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Original Article

Intra-group factorial model as the basis of pedagogical control over motor and functional fitness dynamic of 14-16 years old girls

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Abstract:
The purpose of the research: to determine methodological approaches to pedagogic control over motor and functional fitness dynamic of 14–16 years' age girls. Material: in the research 14 years' age (n=31), 15 years' age (n=26) and 16 years' age (n=28) girls participated. Results: for pedagogic control over motor and functional fitness dynamic of 14–16 years' age girls the most informative were the following tests: for 14 years' age girls: "Serkin's test" (0.854), "Shuttle run 4x9 m" (0.833), "Genchy's test" (.814), "Pressing ups in lying position" (.762); for 15 years' age girls: "Hanging on bent arms" (.967), "Jumps with additions" (.964), "Serkin's test" (.928), "Strange's test" (,927); for 16 years age girls: "Jumps with additions" (.959), "Long jump from the spot" (.959), "Genchy's test" (.945), "Strange's test" (.938). Conclusions: factorial intra-group model of motor and functional fitness dynamic of 14, 15 and 16 years' girls is the basis for optimization of pedagogic control at physical culture lessons in schools. In factorial model of motor and functional fitness dynamic of 14 years' age girls, priority place is taken by functional fitness of respiratory and cardio-vascular systems, coordination and power fitness. In 15 years' age girls the place of priority is taken by coordination and power fitness, functional fitness of respiratory and cardio-vascular systems, differentiation of space characteristics of movements. In 16 years old girls the place of priority is taken by functional fitness of respiratory and cardio-vascular systems, power fitness and power endurance.
Key words: pedagogic control, girls, functional fitness, coordination fitness, power fitness, motor abilities.

Introduction

In modern conditions of schoolchildren's progressing immobility and their organism's low resistance to morbidity there appears a problem of increasing of children's and adolescents' physical education's effectiveness. Results of scientific researches in the field of medical-biological and pedagogic sciences show, that physical exercises are the most powerful means, capable to ensure general and purposeful development of functions and systems of adolescents' organisms (Ruiz, Silva, & Oliveira, 2009; Santos, Mota, & Santos, 2014). This fact is proved by the data about correspondence of tests to national criteria of children's health (Santos, Mota, & Santos, 2014) and by adequacy of the offered tests to children's age (Castro-Piñero, Mora, & Gonzalez-Montesinos, 2009; Gavin, Christine, & Daniel, 2012).

Pedagogic control in sports training (Tuisheva & Ivanenko, 2015) and at physical culture lessons (Golovin, Konchic, & Turygin, 2013) is one of conditions of schoolchildren's motor functioning intensification. The procedure of pedagogic control implies classification of current state of motor and functional fitness, on which taking decisions about children's and adolescents' physical education depends. So, classification of motor fitness current state is of practical importance for working out effective programs of schoolchildren's physical training. Proper organization of pedagogic control over children's and adolescents' motor and functional fitness requires consideration of age peculiarities of their growth. Such approach permits to increase physical exercises' effectiveness. Numerous testing of 14–16 years' age girls permitted to determine specific features of fencing training (Kabanova, 2007), race walking (Tuisheva & Ivanenko, 2015), tennis (Jagiello & Jagiello, 2015), boxing (Aslaev & Kotova, 2015), swimming (Isaev, Erlikh, Nenasheva, Shepilov, & Romanova, 2014; Eider, 2015). Authors note that at all stages of training proper control with the help of tests is an integral part of junior sportsmen many years training. It permits to more effectively perfect components of junior sportsmen physical, technical and psychological training.

In sports-pedagogic practice objective mark of sportsmen's potentials is regarded, even on initial stages of many years training, as one of important problems. In conditions of age development and formation of sportsmen's skillfulness numerous control indicators' reliability and information potential change, owing to

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different circumstances. That is why proper quantitative information permits to individualize sportsmen's training, in compliance with requirements to controlled processes (Zaporozhanov & Boraczynski, 2015; Iermakov, Podrigalo, & Jagiełło, 2016). Such approach witnesses about purposefulness of control improvement for substantiation of increasing quality of sportsmen's status assessment in specific conditions of physical education (Zaporozhanov, Kochanowicz, & Kochanowicz, 2014; Skidan, Sevdalev, & Vrublewskiy, 2015).

Physical exercises' practicing by 14–16 years' age girls requires consideration their physiological characteristics (Piatunina & Gajnanova, 2006; Leer & Zvereva, 2013), hemo-dynamic types (Sokolov & Grechkina, 2008; Levushkin & Son'kin, 2009), environment (Mamaev & Ivanova, 2014). It permits the following:

– Increase effectiveness and immediacy of educational process control (Limarenko, 2010; Parniakov, 2015);

– Perfect and substantiate criteria of assessment of schoolchildren organism's functional characteristics and motor potentials (Majfat, 2014; Selitrenikova & Korolev, 2014);

– Realize support at optimal level and targeted correction of schoolchildren's physical and mental workability (Golovin et al., 2013; Nosko, Razumeyko, Iermakov, & Yermakova, 2016);

– Consider rate of physical condition and motor fitness increment during all period of studying (Germanov, Mashoshina, & Vasenin, 2014);

– Use physiological data for prediction of junior sportsmen's future career progress (Gonaus & Müller, 2012);

– Self-regulation of physical loads among physically developed adolescents (Gerber, Lindwall, Brand, Lang, Elliot, & Pühse, 2915).

In the whole, such approaches facilitate improvement of quality of schoolchildren's physical fitness control. Application of substantiated methods in school practice reduces influence of negative factors on schoolchildren's health. Interaction of physical culture teacher with parents also is of great importance for increase of pedagogic control and schoolchildren's workability. With it, role of family relations often becomes the most important factor in control over children's independent physical loads.

In previous researches were substantiated and improved system of pedagogic control over children's and adolescents' motor fitness. The authors stressed on possibility of classification of 14–16 years' age boys age distinctions on the base of functional and power fitness testing (Ivashchenko, Yermakova, Cieslicka, & Zukowska, 2015; Ivashchenko et al., 2016). The offered methodic of summarizing motor and functional fitness control of 14–16 years' age schoolchildren (Ivashchenko, Khudolii, Yermakova, Wiesława, Radosław, & Błażej, 2015) and 17–18 years' age boys (Kuzmin et al., 2016; Pomeshchikova et al., 2016) permitted to find the most informative variables, which influence on quality of learning. Alongside with it, classification of pupils by level of motor fitness according to their age permitted to confidently determine adequacy of the applied tests (Ivashchenko, Yermakova, Cieslicka, & Muszkieta, 2015; Khudolii, Iermakov, & Ananchenko, 2015; Khudolii, Iermakov, & Prusik, 2015).

