

Level of physical exercises' mastering in structure of 11-13 yrs age boys' motor fitness

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Abstract

- Purpose:** to find the place of physical exercises' mastering level in structure of 11-13 yrs age boys' motor fitness.
- Material:** in the research 11 yrs age boys (n=58), 12 (n=76) and 13 years age (n=93) participated. Testing program included well-known tests: "Forward roll", "Backward roll", "Vault", "Climbing rope (three attempts)", "Bridge", "Stance on shoulder blades".
- Results:** By indicators of physical condition 11-13 yrs age boys statistically confidently differ one from another ($p < 0,001$). Level of mastering of gymnastic exercises "Backward roll", "Vault", "Climbing rope (three attempts)", "Bridge", "Stance on shoulder blades" with age statistically confidently increases ($p < 0,001$).
- Conclusions:** In factorial structure of motor fitness, level of physical exercises' mastering has weight 17,5% (11 yrs age), 36,6% (12 years), 28,5% (13 years). Analysis of communities showed that in 11-13 yrs age boys training of motor abilities is effective (if they become a component of mastered motor skills).
- Keywords:** motor abilities, level of mastering, factorial analysis, 11-13 yrs age boys.

Introduction

The problem of optimization of schoolchildren's physical education was regarded in works of Bodnar I. [1], Vas'kov Iu.V. [2], Krucevich T. et al. [9], Ivashchenko O.V. [8]. Bodnar I. stresses on need in searching new approaches to integrated physical education of different health groups' schoolchildren [1]. The authors defined urgent problems of educational process's perfection at physical culture lessons. Theoretical aspects and conditions of implementation in educational process of such innovative approaches as culturologic, competence, synergetic, axiologic, achmeologic and other are regarded. The ways of the mentioned approaches' implementation in real educational process are open. The results of innovative approaches implementation in personality oriented educational process are analyzed. It was proved that implementation of innovative approaches facilitates rising of educational process's organization. Its basis is personality oriented approach to pupils. Besides, certain difficulties in educational process's organization in comprehensive schools were found [2]. Methodic materials for planning of physical education process in comprehensive schools have been worked out [9]. Conception of physical education, which was built on the base of physical education's simulation, motor abilities' training and pedagogic control has been created. This conception includes: application of factorial and discriminant models of functional state age changes and motor fitness. The purpose of this conception is: planning of educational material, current, finalizing and stage-by-stage control of children's fitness; modes of loading in a lesson and in series of lessons; regimes of alternation of relaxation and exercises [8].

In schoolchildren's physical education there marked

out directions of researches, which are connected with studying of motor abilities [5, 6, 7] and process of motor actions' training [17, 20, 28]. Peculiarities of functional, coordination and power fitness of children and adolescents have been found [4, 11]. Dependence of training of power loads' effects on regime of exercises' fulfillment and relaxation has been determined [18, 23]. The process of motor actions' training was studied from position of interdisciplinary connections [12, 13]; formation of motor competence [14, 15]; formation of meta-cognitive behavior [16]; verbal perception in mastering of sport movements [19]; optimization of regimes of exercises' repetitions and rest intervals [20, 26, 28].

However, in available scientific literature there is a little data about wholeness of motor abilities' development and children's and adolescents' training [27, 29]. Thus, study of motor fitness influence on level of physical exercises' mastering is rather relevant. In other works training of motor fitness and dynamic of physical exercises' mastering in 11-13 yrs age girls were regarded [31, 32]. In our work we have studied motor fitness and dynamic of physical exercises' mastering in 11-13 yrs age boys.

The purpose of the research is to find the place of physical exercises' mastering level in structure of 11-13 yrs age boys' motor fitness.

Material and methods

Participants: in the research 11 yrs age boys (n=58), 12 (n=76) and 13 years age (n=93) participated.

