Power abilities: the structure of development in girls of 12-14 years old

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Abstract

Purpose:	To determine the structure of the development of power abilities in girls aged 12-14 years
Material:	Girls aged 12 years (n = 20) participated in the study; 13 years (n = 27), 14 years old (n = 30). Factorial analysis performed.
Results:	It is determined that the most informative in girls of 12-14 years old are the following tests: which characterize the development of dynamic and static strength of muscles of the feet and hands (girls of 12 years old); which characterize the development of static, high-speed strength of leg muscles, static and dynamic strength of the muscles of the abdomen and hands (girls of 13 years old); which characterize the development of the static and dynamic strength of leg muscles, the dynamic strength of the muscle of the hands (girls of 14 years old).
Conclusions:	Factor analysis allowed to determine informative indicators for controlling the development of power abilities in girls of 12-14 years old. The greatest weight in power preparedness has the relative and static strength of the leg muscles. In the second place, girls of 12-13 years old have the development of muscle strength shoulder girdle. 14 years old girls in second place, have the development of dynamic and static strength of the abdominal muscles and the dynamic strength of muscles of the shoulder girdle. Girls of 12 years old in third place have the development of coordination of movements, the static strength of the shoulder girdle and the dynamic strength of the back muscles. Girls of 13 years in the third place have development of the development of muscle strength of the abdomen. Girls of 14 years in third place have development of high-speed force and coordination of movements.
Keywords:	girls, strength training, factor analysis, structure of force readiness.

Introduction

The problem of studying motor activity is one of the most important in the field of physical education [1, 2]. Physical education of schoolchildren is aimed at increasing the motor activity of children and adolescents [3, 4] and solves the following problem:

• optimizing the physical development, strengthening and health of the child [5, 6];

• improvement of the process of development of motor abilities [7, 8];

• improvement of the process of training physical exercises [9, 10].

In the structure of physical education, power abilities relate to the basic, their level of development affects the manifestation of motor abilities and the effectiveness of teaching physical exercises of schoolchildren [7, 11]. Based on numerous studies, conclusions are drawn:

• on the effectiveness of complex development of strength, vigor, coordination, endurance and flexibility in children [12, 13];

• on the influence of the level of development of force on the process of learning the physical exercises of schoolchildren [7, 14];

• on the effectiveness of the use of means and methods of training in the development of power capabilities [15, 16].

In previously published works, attention was focused on: studying the relationship of indicators of the level of motor abilities' development [7, 17]; determining the structure of motor preparedness in children and adolescents [18, 19].

Multidimensional methods of mathematical statistics such as factor and discriminant analysis [7, 20] are effective for studying the structure of motor readiness of schoolchildren. Using factor analysis allowed to establish the structure of motor readiness of schoolchildren [21, 22]. However, in available literature there is not enough data on the peculiarities of the structure of power abilities development among middle class students.

Thus, the study of the peculiarities of the structure of power abilities development in girls of 12-14 years old is relevant.

The purpose of the research is to determine the structure of power abilities development among girls aged 12-14 years.

Materials and methods

Study participants. The study involved girls: 12 (n =20), 13 (n = 27), 14 (n = 30) years old.

The study protocol was approved by the Ethical Committee of H. S. Skovoroda Kharkiv National Pedagogical University. In addition, the 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.

Study organization. The study used the following methods: analysis and collation of scientific and methodological literature, general scientific methods of theoretical level, such as analogy, analysis, synthesis, abstraction, induction, as well as general scientific methods of empirical level: observation, testing, experiment.