One of promising and effective approaches to improvement of pupils' physical loads control is simulation of its different components. In researches of different authors (Lopat'yev, 2007; Lopat'yev, Vlasov, & Trach, 2013; Iermakov, Arziutov, & Jagiełło, 2016; Bliznevsky, Kudryavtsev, Iermakov, & Jagiełło, 2016) conceptual approaches to simulation of training process and development of motor abilities in physical education and sports were worked out. Besides, models of motor abilities training are regarded, which can be used for current and summarizing control of children's and adolescents' fitness (Lochbaum et al., 2016; Tuisheva et al., 2015); control becomes more effective, when applying models, which correspond age characteristics of pupils.

It was also found that selection of exercises and methods of their application it is purposeful to realize as per results of comparison of the following models: physical fitness and actual condition of pupil's appropriate motor qualities. It permits to obtain quantitative information about drawbacks of every pupil's (group) physical fitness and specify orientation of further work (Arefiev, 2014; Bliznevsky et al., 2016; Pryimakov, Iermakov, Kolenkov, Samokish, & Juchno, 2016). Substantiation of theoretical model of children's and adolescents' sensitive periods of motor abilities' development in the frames of synergetic approach paradigm permits to determine periods of the highest sensitivity to external influences (Kozina et al., 2016; Kozina, Repko, Ionova, Boychuk, & Korobeinik, 2016; Simonov, Chastikhin, Gulin, & Apokin, 2015). Such approach permits to implement basic and perspective models in practical work and increase effectiveness of physical education (Iermakov et al., 2016; Iermakov, Arziutov, & Jagiełło, 2016). It is known that medical-physiological assessment of pupils' regulatory systems' tension facilitates timely determination of organism's adaptation potentials. Specificity of pupils' adaptation, when applying different modes of motor functioning (simulation of physical exercises) at physical culture lessons, implied stabilization of pupils organism's functional state (Gorelik, 2015).

In the previous researches it was found that current control over motor fitness of children and adolescents can be realized on the base of multi-dimensional methods and models (Khudolii & Ivashchenko, 2013; Ivashchenko, Cieślicka, Khudolii, & Iermakov, 2014). It was determined that on the base of children's and adolescents' motor functioning models selection of main and preparatory exercises as well as stage-by-stage control over motor fitness are realized. On the base of training loads models the following is determined: value

and orientation of load; correlation of physical and technical means; periods of application of loads of different orientation; terms for training strength and increasing workability; terms of immediate and current control. On the base of training process models the following is determined: terms for training of motor control skills; training of physical exercises; procedure of solution of training tasks and selection of these tasks; principle instructions on programming of children's and adolescents' training process; terms of immediate and current control (Khudolii & Ivashchenko, 2013). Analysis of researches' results witnesses that the highest statistically confident distinctions in 13–14 years' age girls are observed in tests "Long jump from the spot" and "Squatting". Girls' motor fitness level determines development of speed-power abilities (Gert-Jan & Benjamin, 2011). The researches point at possibilities of pedagogic control implementation through construction of motor fitness models. Such approach permitted to substantiate the choice of the most adequate tests in compliance with pupils' age. Alongside with it, in context of the mentioned approach it is purposeful to conduct researches in other age groups of pupils. Analysis of other authors' researches shows that insufficient attention is paid to studying of simulation method's application for improvement of pedagogic control over children's and adolescents' motor and functional fitness. That is why the purpose of our research is determination of methodological approaches to pedagogic control over motor and functional fitness dynamic of 14–16 years' age girls.

Material and methods

Participants

In the research 14 years' age (n=31), 15 years' age (n=26) and 16 years' age (n=28) girls participated. All research procedures received approval from the University Research Committee, head teachers and physical education teachers from the schools involved. Informed consent was obtained from parents/guardians as well as children involved in the study using approved University and school system protocols.

Research design

Testing program included well-known tests: jumps with "additions" (quantity of jumps in pre-set corridor), shuttle run 4×9 m (sec), pressing ups in lying positions (times), chin ups (times), hanging on bent arms (sec.), long jump from the spot (cm) (Liakh, 2000; Sergiienko, 2001; Khudolii, Ivashchenko, & Karpunets, 2012).

*1. Jumps with "additions"*were fulfilled with the following equipment: sector for jumps, chalk, calculator measuring tape. The test was conducted in the following way: for every participant maximal result in long jumps from the spot was determined. Then, with the help of calculator 50 and 75% from maximal result sould be calculated. At distance of 50% from maximal result first line should be drawn with chalk. For better orientation small cube is installed at the side of the line. At distance of 75% from maximal result second line is drawn. It is individual corridor of jumps with "additions". Then, within this corridor pupils fulfill jumps with "additions". Accounting of additions is stopped, when pupil reaches second line or if in two jumps (fulfilled one-by-one) he does not increase the length of jump. Results are: quantity of jumps with "additions", fulfilled in pre-set corridor. General instructions and remarks are: it is prohibited to fulfill jumps with hard landing; three attempts are given for determination of maximal result; for better understanding of how to fulfill the test a trial attempt is given.

2. Shuttle run 4×9 meters shall be fulfilled with the following equipment: stopwatch and even track of 9 meters length, limited by two parallel lines. Behind every line 2 semi-circumferences, of 50 cm radius with center on the line are depicted. Two wooden cubes (5×5×5 cm); registration table and chair are required. The test is to be fulfilled in the following way: by command "At start" participant stands in position of high start at start line. By command "Go" he runs 9 meters up to second line with maximal speed; takes one of two wooden cubes from semi-circumference; runs back; puts cube in start semi-circumference (no throwing); again runs in previous direction; returns with other cube; puts it in semi-circumference at start. This is the end of the test. Result is time (registered with accuracy up to 0.1 sec.) from the start moment and to the moment when the participant puts the second cube in semi-circumference. General instructions and remarks are the following: every participant is given two attempts. In record the best or average result is noted, which is calculated by two attempts. Attempt is not considered if the tested throws or drops the cube in semi-circumference. The cube shall be put carefully. If this requirement is not fulfilled the repeated attempt is given. Shuttle run track shall be even and not slippery.

3. Pressing ups in lying position: requires flat wooden or ground site. The test is fulfilled in the following way: participant takes lying position, resting hands on floor; arms are straightened, located on shoulder width with fingers forward; torso and legs make straight line; tips of toes resting on the floor. By command "Go" participant starts to rhythmically bend and unbend arms with full amplitude. Result is quantity of correct bending and unbending in one attempt. General instructions and remarks: in bending contact of chest with floor is compulsory. Contact of hips, bending of torso and legs; being in initial position and in position with bent arms more than 3 seconds; lying on floor; unbending of arms in turn; arms' bending and unbending with incomplete amplitude are prohibited. Test is not registered if pressing ups are fulfilled with mistakes.

4. Chin ups: is fulfilled on horizontal bar in the following way. Participant hangs on bar with torso and legs making straight line. By command "Go" the participant starts to rhythmically bend and unbend arms with full amplitude. Result is quantity of armes' bending-unbending in one attempt. Instructions and remarks: in

bending it is necessary to contact bar with shoulders. Being in initial position and in position with bent arms more than 3 seconds is prohibited. Test is not registered if chin ups are fulfilled with mistakes.