Organization of the research: we used the following methods of research: analysis of scientific-methodic literature, pedagogic testing, methods of mathematical statistic. Testing program included well known tests. We registered: body length and mass, vital capacity of lungs (VCL), right and left hand dynamometry. We registered

results in the following tests: “Pressing ups”, times”, “legs’ rising in hanging on Sweden wall position, times”, “Angle on parallel bars, sec.”, “Torso rising in sitting position from lying on back position during 1 min.”, “Forward torso rising from sitting position (legs apart), cm”, “Hanging on bent arms, sec.”, “Torso rising from lying on abdomen position during 30 sec., times”, “Long jump from the sport, cm”, “Throw of filled ball (1 kg) in sitting position”, “Shuttle run 4x9 m, sec.” [25].

We studied mastering level of exercises: “Forward roll”, “Backward roll”, “Vault”, “Climbing rope (three attempts)”, “Bridge”, “Stance on shoulder blades”. [27].

Statistical analysis: the data were processed with the help of statistical analysis program IBM SPSS 20. The used factorial analysis included implied method of principle components. Method of rotation implied Varimax with normalization of Keiser. For every variable we calculated the following statistics: mean values, standard deviations, Student’s t-test for independent samples. The level of mastering was determined as correlation of successful attempts (m) and their general quantity (5): $p = (m/5) \times 100$.

Results

Results of the researches are presented in tables 1-7. By indicators of physical condition 11-13 yrs age boys confidently differ one from another ($p < 0,001$). Body length increased by 8,6%, by 30,9% — body mass, by 32,33% — vital capacity of lungs, by 39,7% — strength of right hand and by 38,3,8% — strength of left hand.

12 yrs boys show confidently better results than 11 yrs boys in tests: “Chin ups in lying position, times”, “Legs’ rising, hanging on Sweden wall, times”, “Angle on parallel bars, sec., times”, “Forward torso bending in sitting position (legs apart), cm”, “Hanging on bent arms, sec.”, “Torso rising from lying on abdomen position during 30 sec., times”, “Long jump from the spot, cm”, “Throw of filled ball (1 kg) from sitting position, cm”.

13 yrs boys show confidently better results in the following tests: “Pressing ups, times”, “Chin ups, times”, “Legs’ rising, hanging on Sweden wall, times”, “Angle on parallel bars, sec., times”, “Torso rising from position lying on back during 1 minute, times”, “Torso rising from lying on abdomen position during 30 sec., times”, “Long jump from the spot, cm”, “Throw of filled ball (1 kg) from

Table 1. Testing results of 11-13 yrs boys

№ №	Description of parameters	Age	N	X	m	Difference		
						of mean values	t	P
1	Height, cm	11	58	143,172	,857	-7,182*	-5,654*	<0,001
		12	76	150,355	,896	-5,225**	-4,581**	<0,001
		13	93	155,580	,726	-12,408***	-10,866***	<0,001
2	Body mass, kg	11	58	35,586	,955	-6,716	-4,616	<0,01
		12	76	42,302	1,040	-4,288	-2,889	<0,001
		13	93	46,591	1,038	-11,005	-7,257	<0,001
3	VCL, cm ³	11	58	1722,413	45,951	-285,480	-4,904	<0,01
		12	76	2007,894	36,838	-270,599	-5,055	<0,001
		13	93	2278,494	37,880	-556,080	-9,245	<0,001
4	Right hand dynamometry, kg	11	58	18,448	,360	-3,485	-4,220	<0,01
		12	76	21,934	,667	-3,850	-4,031	<0,001
		13	93	25,784	,670	-7,336	-8,189	<0,001
5	Left hand dynamometry, kg	11	58	17,586	,646	-2,295	-2,319	<0,05
		12	76	19,881	,710	-4,441	-4,536	<0,001
		13	93	24,322	,668	-6,736	-6,814	<0,001
6	Pressing ups, times	11	58	20,224	,679	-1,657	-1,416	>0,05
		12	76	21,881	,881	-2,828	-2,224	<0,05
		13	93	24,709	,895	-4,485	-3,572	<0,001
7	Chin ups, times	11	58	1,758	,184	-,438	-1,455	>0,05
		12	76	2,197	,222	-1,361	-3,572	<0,001
		13	93	3,559	,292	-1,800	-4,517	<0,001
8	Legs’ rising, hanging on Sweden wall, times	11	58	4,758	,394	-,0440	-,073	>0,05
		12	76	4,802	,431	-2,810	-4,647	<0,001
		13	93	7,612	,417	-2,854	-4,649	<0,001
9	Angle on parallel bars, sec., times	11	58	1,206	,211	,009	,035	>0,05
		12	76	1,197	,177	-,609	-2,294	<0,05
		13	93	1,806	,191	,599	2,039	<0,05
10	Torso rising from position lying on back during 1 minute, times	11	58	39,000	,736	,592	,617	>0,05
		12	76	38,407	,621	-5,151	-5,615	<0,001
		13	93	43,559	,655	-4,559	-4,497	<0,001
11	Forward torso bending in sitting position (legs apart), cm	11	58	4,051	,380	-1,448	-2,728	<0,01
		12	76	5,500	,361	2,231	5,305	<0,001
		13	93	3,268	,239	,782	1,835	>0,05
12	Hanging on bent arms, sec	11	58	5,327	,692	-1,646	-1,368	>0,05
		12	76	6,973	,907	-2,563	-1,996	<0,05
		13	93	9,537	,893	-4,210	-3,348	<0,001