Testing procedure. The testing program included well-known tests [7, 12, 23]. To evaluate motor preparedness, the study recorded the results of motor tests:

– Test 1. Pull-Up / Chin Up Test (low crossbar), quantity of times;
– Test 2. Bent Arm Hang Test (two hands), sec.;
– Test 3. Pull-Up / Chin Up Test (Rope Climbing), quantity of times;
– Test 4. Cadence Push-Up Test, quantity of times;
– Test 5. The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds;
– Test 6. Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times;
– Test 7. Hanging Leg Raises, sec.;
– Test 8. Decline Reverse Crunch on Bench, quantity of times;
– Test 9. Trunk Lift Test, quantity of times;
– Test 10. Squats Test (two legs), quantity of times;
– Test 11. Single Leg Squat (SLS) Test - right leg, quantity of times;
– Test 12. Single Leg Squat (SLS) Test - left leg, quantity of times;
– Test 13. Single Leg Squat (Pistol) - right leg;
– Test 14. Single Leg Squat (Pistol) - left leg;
– Test 15. Handgrip Strength Test, kg;
– Test 16. Standing Long Jump Test (Broad Jump), cm;
– Test 17. Eurofit Sit Up Test (for 30 sec.), quantity of times;
– Test 18. 4x9 m shuttle test, sec.;
– Test 19. Hand tapping test, sec.;
– Test 20. Seated Forward Bend, cm;
– Test 21. Flamingo Balance test - single leg balance test.

Statistical analysis. The IBM SPSS 20 statistical analysis software was used to process the study materials. A factor analysis was performed, for which the study used principal component analysis with the rotation method: Variamax with Kaiser Normalization.

Results

Tables 1-3 show the results of factor analysis.

For girls aged 12 years have been distinguished six factors, which explain the variance variation by 86,017%.

The first factor has a weight of 22,036%. The factor with the greatest correlation is the following:
• Test 14 "Single Leg Squat (Pistol) - left leg" - 0,940;
• Test 12 "Single Leg Squat (SLS) Test - left leg, quantity of times" - 0,926;
• Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" - 0,919;
• Test 13 "Single Leg Squat (Pistol) - right leg" - 0,912.

The factor characterizes the development of the relative and static strength of the leg muscles.

The second factor is 15.264%. The factor with the greatest correlation is the following:
• Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" - 0,904;
• Test 4 "Cadence Push-Up Test, quantity of times" - 0,834;
• Test 3 "Pull-Up / Chin Up Test (Rope Climbing), quantity of times" - 0,669.

The factor characterizes the development of muscle strength of the shoulder girdle.

The third factor has a weight of 14.142%. The factor with the greatest correlation is the following:
• Test 18 "4x9 m shuttle test, sec." – -0,902;
• Test 5 "The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds" – 0,755;
• Test 9 "Trunk Lift Test, quantity of times" – 0,606.

The factor characterizes the development of coordination of movements, the static strength of the shoulder girdle and the dynamic strength of the back muscles.

The fourth factor has a weight of 13.593%. The factor with the greatest correlation is the following:
• Test 19 "Hand tapping test, sec." – -0,843;
• Test 17 "Eurofit Sit Up Test (for 30 sec.), quantity of times" – 0,729;
• Test 15 "Handgrip Strength Test, kg" – 0,723;
• Test 16 "Standing Long Jump Test (Broad Jump), cm" – 0,723.

The factor characterizes the complex development of motor abilities on the system of tests "Eurofit".

The fifth factor has a weight of 13.224%. The factor with the greatest correlation is the following:
• Test 7 "Hanging Leg Raises, sec." – 0,861;
• Test 6 "Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times" – 0,840;
• Test 21 "Flamingo Balance test - single leg balance test" – -0,703;
• Test 8 " Decline Reverse Crunch on Bench, quantity of times " – 0,625.

The factor characterizes the development of leg muscle strength.

The sixth factor has a weight of 7.757%. The factor with the greatest correlation is the following:
• Test 2 "Bent Arm Hang Test (two hands), sec." – 0,810.
• Test 20 "Seated Forward Bend, cm" - -0,458;
• Test 9 "Trunk Lift Test, quantity of times" - 0,448.

The factor characterizes the development of static muscle strength of the shoulder girdle.