5. Hanging on bent arms: is fulfilled on horizontal bar and requires stopwatch and gymnastic mats. The test is fulfilled in the following way: participant takes hanging position with bent arms with the help of instructor; torso and legs make straight vertical line; chin is above bar. By command "Go" the participant keeps this position. Result is time, during which the participant keeps this position. General instructions and remarks: test is stopped if participant lowers chin below bar. Bar shall be held at shoulder width.

6. Long jump from the spot: requires equipment–not slippery site with line, marked in centimeters. Fulfillment of the test: participant stands with his feet at the line; pushing off with legs and waving with arms, he jumps forward as far as possible. Result is distance of jump in centimeters in best from two attempts. Instructions and remaks: testing shall be conducted in compliance with the rules for competitions in long jumps from run. Place of pushing off and landing shall be at the same level.

For assessment of functional status we used tests of Strange, Genchy and Serkin [Dubrovskij, 2005].

7. The *Stange's test* required each student to be in a seated position making a deep breath and exhalation, then breath (approximately 80% of the maximum), covering the mouth and nose simultaneously clamped fingers, hold your breath (stopwatch is included at the end of inhalation and exhalation is excluded from the start).

8. The *Genchy's test* required each student provides holding breath after breath. Procedure*:*

1. A student lies on a bench;
2. A student takes an exhalation;
3. Holds his breath. At that moment a stop-watch is starting. The duration of interval between the each breath is defined by the stop-watch (seconds).

The duration of interval between the each breath is defined by the stop-watch. The stop-watch is stopped at the moment of inhalation. Then check the results. A test conducted not earlier than in 5-7 minutes after Strange's test.

9. The *Serkin's test.* Procedure*:*

1. A student sits on a bench;
2. A student takes a inhalation;
3. Holds his breath. At that moment a stop-watch is starting.
4. The duration of interval between the each breath is defined by the stop-watch (seconds). The stop-watch is stopped at the moment of breath. Then check the results.
5. A student does 20 squats during 30 second;
6. Then repeat procedures 1, 2, 3, 4;
7. A student takes a rest during 1 minute;
8. Then repeat procedures 1, 2, 3, 4.

Intra-group factorial model and information value of testing indicators were determined with the help of factorial analysis, separately for every age.

Statistical analysis

In the research we used program of statistical analysis– IBM SPSS 20 as well as factorial analysis. Rotation method: Varimax with Keiser normalization. For every variable the following statistics were calculated: mean values, standard deviations, t-criterion of Student for independent samples.

Results

Results of testing of 14–16 years' age girls' motor and functional fitness are given in table 1.

Table 1. Results of analysis of 14–16 years' age girls' motor and functional fitness

№	Description of test	14 years (n=31)		15 years (n=26)		16 years (n=28)		Confidence of differences 14–15 years		15–16 years	
		X	s	X	s	X	s	t	p	t	p
1	Jumps with additions (times)	3.8	.83	2.3	.78	1.8	.95	6.93	0.000	2.178	0.034
2	Shuttle run 4x9 m, sec.	13.9	.73	11.9	.58	11.9	.22	11,.48	0.000	-0.157	0.876
3	Pressing ups in lying positions (times)	10.8	3.08	16.0	9.27	19.6	4.98	-2.94	0.005	-1.762	0.084
4	Chin ups (times)	3.6	.75	5.2	2.53	4.4	1.79	-3.317	0.002	1.35	0.183
5	Hanging on bent arms (sec.)	18.5	3.29	14.6	9.40	31.1	12.34	2.177	0.034	-5.504	0.000
6	Long jump from the spot (cm)	151.4	5.71	174.4	1.98	191.0	13.90	-10.149	0.000	-4.858	0.000
7	Strange's test (sec.)	32.6	4.22	56.9	.9.5	61.8	10.51	-6.749	0.000	-1.164	0.250
8	Genchy's test (sec.)	20.2	3.29	31.4	.0.8	39.4	11.18	-5.456	0.000	-2.667	0.01
9	Serkin's test (sec.)	14.8	3.03	18.6	4.51	21.7	5.04	-3.819	0.000	-2.383	0.021

Positive, statistically confident dynamic of testing results is observed in 14–15 years' age girls in tests № 2, № 3, № 4 and № 6. Stable, statistically confident dynamic of testing results is observed in functional tests. 16 years' age girls are assessed as health and trained. With age we observed statistically confident worsening of results in differentiation of motor space characteristics (test № 1).

For determination of functional and motor fitness structure of 14 years' age girls we carried out factorial analysis by 9 indicators of testing. Results of this analysis are presented in table 2 and 3. In the process of analysis we marked out four factors, which explain 72.364% of indicators' total variance (see table 2).

Table 2. Factorial model of motor and functional fitness of 14 years' (n=31), 15 years' (n=26) and 16 years' age girls (n=28). Rotation method: Varimax with Keiser normalization.

№	Description of test	Age, years	Components				h^2
			1	2	3	4	
		14	-.375		-.612	.358	.656
1	Jumps with additions (times)	15		.395	.876		.928
		16					.887
		14		.889			.833
2	Shuttle run 4x9 m, sec.	15	-.720		-.493		.905
		16					.798
		14		-.797		-.333	.762
3	Pressing ups in lying positions (times)	15	.900				.904
		16					.945
		14	-.813		.306		.734
4	Chin ups (times)	15	.908				.862
		16					.910
		14				.813	.691
5	Hanging on bent arms (sec.)	15	.911				.890
		16					.900
		14			.671		.522
6	Long jump from the spot (cm)	15	.909				.967
		16					.921
		14			.701		.647
7	Strange's test (sec.)	15		.405		.877	.964
		16					.959
		14	.799			.403	.814
8	Genchy's test (sec.)	15		.942			.927
		16					.938
		14	,862			.326	.854
9	Serkin's test (sec.)	15		.753	.404		.814
		16					.959
		14	26.076	16.209	15.060	15.019	72.364
	Total explained variance, %	15	42.745	21.521	15.336	11.076	90.678
		16	29.058	24.576	21.926	15.747	91.307

Factor 1 is the most informative (26.076%) and correlates with Genchy's and Serkin's tests. This factor was named "functional fitness of respiratory and cardio-vascular systems".

Factor 2 (information value–16.209%) correlates to the largest extent with indicators of coordination and power fitness: "Pressing ups in lying position" (-.797) and "Shuttle run та 4x9 m" (.889). The factor is bipolar. Improvement of the mentioned indicators weakens this factor that points at complex correlations in development of strength and motor coordination in 14 years' age girls. The factor was named "coordination and power fitness".

Factor 3 (information value–15.060%) correlates to the largest extent with indicators of speed-power fitness and differentiation of space characteristics: "Long jump from the spot" (.671) and "Jumps with additions" (-.612). Improvement of jump indicators strengthens the factor. The factor was named "speed-power endurance".