Table 1 (Continued)

No No	Description of parameters	Age	N	X	m	Difference of mean values	t	P
13	Torso rising from lying on abdomen position during 30 sec., times	11	58	19,137	,399	-1,809	-2,638	<0,005
		12	76	20,947	,515	-4,783	-6,704	<0,001
		13	93	25,731	,488	-6,593	-9,494	<0,001
14	Long jump from the spot, cm	11	58	144,913	2,282	-5,217	-1,831	>0,05
		12	76	150,131	1,779	-16,513	-7,678	<0,001
		13	93	166,645	1,290	-21,731	-8,935	<0,001
15	Throw of filled ball (1 kg) from sitting position, cm	11	58	209,396	5,283	-57,313	-6,838	<0,001
		12	76	266,710	6,109	-69,633	-9,435	<0,001
		13	93	336,344	4,427	-126,947	-18,163	<0,001
16	Shuttle run, 4x9 m, sec.	11	58	11,667	,101	,140	1,016	>0,05
		12	76	11,526	,093	,119	,107	>0,05
		13	93	11,406	1,010	,260	,203	>0,05
17	Forward roll, level of mastering	11	58	80,689	2,252	-9,047	-3,126	<0,002
		12	76	89,736	1,854	-3,596	-1,537	>0,05
		13	93	93,333	1,477	-12,643	-4,900	<0,001
18	Backward roll, level of mastering	11	58	64,931	2,926	-14,016	-3,557	<0,001
		12	76	78,947	2,619	-9,654	-2,877	<0,005
		13	93	88,602	2,149	-23,671	-6,631	<0,001
19	Vault, level of mastering	11	58	72,069	2,553	-18,983	-6,362	<0,001
		12	76	91,052	1,732	-,775	-,299	>0,05
		13	93	91,828	1,865	-19,758	-6,362	<0,001
20	Climbing rope (three attempts), level of mastering	11	58	68,620	3,482	-16,379	-3,995	<0,05
		12	76	85,000	2,402	-1,236	-,335	>0,05
		13	93	86,236	2,700	-17,615	-4,015	<0,001
21	Bridge, level of mastering	11	58	82,069	3,432	-11,878	-3,388	<0,002
		12	76	93,947	1,590	3,839	1,445	>0,05
		13	93	90,107	2,019	-8,038	-2,158	<0,05
22	Stance on shoulder blades, level of mastering	11	58	85,517	2,243	-2,903	-,986	>0,05
		12	76	88,421	1,919	-4,267	-1,614	>0,05
		13	93	92,688	1,803	-7,170	-2,481	<0,05

* comparison of 11-12 years; ** comparison of 12-13 years; *** comparison of 11-13 years

Table 2. Matrix of factorial analysis of 11 yrs boys' testing. Rotation method: Varimax with Keiser's normalization