Analysis of communities shows that the most informative in the structure of motor fitness girls 12 years are the following:
• Test 16 "Standing Long Jump Test (Broad Jump), cm" – 0,959;
• Test 5 "The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds"

Table 1. Factor structure of motor preparedness of the girls 12 years old. Method: principal component analysis. Rotation method: Varimax with Kaiser Normalization (n = 20)

No	Test	Component						h²
		1	2	3	4	5	6	
1	Pull-Up / Chin Up Test (low crossbar), quantity of times		,904					,926
2	Bent Arm Hang Test (two hands), sec.						**,810**	,798
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times		,669		,566			,881
4	Cadence Push-Up Test, quantity of times	**,834**	,342					,871
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds		,525	**,755**				,957
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times					**,840**	,309	,832
7	Hanging Leg Raises, sec.					,861		,805
8	Decline Reverse Crunch on Bench, quantity of times	,319	,510			,625		,810
9	Trunk Lift Test, quantity of times	,509		,606			,448	,871
10	Squats Test (two legs), quantity of times	,608		,561			,355	,893
11	Single Leg Squat (SLS) Test - right leg, quantity of times	,919						,941
12	Single Leg Squat (SLS) Test - left leg, quantity of times	,926						,949
13	Single Leg Squat (Pistol) - right leg	,912						,940
14	Single Leg Squat (Pistol) - left leg	,940						,901
15	Handgrip Strength Test, kg			-,310	,723			,674
16	Standing Long Jump Test (Broad Jump), cm		,395	,455	**,723**			,959
17	Eurofit Sit Up Test (for 30 sec.), quantity of times		,432	,322	**,729**			,900
18	4x9 m shuttle test, sec.			-,902				,915
19	Hand tapping test, sec.				-,843			,804
20	Seated Forward Bend, cm	,422	-,356	-,416		-,309	-,458	,802
21	Flamingo Balance test - single leg balance test					-,703		,636
	% dispersion	22,036	15,264	14,142	13,593	13,224	7,757	86,017

– 0,957;
- Test 12 "Single Leg Squat (SLS) Test - left leg, quantity of times" – 0,949;
- Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" – 0,941;
- Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" – 0,926.

The above tests describe the development of the dynamic and static strength of the muscles of the feet and hands of girls aged 12 years.

Sixteen factors have been identified among girls aged 13 years, which explain the variation of dispersion by 75.876% (Table 2).

The first factor has a weight of 22.019%. The factor with the greatest correlation is the following:
- Test 13 "Single Leg Squat (Pistol) - right leg" - 0,894;
- Test 14 "Single Leg Squat (Pistol) - left leg" - 0,855;
- Test 10 "Squats Test (two legs), quantity of times" – 0,824;
- Test 12 "Single Leg Squat (SLS) Test - left leg, quantity of times" - 0,786;
- Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" - 0,719.

The factor characterizes the development of the relative and static strength of the leg muscles.

The second factor has a weight of 16.518%. The factor with the greatest correlation is the following:
- Test 3 "Pull-Up / Chin Up Test (Rope Climbing), quantity of times" - 0,838;
- Test 8 " Decline Reverse Crunch on Bench, quantity of times " - 0,824;
- Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" - 0,817.

The factor characterizes the development of muscle

Table 2. Factor structure of motor preparedness of the girls 13 years old. Method: principal component analysis. Rotation method: Varimax with Kaiser Normalization (n = 27)