Factor 4 (information value–15.019%) correlates to the largest extent with indicators of static power fitness: "Hanging on bent arms" (813). The factor was named "power endurance".

Thus, in factorial structure of 14 years' age girls the place of priority is taken by functional, coordination and power fitness. Analysis of communities shows that the offered tests' battery is rather informative (see table 2). For 14 years' age girls the most informative were the following indicators: "Serkin's test" (0.854), "Shuttle run 4x9 m" (0.833), "Genchy's test" (.814), "Pressing ups in lying positions" (.762).

Table 3. Interpretation of factorial analysis results

Factor	Age 14 years	15years	16 years
1	Functional fitness of respiratory and cardio-vascular systems	Coordination and power fitness	Functional fitness of respiratory and cardio-vascular systems
2	Coordination and power fitness	Functional fitness of respiratory and cardio-vascular systems	power fitness
3	Speed-power fitness	Differentiation of space-motor characteristics	Power endurance
4	Power endurance	Functional fitness of respiratory and cardio-vascular systems	Functional fitness of respiratory and cardio-vascular systems
Informative indicators of girls' functional and motor fitness			
Rank	Age 14 years	15years	16 years
1	Serkin's test, sec. (0.854)	Hanging on bent arms, sec. (0.967)	Jumps with additions, times (0.959)
2	Shuttle run 4x9 m, sec. (0.833)	Jumps with additions, times (0.964)	Long jump from the spot, cm (0.959)
3	Genchy's test, sec. (0.814)	Serkin's test, sec. (0.928)	Genchy's test, sec. (0.945)
4	Pressing ups in lying position (times) (0.762)	Strange's test, sec. (0.927)	Strange's test, sec. (0.938)

For determination of functional and motor fitness structure of 15 years' age girls we carried out factorial analysis by 9 testing indicators. Results of this analysis are given in tables 2 and 3. In the process of analysis we found four factors, explaining 90.678% of indicators' total variance (see table 2).

Factor 1 is the most informative (42.745%) and correlates with tests, characterizing power fitness, power endurance and speed-power fitness of 15 years' age girls. This factor was named "coordination and power fitness". . This factor was named "functional fitness of respiratory and cardio-vascular systems".

Factor 2 (information value–21.521%) correlates to the largest extent with indicators of respiratory and cardio-vascular systems: "Genchy's test" (.942) and Serkin's test (.753). The factor was named "functional fitness of respiratory and cardio-vascular systems".

Factor 3 (information value–15.336%) correlates to the largest extent with indicators of motor coordination "Jumps with additions" (.876). The factor was named "ability for differentiation of space motor characteristics".

Factor 4 (information value–11.076%) correlates to the largest extent with indicators of Strange's test (.877). This factor supplements the second factor.

Thus, in factorial structure of 15 years' age girls the place of priority is taken by functional, coordination and power fitness.

Analysis of communities shows that the offered tests' battery is rather informative (see table 2). For 15 years' age girls the most informative were the following indicators: "Hanging on bent arms" (.967), "Jumps with additions" (.964), "Serkin's test" (.028), "Strange's test" (.927).

For determination of functional and motor fitness structure of 16 years' age girls we carried out factorial analysis by 9 testing indicators. Results of this analysis are given in tables 1- 3. In the process of analysis we found four factors, explaining 91.307% of indicators' total variance (see table 2).

Factor 1 is the most informative (29.058%) and correlates with tests, characterizing functional fitness–tests of Genchy and Serkin. This factor was named "functional fitness of respiratory and cardio-vascular systems".

Factor 2 (information value –24.576 %) correlates to the largest extent with the following indicators: Pressing ups in lying position" (.952) and "Chin ups" (.850). The factor was named "power fitness".

Factor 3 (information value–21.926%) correlates to the largest extent with indicators of static strength and is named "power endurance".

Factor 4 (information value–15.747%) correlates to the largest extent with indicators of Strange's test (.948). This factor supplements the first factor.

Thus, in factorial structure of 16 years' age girls the place of priority is taken by power, functional and coordination fitness.

Analysis of communities shows that the offered tests' battery is rather informative (see table 2 and 3). For 16 years' age girls the most informative were the following indicators: "Jumps with additions" (.959), "Genchy's test" (.945), "Strange's test" (.938).

In table 3 generalizing information about dynamic of changes of functional and motor fitness structure is given as well as indicators of priority for their control in 14–16 years' age girls.

Discussion

The received results supplement information about development of children's and adolescents' motor abilities and possibility of receiving of new information with the help of simulation method (Khudolii & Ivashchenko, 2013; Podrigalo, Iermakov, Galashko, Galashko, & Dzhym, 2015; Podrigalo, Iermakov, Nosko, Galashko, & Galashko, 2015). In researches, devoted to physical education and sports, multi-dimensional methods are used for the following:

– for classification of pupils and motivation of them for sports practicing (Milić, Milavić, & Grgantov, 2014);

– by motor functioning (Gert-Jan & Benjamin, 2011);

– for classification of groups in sportsmen and non-sportsmen (Lulzim, 2012);

– for determination of dynamic of children's physical condition under influence of fitness programs (Li, Wu, Cairney, & Hsieh, 2011);

– for summarizing control of children's and adolescents' functional and motor fitness (Khudolii & Ivashchenko, 2013);

– for assessment of motor tests' competence (Fransen, D'Hondt, Bourgois, Vaeyens, Philippaerts, & Lenoir, 2014).

Other authors point at possibility to use statistical analysis for classification of children's motor functioning, depending on its scope (Geoffrey & Gabie, 1982), for identification of youth with rough problems of motor coordination and providing them with effective intervention programs (de Chaves, 2016), for classification of variable health indicators in monitoring of children's physical condition (Gonçalves, Szmuchrowski, & Damasceno, 2014). In other works (Khudolii et al., 2015) by results of such analysis the authors found informative tests for end-to-end control of boys' motor fitness. In end-to-end control of boys' motor fitness indicators of physical condition, quickness, endurance and motor coordination have the highest value. The offered by the authors approach permits to obtain information about condition of senior children. Such information is required for taking decisions in process of control over physical education and for working out effective programs of children's and adolescents' physical training.

The received results supplement the data about demand in structural and functional analysis of children's and adolescents's motor fitness (Kravchuk & Kurochka, 2013; Ivashchenko et al., 2015). These data confirm idea that factorial model is the basis of pedagogic control of 14–16 years' age girls. In our research we observe high prognostic potential of factorial analysis in determination of model and informative indicators of 14–16 years' age girls' motor fitness.