No No	Description of parameters	Component						h2
		1	2	3	4	5	6	
1	VCL, cm3		,778		,379			,803
2	Right hand dynamometry, kg		,702	,343	,318			,827
3	Left hand dynamometry, kg				,741			,633
4	Pressing ups, times		,530	-,606				,784
5	Chin ups, times		,373	-,693				,788
6	Legs' rising, hanging on Sweden wall, times	,706						,577
7	Angle on parallel bars, sec., times	,803					-,346	,897
8	Torso rising from position lying on back during 1 minute, times	,534	-,472		,326			,719
9	Forward torso bending in sitting position (legs apart), cm	,777						,706
10	Hanging on bent arms, sec	,664	-,329				,310	,747
11	Torso rising from lying on abdomen position during 30 sec., times		-,368			,635		,639
12	Long jump from the spot, cm	,569	-,382			,305	-,449	,854
13	Throw of filled ball (1 kg) from sitting position, cm	,725						,602
14	Shuttle run, 4x9 m, sec.	,627						,510
15	Forward roll, level of mastering	,657					-,378	,601

Table 2 (Continued)

№ №	Description of parameters	Component						h2
		1	2	3	4	5	6	
16	Backward roll, level of mastering			,446		,615		,750
17	Vault, level of mastering	,759						,685
18	Climbing rope (three attempts), level of mastering	,778						,750
19	Bridge, level of mastering	,834						,815
20	Stance on shoulder blades, level of mastering	,850						,860
21	Bridge, level of mastering	,532	,412	,366	-,390			,759
22	Stance on shoulder blades, level of mastering	,736						,706

Table 3. Full explained dispersion

Component	Interpretation	Sum of squares of rotation loads	
		% of dispersion	Cumulative %
1	Level of mastering and motor fitness	17,505	17,505
2	Physical condition	17,108	34,613
3	Strength of hand	13,390	48,003
4	Functional state of respiratory system	8,954	56,957
5	Motor coordination	8,896	65,853
6	Static power	6,920	72,773

Table 4. Matrix of factorial analysis of 12 yrs boys' testing. Rotation method: Varimax with Kaiser's normalization

№ №	Description of parameters	Компонента				h2
		1	2	3	4	
1	Height, cm				,821	,781
2	Body mass, kg	-,364			,703	,719
3	VCL, cm3		,533		,511	,588
4	Right hand dynamometry, kg		,776	,300		,768
5	Left hand dynamometry, kg		,729			,659
6	Pressing ups, times	,632		,431		,687
7	Chin ups, times	,761		,441		,842
8	Legs' rising, hanging on Sweden wall, times	,654		,525		,783
9	Angle on parallel bars, sec., times	,455	,309	,665		,761
10	Torso rising from position lying on back during 1 minute, times	,806	,354			,803
11	Forward torso bending in sitting position (legs apart), cm	-,513	-,609			,707
12	Hanging on bent arms, sec	,549		,629		,788
13	Torso rising from lying on abdomen position during 30 sec., times	,696		,433		,723
14	Long jump from the spot, cm			,699	,328	,613
15	Throw of filled ball (1 kg) from sitting position, cm	,341			,712	,640
16	Shuttle run, 4x9 m, sec.	-,596	,438	-,371		,708
17	Forward roll, level of mastering	,887				,812
18	Backward roll, level of mastering	,927				,902
19	Vault, level of mastering	,806	-,315			,772
20	Climbing rope (three attempts), level of mastering	,858				,778
21	Bridge, level of mastering	,572	-,547	,309		,762
22	Stance on shoulder blades, level of mastering	,860				,817

Table 5. Full explained dispersion

Component	Interpretation	Sum of squares of rotation loads	
		% of dispersion	Cumulative %
1	Level of mastering and motor fitness	36,646	36,646
2	Physical condition	14,067	50,713
3	Speed power	12,639	63,352
4	Physical condition	11,255	74,607

Table 6. Matrix of actorial analysis of 13 yrs boys' testing. Rotation method: Varimax with Kwiser's normalization