No	Test	Component						h²
		1	2	3	4	5	6	
1	Pull-Up / Chin Up Test (low crossbar), quantity of times		,817					,748
2	Bent Arm Hang Test (two hands), sec.	,586				-,547		,683
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times		,838					,757
4	Cadence Push-Up Test, quantity of times		-,373	-,309	,648			,724
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds		,616	,334				,666
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times			,880				,869
7	Hanging Leg Raises, sec.			,865				,841
8	Decline Reverse Crunch on Bench, quantity of times		,824					,812
9	Trunk Lift Test, quantity of times		,615	,437	-,326			,739
10	Squats Test (two legs), quantity of times	,824						,795
11	Single Leg Squat (SLS) Test - right leg, quantity of times	,719			-,456			,769
12	Single Leg Squat (SLS) Test - left leg, quantity of times	,786						,776
13	Single Leg Squat (Pistol) - right leg	,894						,874
14	Single Leg Squat (Pistol) - left leg	,855						,778
15	Handgrip Strength Test, kg	-,308				-,676		,643
16	Standing Long Jump Test (Broad Jump), cm	,467		,507			**,512**	,798
17	Eurofit Sit Up Test (for 30 sec.), quantity of times				,790			,738
18	4x9 m shuttle test, sec.		-,348		-,370	**,572**		,758
19	Hand tapping test, sec.						**,857**	,812
20	Seated Forward Bend, cm			,599		,566		,756
21	Flamingo Balance test - single leg balance test	,643						,598
	% dispersion	22,019	16,518	14,428	8,760	7,688	6,464	75,876

strength of the shoulder girdle.

The third factor has a weight of 14,428%. The factor with the greatest correlation is the following:

- Test 6 "Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times" – 0,880;
- Test 7 "Hanging Leg Raises, sec." – 0,865;
- Test 20 "Seated Forward Bend, cm" – 0,599.

The factor characterizes the development of the strength of the muscles of the abdomen.

The fourth factor has a weight of 8,760%. The factor with the greatest correlation is the following:

- Test 17 "Eurofit Sit Up Test (for 30 sec.), quantity of times" – 0,790;
- Test 4 "Cadence Push-Up Test, quantity of times" – 0,648;
- Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" - -0,456.

The factor characterizes the complex development of force.

The fifth factor has a weight of 7,688%. The factor with the greatest correlation is the following:

- Test 15 "Handgrip Strength Test, kg" – -0,676;
- Test 18 "4x9 m shuttle test, sec." – 0,572;
- Test 21 "Flamingo Balance test - single leg balance test" – -0,703;
- Test 20 "Seated Forward Bend, cm" – 0,566.

The factor characterizes the complex development of motor abilities on the system of tests "Eurofit".

The sixth factor has a weight of 6,464%. The factor with the greatest correlation is the following:

- Test 19 "Hand tapping test, sec." – 0,857.
- Test 16 "Standing Long Jump Test (Broad Jump), cm" - 0,512;

The factor characterizes the development of velocity force.

The analysis of communities shows that the most

Table 3. Factor structure of motor preparedness of the girls 14 years old. Method: principal component analysis. Rotation method: Varimax with Kaiser Normalization (n = 30)

No	Test	Component							h²
		1	2	3	4	5	6	7	
1	Pull-Up / Chin Up Test (low crossbar), quantity of times		,794				,425		,862
2	Bent Arm Hang Test (two hands), sec.					-,302		,863	,864
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times				**-,500**	-,353	**,611**		,860
4	Cadence Push-Up Test, quantity of times				,504			**-,420**	,779
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds					,870			,828
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times		,753						,788
7	Hanging Leg Raises, sec.		,826						,800
8	Decline Reverse Crunch on Bench, quantity of times		,821						,778
9	Trunk Lift Test, quantity of times		,461	,335		,552			,668
10	Squats Test (two legs), quantity of times	,731							,627
11	Single Leg Squat (SLS) Test - right leg, quantity of times	,908							,887
12	Single Leg Squat (SLS) Test - left leg, quantity of times	,911							,866
13	Single Leg Squat (Pistol) - right leg	,896							,913
14	Single Leg Squat (Pistol) - left leg	,889							,879
15	Handgrip Strength Test, kg				,867				,842
16	Standing Long Jump Test (Broad Jump), cm			,878					,833
17	Eurofit Sit Up Test (for 30 sec.), quantity of times	,389		,360	-,455			,331	,673
18	4x9 m shuttle test, sec.			-,832					,774
19	Hand tapping test, sec.		,631		,402			-,343	,774
20	Seated Forward Bend, cm						-,829		,710
21	Flamingo Balance test - single leg balance test		-,485			,362		**,495**	,700
	% dispersion	19,467	17,126	9,829	8,772	8,497	8,364	7,490	79,544

informative in the structure of motor preparedness girls aged 13 years are the following:

- Test 13 "Single Leg Squat (Pistol) - right leg" – 0,874;
- Test 6 "Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times" – 0,869;
- Test 7 "Hanging Leg Raises, sec." – 0,841;
- Test 19 "Hand tapping test, sec." – 0,812;
- Test 16 "Standing Long Jump Test (Broad Jump), cm" – 0,798.