The presented results also supplement the data about high informative value of tests of Strange, Genchy, Serkin in assessment of pupils' functional state (Solianik, 2013), about factorial structure of schoolchildren's motor fitness (Kozina & Popova, 2013). Appropriateness of factorial analysis application in our research is confirmed by the data of other researches. The authors of these researches present results of application of methodic of multi-functional express-diagnostic and regard possibilities of students' responses' to physical loads prognostication (Holets & Evdokimov, 2009). Zinchenko (2009) regard role and place of control training tasks for sportsmen's skillfulness. Vertel and Gradusov (2011) they also regarded effectiveness of factorial analysis in determination of informative data of the conducted researches. The received data permitted for the authors to find out effectiveness extent of indicators for their usage on control of special physical fitness at certain stages of junior sportsmen's training. It was proved that physical fitness structure of 10–14 years' age junior sportsmen has dynamic changeable character and change depending on their age. In other work metric invariance (i.e. equal factorial loads) was demonstrated on the base of index stability between two models. It permitted to distribute children into groups by certain properties (Limbers, Newman, & Varni, 2008).

In fulfillment of different exercises of game character important element of children's motor fitness can be motivation component (Lochbaum, Okafor, Brenner, & Cetinkalp, 2015). The researeches showed that increase of physical functioning is facilitated by positive emotions (Lochbaum & Stevenson, 2014). This fact especially manifests in sports functioning of adolescents (Podlog, Lochbaum, & Kleinert, 2013). The mentioned approaches are confirmed by the data of other scientists about demand in finding the factors, connected with emotional symptoms at individual and class levels (Meilstrup et al., 2016).

Results of our research confim the data of Zaporozhanov and Borachinski (2015). These authors stress on the fact that such approach permits to receive metric marks of measurements' reliability: stability, concordance and informational potential of data of control for currecnt diagnostic and prognostication of children's sp(orts prospects.

Appropriateness of our using approaches for assessment of 14–16 years' age girls' motor and functional fitness is confirmed by other researches (Zaharova & Lyulina, 2014). These authors point at possibility of rising quality of educational-training process on the base of complex immediate control means (Lebedinskiy, Bomin, & Litvinova, 2012). The presented by them results permit to determine specific features of training process

construction from junior sportsmen. Besides, they permit to consider specific of pedagogic control application in assessment of children's coordination. The authors note that most of coaches support idea about tests' modification in compliance with children's age and complex assessment of their coordination abilities (Kozak & Ibraimova, 2014). In other research the authors render results of analysis of 15–16 years' age sportsmen's physical fitness in structure of annual training cycle. They note that for determination of structure of sportsmen's physical fitness it is necessary to have a set of adequate methodic and tests. Analysis of experimental data permitted for the authors to find out informational value of components of physical fitness structure at different stages of annual training cycle (Lisenchuk, Zaloylo, & Guravlev, 2010). In these aspects our researches supplement the data of the mentioned above works. The novelty of our research is the finding, that 15–16 years' age girls' functional, coordination and power fitness take the place of priority in factorial structure.

Conclusions

1. Factorial intra-group model of dynamic of 14, 15 and 16 years' age girls' motor and functional fitness is the basis for optimization of pedagogic control at school physical culture lessons. In factorial model of 14 years' age girls' motor and functional fitness the place of priority is taken by respiratory and cardio-vascular systems, coordination and power fitness. Concerning 15 years' age girls–the place of priority is taken by coordination and power fitness; by functional fitness of respiratory and cardio-vascular systems; by differentiation of motor space characteristics. In case of 16 years' age girls the most important place is taken by functional fitness of respiratory and cardio-vascular systems; by power fitness and power endurance.

2. For pedagogic control over motor and functional fitness of 14–16 years' age girls the most informative are the following tests:

– For 14 years' age girls: "Serkin's test" (0.854), "Shuttle run 4x9 m" (0.833), "Genchy's test" (.814), "Pressing ups in lying position " (.762);

– For 15 years' age girls: "Hanging on bent arms" (.967), "Jumps with additions" (.964), "Serkin's test" (.928), "Strange's test" (.927);

– For 16 years' age girls: "Jumps with additions" (.959), "Long jump from the spot" (959), "Genchy's test" (.945), "Strange's test" (.938).

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References

Arefiev, V.G. (2014). Modeling of differentiated physical fitness in school children. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 1,* 3–8.

Aslaev, T.S., & Kotova, N.Iu. (2015). Razvitie koordinacionnykh sposobnostej devushek-bokserov 14–16 let massovykh razriadov posredstvom razvitiia sensomotronoj koordinacii [Development of coordination of 14–16 years' age girls-boxers of mass grades by means of sensor-motor coordination training]. *Sovremennye problemy nauki i obrazovaniia, 4*, 10–14.

Bliznevsky, A., Kudryavtsev, M., Kuzmin, V., Tolstopyatov, I., Ionova, O., & Yermakova, T. (2016). Influence of personal characteristics of pupils and students on the effectiveness of the relationship to the specific physical activities. *Journal of Physical Education and Sport, 16*(2), 424–432. doi:10.7752/jpes.2016.02066

Bliznevsky, A.A., Kudryavtsev, M.D., Iermakov, S.S., & Jagiełło, W. (2016). Formation of active-effective attitude of 12–13 years' judo athletes to sports functioning in competition period. *Archives of Budo, 12,* 101–115.

Castro-Piñero, J., Mora, J., & Gonzalez-Montesinos, J.L. (2009). Criterion-related validity of the one-mile run/walk test in children aged 8–17 years. *Journal of Sports Sciences, 27*(4), 405–413. doi:10.1080/02640410802603889

de Chaves, R.N., Bustamante Valdívia, A., Nevill, A., Freitas, D., Tani, G., Katzmarzyk, P.T., & Maia, J.A.R. (2016). Developmental and physical-fitness associations with gross motor coordination problems in Peruvian children. *Research in Developmental Disabilities*, *53-54*, 107–114. doi:10.1016/j.ridd.2016.01.003

Dubrovskij, V.I. (2005). *Sportivnaja medicina* [Sports medicine], Moscow: Vlados.

Eider, Paul. (2015). Changes in motor skills of children who train sports swimming at the initial stage of school education (in annual training cycle*). Pedagogics, psychology, medical-biological problems of physical training and sports, 12*, 109–119. doi:10.15561/18189172.2015.12017

Fransen, J., D'Hondt, E., Bourgois, J., Vaeyens, R., Philippaerts, R. M., & Lenoir, M. (2014). Motor competence assessment in children: Convergent and discriminant validity between the BOT-2 Short Form and KTK testing batteries. *Research in Developmental Disabilities*, *35*(6), 1375–1383. doi:10.1016/j.ridd.2014.03.011

Gavin, Sandercock., Christine, Voss., & Daniel, Cohen. (2012) Centilecurves and normative values for the twenty metre shuttle-run test in English schoolchildren, *Journal of Sports Sciences* 30(7), 679–687. doi:10.1080/02640414.2012.660185

Geoffrey, D. Broadhead, & Gabie, E. Church. (1982). Discriminant analysis of gross and fine motor proficiency data. *Perceptual and Motor Skills*, *55*, 547–552. doi:10.2466/pms.1982.55.2.547

Gerber, M., Lindwall, M., Brand, S., Lang, C., Elliot, C., & Pühse, U. (2015). Longitudinal relationships between perceived stress, exercise self-regulation and exercise involvement among physically active adolescents. *Journal of Sports Sciences*, *33*(4), 369–380. doi:10.1080/02640414.2014.946072

Germanov, G.N., Mashoshina, I.V., & Vasenin, G.A. (2014). Tempy prirosta pokazatelej fizicheskogo razvitiia, funkcional'noj i dvigatel'noj podgotovlennosti shkol'nikov v razlichnye periody vozrastnogo razvitiia [Increment of physical condition, functional and motor fitness of pupils in different periods of their growth]. *Kul'tura fizicheskaia i zdorov'e*, *4*(51), 81–87.