No No	Description of parameters	Components					h ²
		1	2	3	4	5	
1	Height, cm			,706			,656
2	Body mass, kg	-,380		,762	-,357		,856
3	VCL, cm3		,381	,501	-,486		,668
4	Right hand dynamometry, kg			,937			,901
5	Left hand dynamometry, kg			,950			,921
6	Pressing ups, times	,424	,666			,314	,737
7	Chin ups, times	,388	,699				,810
8	Legs' rising, hanging on Sweden wall, times	,345	,766				,795
9	Angle on parallel bars, sec., times		,791				,792
10	Torso rising from position lying on back during 1 minute, times	,376	,680				,800
11	Forward torso bending in sitting position (legs apart), cm			-,325	,821		,813
12	Hanging on bent arms, sec		,728			,380	,858
13	Torso rising from lying on abdomen position during 30 sec., times	,697	,569				,814
14	Long jump from the spot, cm	,347	,582				,595
15	Throw of filled ball (1 kg) from sitting position, cm	,334				,796	,797
16	Shuttle run, 4x9 m, sec.					,463	,260
17	Forward roll, level of mastering	,904					,883
18	Backward roll, level of mastering	,889					,858
19	Vault, level of mastering	,886					,895
20	Climbing rope (three attempts), level of mastering	,881					,876
21	Bridge, level of mastering	,794					,822
22	Stance on shoulder blades, level of mastering	,909					,917

Table 7. Full explained dispersion

Component	Interpretation	Sum of squares of rotation loads	
		% of dispersion	Cumulative %
1	Level of mastering and motor fitness	28,497	28,497
2	Strength of abdomen muscles	20,299	48,796
3	Physical condition	16,126	64,922
4	Flexibility	6,994	71,916
5	Speed power	6,821	78,737

sitting position, cm", "Shuttle run 4x9 m, sec".

The level of mastering the exercises "Forward roll", "Backward roll", "Vault", "Climbing rope (three attempts)", "Bridge", "Stance on shoulder blades" statistically confidently increases with age ($p < 0,001$) (see table 1).

Thus, in 11-13 yrs age boys we noted positive dynamic of physical condition, motor abilities and gymnastic

exercises' mastering level indicators.

For specifying motor fitness influence on physical exercises' mastering level we fulfilled factorial analysis.

Results of factorial analysis are given in tables 1-7. In the process of analysis in 11 yrs boys we marked out six factors, which explain 72,773% of total dispersion (see table 2-3).

Factor 1 has the highest weight (21,735%) and

correlates with the following tests' results:

- Climbing rope (three attempts), level of mastering.
- Vault, level of mastering, 834.
- Backward roll, level of mastering, 778.

The factor was named level of mastering and motor fitness.

Factor 2 has weight 17,108% and correlates with the following results:

- Height, cm, 778.
- Body mass, kg, 702.

The factor was named physical condition.

Factor 3 has weight 13,390% and correlates with the following:

- Right hand dynamometry, kg - -,606.
- Left hand dynamometry, kg— -,693.

The factor was named hand's strength.

Factor 4 has weight 8,954% and correlates with the following:

- VCL, cm³ — ,741.

The factor was named functional state of respiratory system.

Factor 5 has weight 8,896% and correlates:

- Forward torso bending in sitting position (legs apart), cm— ,635.
- Shuttle run, 4x9 m, sec.— ,615.

The factor was named motor coordination.

Factor 6 has weight 6,920% and correlates with the following tests' results:

Hanging on bent arms, sec.— -,449.

The factor was named static power.

- Analysis of communities showed that in motor fitness structure of 11 yrs boys the biggest influence is rendered by: "Chin ups— ,897"; "Climbing rope (three attempts), level of mastering.

— ,860; "Hanging on bent arms,— ,854"; "Vault, level of matsrerig— ,815".

Analyzing 12 yrs boys we marked out 4 factors, which explain 74,607% of total indicators' dispersion (see table 4, 5).

Factor 1 has the highest weight (36,646%) and correlates with:

- Backward roll, level of mastering— ,927.
- Forward roll, level of mastering— ,887.
- Climbing rope (three attempts), level of mastering - ,858.
- Vault, level of matsrerig— ,806.

The factor was named level of mastering and motor fitness.

Factor 2 has weight— 14,067% and correlates with physical condition indicators:

- Right hand dynamometry, kg — ,776.
- Left hand dynamometry, kg— ,729.
- VCL, cm³ — ,533.

The factor was named physical condition.

Factor 3 has weight— 12,639% and correlates with the following:

- Long jump from the spot, cm— ,699.
- Angle on parallel bars, sec— ,665.
- Hanging on bent arms, sec.— ,629.