The tests described characterize the development of static, high-speed strength of leg muscles, static and dynamic strength of muscles of the abdomen and hands in girls 13 years.

Seven factors have been identified in girls for 14 years, which explain the variance of variance by 79.544%.

The first factor has a weight of 19.467%. The factor with the greatest correlation is the following:

- Test 12 "Single Leg Squat (SLS) Test - left leg, quantity of times" - 0,911;
- Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" - 0,908;
- Test 13 "Single Leg Squat (Pistol) - right leg" – 0,896;
- Test 14 "Single Leg Squat (Pistol) - left leg" - 0,889.

The factor characterizes the development of the relative and static strength of the leg muscles.

The second factor is 17.126%. The factor with the greatest correlation is the following:

- Test 7 "Hanging Leg Raises, sec." - 0,826;
- Test 8 " Decline Reverse Crunch on Bench, quantity of times " - 0,821;

PEDAGOGICS medical-biological
PSYCHOLOGY problems of physical
training and sports

- Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" - 0,794;
- Test 6 "Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times" – 0,753.

The factor characterizes the development of the dynamic and static strength of the abdominal muscles and the dynamic force of muscles of the shoulder girdle.

The third factor has a weight of 9.829%. The factor with the greatest correlation is the following:

- Test 16 "Standing Long Jump Test (Broad Jump), cm" – 0,878;
- Test 18 "4x9 m shuttle test, sec." – -0,832.

The factor characterizes speed-power and coordination readiness.

The fourth factor is weighing 8,772%. The factor with the greatest correlation is the following:

- Test 15 "Handgrip Strength Test, kg" – 0,867;
- Test 4 "Cadence Push-Up Test, quantity of times" – 0,504;
- Test 3 "Pull-Up / Chin Up Test (Rope Climbing), quantity of times" - -0,500.

The factor characterizes the development of the strength of the brush and the relative strength of the muscles of the shoulder girdle.

The fifth factor has a weight of 8,497%. The factor with the greatest correlation is the following:

- Test 5 "The subject lies in prone position, arms bent at the elbow 90 degrees – hold position in seconds" – 0,870;
- Test 9 "Trunk Lift Test, quantity of times" – 0,552.

The factor characterizes the development of the static muscle strength of the shoulder girdle and the dynamic strength of the back muscles.

The sixth factor has a weight of 8,364%. The factor with the greatest correlation is the following:

- Test 20 "Seated Forward Bend, cm" – -0,829;
- Test 3 "Pull-Up / Chin Up Test (Rope Climbing), quantity of times" - 0,611;
- Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" - 0,425.

The factor characterizes the development of flexibility and dynamic strength of muscles of the shoulder girdle.

The seventh factor has a weight of 7.490%. The factor with the greatest correlation is the following:

- Test 2 "Bent Arm Hang Test (two hands), sec." – 0,863;
- Test 21 "Flamingo Balance test - single leg balance test" - 0,495;
- Test 4 "Cadence Push-Up Test, quantity of times" - -0,420.

The factor characterizes the development of static and dynamic muscle strength of the shoulder girdle and coordination abilities.