Gert-Jan, de B., & Benjamin, G. (2011). Active Commuting and Habit Strength: An Interactive and Discriminant Analyses Approach. *American Journal of Health Promotion*, *25*(3), 27–36.

Golovin, O.V., Konchic, N.S., & Turygin, S.P. (2013). Sostoianie fizicheskogo zdorov'ia shkol'nikov i tekhnologiia ego kompleksnoj ocenki [Schoolchildren's physical health condition and technology of its complex assessment]. *Sibirskij pedagogicheskij zhurnal, 3*, 18–23.

Gonaus, C., & Müller, E. (2012). Using physiological data to predict future career progression in 14- to 17-year-old Austrian soccer academy players. *Journal of Sports Sciences*, *30*(15), 1673–1682. doi:10.1080/02640414.2012.713980

Gonçalves, R., Szmuchrowski, L.A., & Damasceno, V.O. (2014). Association of body mass index and aerobic physical fitness with cardiovascular risk factors in children. *Revista Paulista de Pediatria, 32*(3), 208–214. doi:10.1016/S2359-3482(15)30012-9

Gorelik, V.V. (2015). Reguliaciia funkcional'nogo sostoianiia uchashchikhsia na osnove mediko-fiziologicheskoj ocenki napriazheniia reguliatornykh sistem [Regulation of students' functional state on the base of medical-biological estimation of regulatory systems' tension]. *Sportivnaia medicina: nauka i praktika*, *2*, 5–12.

Holets, V.A., & Evdokimov, E.I. (2009). The employment of S.A. Dushanins multifactorial express diagnostics for predicting response to physical stress. *Physical Education of Students*, *3*, 6–11.

Iermakov, S. S., Arziutov, G. N., & Jagiełło, W. (2016). Quick training of students to judo techniques. *Archives of Budo, 12*, 15–24.

Iermakov, S., Podrigalo, L., Romanenko, V., Tropin, Y., Boychenko, N., Rovnaya, O., & Kamaev, O. (2016). Psycho-physiological features of sportsmen in impact and throwing martial arts. *Journal of Physical Education and Sport, 16*(2), 433–441. doi:10.7752/jpes.2016.02067

Iermakov, S.S., Podrigalo, L.V., & Jagiełło, W. (2016). Hand-grip strength as an indicator for predicting the success in martial arts athletes. *Archives of Budo, 12,* 179–186.

Isaev, A.P., Erlikh, V.V., Nenasheva, A.V., Shepilov, A.O., & Romanova, E.V. (2014). Integrativnaia ocenka funkcional'nogo i metabolicheskogo sostoianiia devushek-plovcov 14–16 let v sezonnykh issledovaniiakh na predsorevnovatel'nykh etapakh podgotovki [Integrative assessment of functional and metabolic state of 14-16 years' age girls-swimmers in season testing at pre-competition stages of training]. *Vestnik Iuzhno-Ural'skogo gosudarstvennogo universiteta*, *14*(1), 34–42.

Ivashchenko, O. V., Khudolii, O. M., Yermakova, T. S., Wiesława, P., Radosław, M., & Błażej, S. (2015). Simulation as method of classification of 7-9th form boy pupils' motor fitness. *Journal of Physical Education and Sport, 15*(1), 142–147. doi:10.7752/jpes.2015.01023

Ivashchenko, O. V., Yermakova, T. S., Cieslicka, M., & Muszkieta, R. (2015). Discriminant analysis as method of pedagogic control of 9–11 forms girls' functional and motor fitness. *Journal of Physical Education and Sport, 15*(3), 576–581. doi:10.7752/jpes.2015.03086

Ivashchenko, O., Khudolii, O., Yermakova, T., Iermakov, S., Nosko, M., & Nosko, Y. (2016). Factorial and discriminant analysis as methodological basis of pedagogic control over motor and functional fitness of 14–16 year old girls. *Journal of Physical Education and Sport, 16*(2), 442–451. doi:10.7752/jpes.2016.02068

Ivashchenko, O.V., Cieślicka, M., Khudolii, O.M., & Iermakov, S.S. (2014). Modelyuvannya sylovoyi pidhotovlenosti divchatok 6–7 klasiv [Simulation of power fitness of 6-7 form girls]. *Teoria ta metodika fizicnogo vihovanna*, *3*, 10–16. doi:10.17309/tmfv.2014.3.1103

Ivashchenko, O.V., Yermakova, T.S., Cieslicka, M., & Zukowska, H. (2015). Discriminant analysis in classification of motor fitness of 9–11 forms' juniors*. Journal of Physical Education and Sport, 15*(2), 238–244. doi:10.7752/jpes.2015.02037

Jagiello, Marina., & Jagiello, Wladyslaw. (2015). The level of self-esteem in 14–16-year–old female tennis players. *Pedagogics, psychology, medical-biological problems of physical training and sports, 11,* 78–80. doi:10.15561/18189172.2015.1112

Kabanova, I.A. (2007). Kriterii tekhniko-takticheskoj podgotovlennosti fekhtoval'shchic na shpagakh 14–16 let na etape uglublennoj podgotovki [Criteria of 14–16 years' age epee fencers' technical-tactic fitness at stage of profound training]. *Fizicheskaia kul'tura: vospitanie, obrazovanie, trenirovka, 4,* 59–62.