The factor was named speed power.

Factor 4 has weight— 11,255% and correlates: Height, cm— ,821.

- Body mass,— ,703.

The factor was named physical condition.

Analysis of communities showed that in motor fitness structure of 12 yrs boys the biggest influence is rendered by: "Backward roll, level of mastering— ,902"; "Chin ups, times— ,842"; "Forward roll, level of mastering — ,812".

Analyzing 13 yrs boys we marked out 5 factors, which explain 78,737% of total indicators' dispersion (see table 6, 7).

Factor 1 has the biggest weight (28,497%) and correlates with the following results:

- Forward roll, level of mastering — ,904.
- Backward roll, level of mastering — ,889.
- Vault, level of matsrerig — ,886.
- Climbing rope (three attempts), level of mastering — ,881.

The factor was named level of mastering and motor fitness.

Factor 2 has the biggest weight— 20,299% and correlates with the following results:

- Angle on parallel bars, sec — ,791.
- Leggs' rising on Sweden wall, times— ,766.
- Hanging on bent arms, sec— ,728.

The factor was named strength of abdomen muscles.

Factor 3 has weight— 16,126% and correlates with the following:

- Left hand dynamometry, kg— ,950.
- Right hand dynamometry, kg — ,937.
- Body mass, kg — ,762.
- Height, cm— ,706.

The factor was named physical condition.

Factor 4 has weight — 6,994% and correlates with the following results:

- Forward torso bending in sitting position (legs apart), cm— ,821.

The factor was named flexibility.

Factor 5 has weight — 6,821% and correlated with the following tests' results:

Throw of filled (1 kg) ball from sitting position, cm — ,796.

The factor characterizes speed power.

Analysis of communities showed that motor fitness of 13 yrs. boys is influenced to the largest extent: "Left hand dynamometry, kg — ,921"; "Vault, level of mastering— ,895"; "Stance on shoulder blades, level of mastering— ,917; "Forward roll, level of mastering — ,883".

Discussion

In our work we studied assumption about wholeness of motor abilities processes' development and training from position of systemic approach [3, 8]. We found that variation of results in total dispersion of 11-13 yrs boys by 72,773%, 74,607%, 78,737% depends on the regarded factors. Mastering level in factorial structure has weight 17,505% (11 years), 36,646% (12 years), 28,497% (13

years). Analysis of communities showed that in 11-13 yrs boys development of motor abilities is effective if they are a component of the mastered motor skills.

The same dynamic of physical exercises mastering we observed in 11-13 yrs girls. We found that variation of results in total dispersion of 11-13 yrs girls by 81,259%, 79,353%, 71,019% is conditioned by the following factors: physical condition, level of motor abilities and level of physical exercises' mastering. In factorial structure level of physical exercises' mastering has weight 16,435% (11 years), 27,963% (12 years), 17,010% (13 years) [31].

In 11-13 yrs boys we observed higher contribution of mastering level in motor fitness structure.

The presented data supplements the results of Xu X. and Ke F. [30], Repko E. et al. [10], Khudolii O.M. et al. [28].

The conducted factorial analysis permitted to regard development of motor abilities and training as holistic process. It supplements the data of Ivashchenko O. et al. [21], Ivashchenko O. et al. [22] about effectiveness of factorial analysis application in physical education. Analysis of communities in factorial analysis permits to find the role of one or another indicator in factorial structure of the process. It points at demand in application of multidimensional mathematical statistic methods in studying of children's and adolescents' physical education laws [8, 24, 25, 33].

Conclusions

In 11-13 yrs boys we found positive dynamic of physical condition, indicators of motor abilities' development and mastering level of gymnastic exercises.

We found that variation of results in total dispersion of 11-13 yrs boys by 72,773%, 74,607%, 78,737% depends on the regarded factors. Mastering level in factorial structure has weight 17,505% (11 years), 36,646% (12 years), 28,497% (13 years). Analysis of communities in factorial analysis permits to find that in 11-13 yrs boys development of motor abilities is effective if they are a component of the mastered motor skills.

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Conflict of interests

The authors declare that there is no conflict of interests.

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