The analysis of communities shows that the most informative in the structure of motor readiness of girls aged 14 years are the following:

- Test 13 "Single Leg Squat (Pistol) - right leg" – 0,913;
- Test 11 "Single Leg Squat (SLS) Test - right leg, quantity of times" – 0,887;

- Test 14 "Single Leg Squat (Pistol) - left leg" – 0,879;
- Test 12 "Single Leg Squat (SLS) Test - left leg, quantity of times" – 0,866;
- Test 2 "Bent Arm Hang Test (two hands), sec." – 0,864;
- Test 1 "Pull-Up / Chin Up Test (low crossbar), quantity of times" – 0,862;
- Test 3 "Pull-Up / Chin Up Test (Rope Climbing), quantity of times" – 0,860.

The above presented tests describe the development of static and dynamic strength of the leg muscles, the dynamic strength of the muscle of the hands of girls aged 14 years.

Discussion

The presented results indicate that the power abilities have structural features of development in girls of 12-14 years old. It was found that girls have the greatest weight in the development with relative and static strength of leg muscles (22,036%, 22,019%, 19,467% respectively). In girls of 12-13 years old in the second place the development of muscle strength shoulder girdle (15.264%, 16.518% respectively). In girls aged 14 years in second place, the development of dynamic and static strength of abdominal muscles and dynamic muscle strength of the shoulder girdle (17.126%). In girls aged 12 years in third place, the development of coordination of movements, the static strength of the shoulder girdle and the dynamic strength of the muscles of the back (14,142%). In girls aged 13 years in the third place the development of muscle strength of the abdomen (14,428%), girls aged 14 years – speed and coordination of movements (9,829%).

It is confirmed that multidimensional methods of mathematical statistics are effective for the study of the strength training structure of girls aged 12-14 years: factor and discriminant analysis [7, 20]. It is added that the use of factor analysis allows to determine the structure of the development of power abilities and their interrelation with endurance in girls aged 12-14 years [21, 22].

The obtained results characterize the peculiarities of the dynamics of force readiness of middle classes girls and complement the data of Veremeenko [24], Ivashchenko et al. [25] on the regularities of motor preparedness of children and adolescents. The authors recognize that with age, the weight of high-speed force and coordination of movements in the structure of motor-preparedness of girls increases. Our results complement the data on the development of coordination of movements in adolescents [14, 26].

On the basis of the analysis of communities it is determined that the most informative in girls aged 12-14 years are the following tests: which characterize the development of dynamic and static strength of muscles of the legs and hands (girls 12 years old); which characterize the development of static, high-speed strength of leg muscles, static and dynamic strength of the muscles of the abdomen and hands (girls 13 years old); which characterize the development of the static and dynamic strength of leg muscles, the dynamic strength of the muscle of the hands

200

(girls 14 years old). These results supplement the data of other authors [22, 25] on pedagogical control in the physical education of schoolchildren.

The results obtained can be applied in the process of planning force training of girls 12-14 years old. The structure of force's preparedness of girls points to the need for a comprehensive development of power abilities. Attention is paid to the development of the static and dynamic strength of the leg muscles. The most informative tests can be used to control girls' preparedness.

Consequently, the problem of development of power abilities is considered from the point of view of age dynamics [22] and the planning of work force in training sessions [27, 28]. The discussion of data is carried out from the standpoint of the purpose of the analysis [29]. Disclaimers and methodological approaches to the purpose of the analysis are set out in the work of Fisher [30].

Further investigations require the study of patterns of development and the relationship between strength and endurance of muscles among boys of middle school age.

Conclusions

Factor analysis allowed to determine informative indicators for controlling the development of power abilities in girls of 12-14 years old. The greatest weight in power preparedness has the relative and static strength of the leg muscles. In the second place, girls of 12-13 years old have the development of muscle strength shoulder girdle. 14 years old girls in second place, have the development of dynamic and static strength of the abdominal muscles and the dynamic strength of muscles of the shoulder girdle. Girls of 12 years old in third place have the development of coordination of movements, the static strength of the shoulder girdle and the dynamic strength of the back muscles. Girls of 13 years in the third place have development of the development of muscle strength of the abdomen. Girls of 14 years in third place have development of high-speed force and coordination of movements.