Khudolii, O. M., Iermakov, S. S., & Ananchenko, K. V. (2015). Factorial model of motor fitness of junior forms' boys. *Journal of Physical Education and Sport, 15*(3), 585–591. doi:10.7752/jpes.2015.03088

Khudolii, O. M., Iermakov, S. S., & Prusik, K. (2015). Classification of motor fitness of 7-9 years old boys. *Journal of Physical Education and Sport, 15*(2), 245–253. doi:10.7752/jpes.2015.02038

Khudolii, O.M., Ivashchenko, O.V., & Karpunets, T.V. (2012). Robocha prohrama z pedahohichnoyi praktyky v shkoli [Working program of school pedagogic practice]. *Teoria ta metodika fizicnogo vihovanna, 9*, 19–31. doi:10.17309/tmfv.2012.9.821

Khudolii, O.M., & Ivashchenko, O.V. (2013). Kontseptualni pidhodi do modelyuvannya protsesu navchannya i rozvitku ruhovih zdibnostey u ditey i pidlitkiv [Conceptual approaches to simulation of motor abilities' training in children and adolescents]. *Teoria ta metodika fizicnogo vihovanna*, *10*, 3–16. doi:10.17309/tmfv.2013.2.1012

Kozak, A. M., & Ibraimova, M. V. (2014). Construction of training process of tennis players aged 5–6 years, taking into account the specifics of the development and control of their coordination skills. *Physical Education of Students*, *6*, 17–23. doi:10.15561/20755279.2014.0604

Kozina, Z., Repko, O., Ionova, O., Boychuk, Y., & Korobeinik, V. (2016). Mathematical basis for the integral development of strength, speed and endurance in sports with complex manifestation of physical qualities. *Journal of Physical Education and Sport, 16*(1), 70–76. doi:10.7752/jpes.2016.01012

Kozina, Z., Repko, O., Kozin, S., Kostyrko, A., Yermakova, T., Goncharenko, V. (2016). Motor skills formation technique in 6 to 7-year-old children based on their psychological and physical features (rock climbing as an example). *Journal of Physical Education and Sport, 16*(3), 866 – 874. doi:10.7752/jpes.2016.03137

Kozina, Z.L., & Popova, N. (2013). Faktornaia struktura fizicheskoj podgotovlennosti devochek 11–15 let [Factorial structure of physical fitness of 11–15 years' age girls]. *Teoria ta Metodika Fizicnogo Vihovanna, 4*, 48–52.

Kravchuk, T.M., & Kurochka, O.S. (2013). Primenenie sredstv baleta v fizicheskom vospitanii devochek starsheklassnic [Application of body ballet means in physical education of senior pupils-girls]. *Teoria ta Metodika Fizicnogo Vihovanna, 4,* 40–47.

Kuzmin, V. A., Kopylov, Y. A., Kudryavtsev, M. D., Tolstopyatov, I. A., Galimov, G. Y., & Ionova, O. M. (2016). Formation of professionally important qualities of students with weakened motor fitness using a health related and sport-oriented training program. *Journal of Physical Education and Sport, 16*(1), 136–145. doi:10.7752/jpes.2016.01023

Lebedinskiy, V.Yu., Bomin, V.A., & Litvinova, O.V. (2012). Control of the functional state of organism of sportsmen-youths in educational training process with the use of telemetric system. *Physical Education of Students*, *2*, 54–56.

Leer, E.I., & Zvereva, S.V. (2013). Osobennosti vliianiia muzyki raznykh napravlenij na fiziologicheskie kharakteristiki aktivnosti serdca iunoshej i devushek 14–16 let [Specific features of music influence on physiological characteristics of 14-16 years' age boys and girls' heart functioning]. *Molodoj uchenyj*. *1*, 310–318.

Levushkin, S.P., & Son'kin, V.D. (2009). Problema optimizacii fizicheskogo sostoianiia shkol'nikov sredstvami fizicheskogo vospitaniia [Problem of schoolchildren's physical condition optimization by means of physical education]. *Fiziologiia cheloveka*, *35*(1), 67–74.

Li, Y.-C., Wu, S. K., Cairney, J., & Hsieh, C.-Y. (2011). Motor coordination and health-related physical fitness of children with developmental coordination disorder: A three-year follow-up study. *Research in Developmental Disabilities*, *32*(6), 2993–3002. doi:10.1016/j.ridd.2011.04.009

Liakh, V.I. (2000). *Dvigatel'nye navyki shkol'nikov* [Motor skills of school children]. Moscow: Terra-Sport.

Limarenko, O.V. (2010). Interaktivnyj monitoring zdorov'ia kak universal'naia forma kontrolia kachestva fizkul'turnogo obrazovaniia shkol'nikov [Interactive monitoring of health as universal form of control over schoolchildren's physical education]. *Zdorov'e dlia vsekh, 1*, 28–34.

Limbers, C.A., Newman, D.A., & Varni, J.W. (2008). Factorial Invariance of Child Self-Report across Age Subgroups: A Confirmatory Factor Analysis of Ages 5 to 16 Years Utilizing the PedsQL 4.0 Generic Core Scales. *Value in Health*, *11*(4), 659–668. doi:10.1111/j.1524–4733.2007.00289.x

Lisenchuk, G.A., Zaloylo, V.V., & Guravlev, S.O. (2010). Specification of physical preparation of football players of 15-16 years old as a basic for complex control. *Physical Education of Students*, *1*, 75–79.

Lochbaum Marc, R., Jean-Noel, Javan, Çetinkalp, Zişan Kazak, Vallejo-Reyes, Felipe, Andrés, & Mena-Campbell, Jose, (2016). 2 x 2 achievement goals profiles in chilean competitive and recreational athletes: a first look. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 1*, 41–46. doi:10.15561/18189172.2016.0106

Lochbaum, Marc., & Stevenson, Sarah. (2014). Effects of achievement goals on perceptions of success and achievement emotions in minority children. *Kinesiology, 46*(2), 202–209.

Lochbaum, Marc., R., Okafor, Emeka., T., Brenner David., C., & Cetinkalp, Zisan., Kazak. (2015). Achievement goals and intensivity of physical activity during free play in children: the moderating role of perceived sport confidence. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 11*,72–77. doi:10.15561/18189172.2015.1111

Lopat'yev, A.O. (2007). Modeliuvannia iak metodologiia piznannia [Simulation as methodology of cognition]. *Teoria ta metodika fizicnogo vihovanna*, *8*, 4–10.

Lopat'yev, A.O., Vlasov, A.P., & Trach, V.M. (2013). Informatsiyni ta enerhetychni aspekty analizu skladno-koordynatsiynykh rukhiv stril'tsiv [Informational and energetic aspects of analysis of shooters' movements with complex coordination]. *Teoria ta metodika fizicnogo vihovanna*, *4,* 19–24. doi:10.17309/tmfv.2013.4.1032

Lulzim, I. (2012). Discriminant analysis of morphologic and motor parameters of athlete and non athlete girl pupils of primary school on age 14 to 15 years. *Research in Kinesiology*, *40*(2), 185–190.

Majfat, S.P. (2014). Teoriia i praktika funkcional'nogo kontrolia fizicheskoj rabotosposobnosti shkol'nikov [Theory and practice of schoolchildren's physical workability's functional control]. *Sovremennaia nauka: aktual'nye problemy teorii i praktiki*, *11–12*, 45–48.

Mamaev, A.R., & Ivanova, E.N. (2014). Razvitie dvigatel'nykh kachestv podrostkov v usloviiakh ozdorovitel'nykh kompleksov [Training of adolescents'motor abilities in conditions of health improvement centers]. *Sovremennye issledovaniia social'nykh problem*, *10*(42), 76–84.

