4x9 m, sec.	11.9	.23	9.94	.8	10.2	1.03	8.759	<0.001	6.065	<0.001	6.065	<0.001
3	Pressing ups in lying position (times)	19.5	5.08	21.9	10.0	14.8	7.38	-7.58	>0.05	2.026	<0.05	2.026	<0.05
4	Chin ups (times)	4.43	1.82	8.55	5.57	5.68	3.13	-	<0.01	-	>0.05	-	>0.05
5	Hanging on bent arms, sec.	30.5	13.5	38.0	11.5	28.1	11.4	-	>0.05	.541	>0.05	.541	>0.05
6	Long jump from the spot, cm	191.	14.2	182.	22.1	171.	15.3	1.223	>0.05	3.568	<0.001	3.568	<0.001
7	Shtange's test, sec.	61.7	10.6	55.3	10.0	46	6.05	1.514	>0.05	5.035	<0.001	5.035	<0.001
8	Genchi's test, sec.	39.3	11.3	38.4	9.7	28.3	6.57	.217	>0.05	3.295	<0.001	3.295	<0.001
9	Serkin's test, sec.	21.7	5.14	40.2	6.64	32.5	4.15	-	<0.001	-	<0.001	-	<0.001
		2		8		5		7.885	1	6.373	1	6.373	1

Notes: x – mean value; s – mean square deviation; t – Student's criterion; p – level of significance.

In tables 2-3 we present results of discriminant analysis, permitting to classify 9-11th form's' pupils by functional state and motor fitness. In table 2 we give normalized coefficients of canonic discriminant function, which permit to determine correlations of variables' contribution in function's result. The highest contribution to canonic function 1 belongs to variables 3, 4 and 7: the higher are these variables the greater is the value of the function. The highest contrition to canonic function 2 belongs to variables 1, 8 and 5: the higher are these variables the greater is the value of the function. The first function explains variation of results by 96.9%, the

second – by 3.1%. The above said witnesses about possibility to classify age distinctions of 9-11 forms' girls on the basis of testing of their functional, powers and coordination fitness.

Besides, in table 2 there are given structural coefficients of canonic discriminant function, which are correlation coefficients of variables with function. For example the function is most closely connected with variables 9, 7 and 6. So, substantial difference between 9-11 forms' girls is observed in functional and motor fitness (Serkin's test, speed-power, motor coordination, and strength by itself).

Table 2. Normalized and structural coefficients of canonic discriminant function

N of test (variables)	Description of tests	Normalized coefficients		Structural coefficients	
		Function 1	2	Function 1	2
1	Jumps with "additions" (times)	-.099	.696	-.243	.365*
2	Shuttle run 4x9 m, sec.	.599	.326	.243*	-.141
3	Pressing ups in lying position (times)	1.290	.554	.024	.459*
4	Chin ups (times)	-1.131	-.375	-.071	.374*
5	Hanging on bent arms, sec.	-.002	.656	-.015	.394*
6	Long jump from the spot, cm	.478	-.179	.091	.307*
7	Shtange's test, sec.	.932	.217	.136	.523*
8	Genchi's test, sec.	.924	.658	.075	.535*
9	Serkin's test, sec.	-1.713	.012	-.280	.686*

Notes: * maximal by absolute correlation value between variables and discriminant functions.

In table 3 we present coordinates of centroids for three groups. They permit to interpret canonic function in respect to its role in classification. On positive pole there is centroid for 9th form; on opposite – for 10th and 11th forms. It witnesses about substantial difference in fitness of 9-11 forms' girls' fitness.

Table 3. Results of groups' classification and functions in groups' centroids

	Classifier	Prognosticated belonging to group			Total	
		9 th form	10 th form	11 th form		
Initial data	9.00	14	0	0	14	
	10.00	0	6	5	11	
	11.00	0	3	13	16	
	%	9.00	100.0	.0	.0	100.0
		10.00	.0	54.5	45.5	100.0
		11.00	.0	18.8	81.3	100.0
Functions in groups' centroids		6.334	-3.414	-3.195		

In table 3 and in fig.1 there are shown results of groups' classification: 80.5% of initial grouped observations have been classified correctly. Thus, canonic discriminant function can be used for classification of age distinctions of 9-11th forms' girls. Material in fig.1 illustrates density of objects inside every form and distinct borderline between forms. It permits to affirm that classification of 9-11th forms' girls by tests' battery is possible.