Meilstrup, C., Thygesen, L. C., Nielsen, L., Koushede, V., Cross, D., & Holstein, B. E. (2016). Does self-efficacy mediate the association between socioeconomic background and emotional symptoms among schoolchildren? *International Journal of Public Health, 1*,8–12. doi:10.1007/s00038-016-0790-3

Milić, M., Milavić, B., & Grgantov, Z. (2014). Relations between kinesiological engagement, psychological characteristics and types of mobile phone and computer use in adolescents. *Facta Universitatis, Series: Physical Education and Sport, 2,* 191 – 201.

Nosko, M., Razumeyko, N., Iermakov, S., & Yermakova, T. (2016). Correction of 6 to 10-year-old schoolchildren postures using muscular-tonic imbalance indicators. *Journal of Physical Education and Sport, 16*(3), 988–999. doi:10.7752/jpes.2016.03156

Parniakov, D.M. (2015). Avtomatizirovannyj kontrol' pokazatelej fizicheskoj podgotovlennosti i fizicheskogo razvitiia shkol'nikov srednego zvena [Automated control of indicators of secondary schoolchildren's physical fitness and physical condition]. *Molodoj uchenyj*, *11*, 604–608.

Piatunina, O.I., & Gajnanova, N.K. (2006). Reakcii serdechno-sosudistoj sistemy na nagruzku u devochek-podrostkov [Reactions of girls teens' cardio-vascular system to load]. *Fizicheskaia kul'tura: vospitanie, obrazovanie, trenirovka*, *3*, 14–16.

Podlog, Leslie., Lochbaum, Marc., & Kleinert, Jens. (2013). The relationship between self-presentation concerns and pre-game affect among adolescent American football players. *Journal of Sport and Health Science*, *2*(3), 168–175.

Podrigalo, L. V., Iermakov, S. S., Galashko, N. I., Galashko, M. N., & Dzhym, V. Y. (2015). Assessment of arm wrestlers'adaptation status on the base of saliva biochemical characteristics in dynamic of competition and training loads. *Journal of Physical Education and Sport, 15*(4), 849–856. doi:10.7752/jpes.2015.04131

Podrigalo, L. V., Iermakov, S. S., Nosko, M. O., Galashko, M. N., & Galashko, N. I. (2015). Study and analysis of armwrestlers' forearm muscles' strength. *Journal of Physical Education and Sport, 15*(3), 531–537. doi:10.7752/jpes.2015.03080

Pomeshchikova, I. P., Shevchenko, O. O., Yermakova, T. S., Paievskyi, V. V., Perevoznyk, V. I., Koval, M. V., . . . Moiseienko, O. K. (2016). Influence of exercises and games with ball on coordination abilities of students with disorders of muscular skeletal apparatus. *Journal of Physical Education and Sport, 16*(1), 146–155. doi:10.7752/jpes.2016.01024

Pryimakov, O., Iermakov, S., Kolenkov, O., Samokish, I., & Juchno, J. (2016). Monitoring of functional fitness of combat athletes during the precompetitive preparation stage. *Journal of Physical Education and Sport, 16*(2), 551–561. doi:10.7752/jpes.2016.02087

Ruiz, J.R., Silva, G., & Oliveira, N. (2009). Criterion-related validity of the 20-m shuttle run test in youths aged 13–19 years. *Journal of Sports Sciences, 27*(9), 899–906. doi:10.1080/02640410902902835

Santos, R., Mota, J., & Santos, D.A. (2014) Physical fitness percentiles for Portuguese children and adolescents aged 10–18 years. *Journal of Sports Sciences, 32*(16), 1510–1518. doi:10.1080/02640414.2014.906046

Selitrenikova, T.A., & Korolev, S.A. (2014). Testirovanie dvigatel'nykh sposobnostej shkol'nikov posredstvom issledovaniia vozmozhnostej oporno-dvigatel'nogo apparata [Testing of pupils' motor abilities by studying of muscular skeletal apparatus's potentials]. *Adaptivnaia fizicheskaia kul'tura*, *1*(57), 25–27.

Sergiienko, L.P. (2001). *Testuvannia rukhovikh zdibnostej shkoliariv* [Testing of school children's motor skills]. Kiev: Olympic Literature.

Simonov, S.N., Chastikhin, A.A., Gulin, A.V., & Apokin, V.V. (2016). Sinergeticheskoe modelirovanie sensitivnykh periodov razvitiia dvigatel'nykh sposobnostej shkol'nikov [Synergetic simulation of sensitive periods of pupils' motor abilities' development]. *Teoriia i praktika fizicheskoj kul'tury, 1*, 83–86.

Skidan, A.A., Sevdalev, S.V., & Vrublewskiy, E.P. (2015). Content of health related shaping training methodic for girls in the process of physical education. *Physical Education of Students*, *6,* 56–62. doi:10.15561/20755279.2015.0608

Sokolov, A.Ia., & Grechkina, L.I. (2008). Uroven' fizicheskogo razvitiia u podrostkov g. Magadana s razlichnymi tipami gemodinamiki [Physical condition level of Magadan adolescents with different types of hemo-dynamic]. *Valeologiia*, *4*, 12–17.

Solianik, I.I. (2013). Osobennosti razvitiia dvigatel'nykh sposobnostej u mal'chikov 6–7 klassov [Specific features of motor abilities' development in boys of 6–7 forms]. *Teoria ta Metodika Fizicnogo Vihovanna, 3*, 22–31.

Tuisheva, V.S., & Ivanenko, O.A. (2015). Fizicheskoe razvitie i fizicheskaia podgotovlennost' devushek 14–16 let, specializiruiushchikhsia v sportivnoj khod'be [Physical condition and physical fitness of 14–16 years' age girls, who specialize in race walking]. *Fizicheskaia kul'tura, sport–nauka i praktika, 2*, 60–63.

Vertel, A.V., & Gradusov, V.A. (2011). Factor structure of physical training of young volleyball players of 10–14 years old at the stage of initial and previous basic training. *Physical Education of Students*, *1*, 25–29.

Zaharova, L.V., & Lyulina, N.V. (2014). Basis of integrated approach to sports and recreational activities of students of special medical groups. *Physical Education of Students*, *1,* 17–21. doi:10.6084/m9.figshare.903688

Zaporozhanov, V.A., & Boraczynski, Tomasz, (2015). Discussion on the concepts of "coordination" and "agility" in terms of physical education. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 3*, 15–19. doi:10.15561/18189172.2015.0303

Zaporozhanov, V.A., & Boraczynski, Tomasz. (2015). Discussion on the concepts of "coordination" and "agility" in terms of physical education. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 3*, 15–19. doi:10.15561/18189172.2015.0303

Zaporozhanov, V.A., Kochanowicz, K., & Kochanowicz, A. (2014). Improvement of comprehensive assessment of specially trained childhood and adolescence gymnasts. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports, 10*, 3–7. doi:10.5281/zenodo.10482

Zinchenko, I.O. (2009). Perfection of technical preparation in cheerleading (work is with pompons). *Physical Education of Students*, *3*, 31–37.