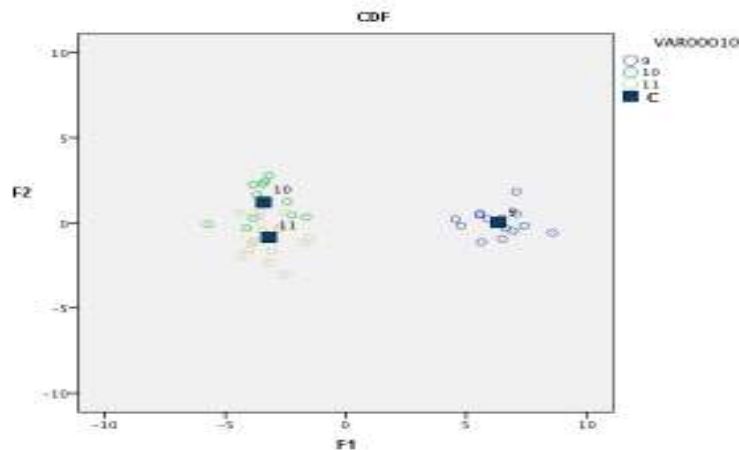


Fig.1. Graphic illustration of classification results:

CDF – canonic discriminant functions; F1 –function 1, F2 – function 2, C – centroid of group.

Discussions

The obtained results supplement the data about characteristics of children's and adolescents' motor skills' development (Khudolii, Titarenko, 2010; Khudolii, Ivashchenko, Pimenov, 2012), about possibility to receive new information with the help of simulation method (Iermakov, 2010; Iermakov, Adashevskiy, 2011; Khudolii et al., 2013, 2014; Supilo, 2014; Muntian, 2013; Ivashchenko, Khudolii, Yermakova, Pilewska, Muszkieta, Stankiewicz, 2015).

In researches in physical education and sports discriminant function is used for classification of pupils by their motivation for sport trainings (Veale, Pearce, & Carlson, 2010; Milić, Milavić, & Grgantov, 2011; Tkachenko, 2011), by motor functioning (Gert-Jan and Benjamin, 2011; Robertson, Woods, & Gustin, 2015), for classification of groups into sportsmen and not sportsmen (Lulzim, 2013; Ferrar, Olds, & Maher, 2013), for determination of dynamic of 9-12 age children's physical condition under influence of fitness programs (Dorita, Anita, Pienaar, & Leani, 2011; Phillips, Parfitt, & Rowlands, 2013), for finalizing control of children's and adolescents' functional and motor fitness (Ivashchenko et al., 2015; Ivashchenko, Yermakova, Cieslicka, Zukowska, 2015; Khudolii, Iermakov, Prusik, 2015).

Geoffrey, Broadhead, Gabie, Church (1982) point at possibility to use discriminant analysis for classification of 5-12 age children's motor functioning, depending on its scope; equations of discriminant function permit to classify correctly 93% of grouped data. Results of the research points at need in structural and functional analysis of children's and adolescents' fitness. They base on researches of Arefiev (2014), Chyzyk and Gordiychuk (2014), Khudolii et al. (2014), Tkachenko (2014). The conducted analysis confirms that separation of 9th form's girls from girls of 10th and 11th forms is possible by the mentioned above set of indicators with accent on functional tests and results of speed-power testing.

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.

Conclusions

1. Analysis shows that by results of 9th-11th forms' girls' testing there are observed statistically confident distinctions in functional fitness of respiratory and blood circulation systems as well as in coordination and in strength itself. By functional fitness the girls are assessed as healthy but not trained.

2. Analysis shows that by results of 9th-11th forms' girls' testing there are observed statistically confident distinctions by indicators of tests 1-3 and 6-9 ($p < 0.05:0.001$). By functional fitness the 11th form's girls are assessed as healthy but not trained.

3. Statistically confident differences between 10th and 11th form's girls are observed in tests, which characterize functional, coordination and power fitness ($p < 0.001$). 10th form's girls have better fitness by results of tests' battery. They also have better indicators of static strength, motor coordination and functional state of respiratory and blood circulation system.

3. Normalized coefficients of canonic discriminant function permit to determine correlation of variables' contribution in function's result. The highest contribution to canonic function 1 belongs to variables 3, 4 and 7: the higher are these variables the greater is the value of the function. The highest contribution to canonic function 2 belongs to variables 1, 8 and 5: the higher are these variables the greater is the value of the function. The first function explains variation of results by 96.9%, the second – by 3.1%. The above said witnesses about possibility to classify age distinctions of 9-11 forms' girls on the basis of testing of their functional, powers and coordination fitness.

4. Structural coefficients of canonic discriminant function witness that it is most closely connected with variables 9, 7 and 6: so, noticeable differences between girls of 9th, 10th and 11th forms is observed in tests of Serkin, Shtange and speed-power.

5. For finalizing pedagogic control over motor and functional fitness of 9-11 forms' girls, first discriminant function with accent on the most informative variables can be used.

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