Conflict of Interest

The authors state that there is no conflict of interest.

References

1. Bădicu G. Physical Activity and Health-Related Quality of Life in Adults from Braşov, Romania. *Education Sciences*, 2018; 8(2): 52. doi:10.3390/educsci8020052

2. Bădicu G, Balint L. The influence of leisure sports activities on social health in adults. *SpringerPlus*, 2016; 5(1): 1647. doi:10.1186/s40064-016-3296-9

3. Balsevich VK. *Ontokinesiology of man*. Moscow: Theory and practice of physical culture; 2000. (in Russian)

4. Novak D, Podnar H, Emeljanovas A, Marttinen R. Comparison of Fitness Levels between Croatian and Lithuanian Students. *Montenegrin Journal of Sports Science and Medicine*, 2015; 4(1): 5–11.

5. Krutsevych TYu, Bezverkhnia HV. *Recreation in the physical culture of different population groups: teaching. manual.* Kiev: Olympic Literature; 2010. (in Ukrainian)

6. Bădicu G. Teaching Methods Used in Primary Education for Making Physical Education Class More Effective. *Teorìâ Ta Metodika Fìzìčnogo Vihovannâ*, 2018; 18(2): 86-92. doi:10.17309/tmfv.2018.2.05

7. Ivashchenko OV. *Modelling of physical education students*. Kharkiv: OVS; 2016. (in Ukrainian)

8. Emeljanovas A, Mieziene B, Putriute V. The Relationship Between Physical Activity and Content of the Physical Education Classes in 11-12 Years Old Lithuanian Schoolchildren. The Pilot Study. *Croatian Journal of Education-Hrvatski Casopis Za Odgoj I Obrazovanje*, 2015; 17(1): 93–120.

9. Ivashchenko O, Abdulkhalikova T, Cieślicka M. Effectiveness of Motor Skills Development in 5th-7th Grade Girls at Different Modes of Physical Exercises. *Teorìâ Ta Metodika Fìzìčnogo Vihovannâ,* 2017;17(4):201-7. doi:10.17309/tmfv.2017.4.1205

10. Ivashchenko O, Khudolii O, Iermakov S, Harkusha S. Physical exercises' mastering level in classification of motor preparedness of 11-13 years old boys. *Journal of Physical Education and Sport,* 2017;17(3):1031-6. doi:10.7752/jpes.2017.03158

11. Ilyin EP. *Psychomotor organization of man: training. for universities*. St. Petersburg: Peter; 2003. (in Russian)

12. Liakh VI. *Driving abilities of schoolchildren: Fundamentals of theory and methods of development*. Moscow: Terra–Sport; 2000. (in Russian)

13. Khudolii OM. *General Fundamentals of Theory and Methodology of Physical Education*. Kharkiv: OVS; 2008. (in Ukrainian)

14. Ivashchenko O, Prykhodko V, Cieslicka M. Movement Coordination: Factor Structure of Development in 5th-7th Grade Girls. *Teorìâ Ta Metodika Fìzìčnogo Vihovannâ*, 2018; 18(1): 38-49. doi:10.17309/tmfv.2018.1.05

15. Liu C, Chen CS, Ho WH, Fule RJ, Chung PH, Shiang TY. The Effects of Passive Leg Press Training on Jumping Performance, Speed, and Muscle Power. *Journal of Strength and Conditioning Research,* 2013; 27(6): 1479–86.

16. Cieślicka M, Ivashchenko O. Discriminant analysis method to determine the power of the boys 11-12 year. *Journal of Education, Health and Sport*, 2016; 6(10): 721-9.

17. Khudolii OM, Ivashchenko OV. *Simulation of the learning process and development of motor abilities in children and adolescents*. Kharkiv: OVS; 2014. (in Ukrainian)

18. Ivashchenko O, Khudolii O, Iermakov S, Lochbaum M, Cieślicka M, Zukow W, Nosko M, Yermakova T. Methodological approaches to pedagogical control of the functional and motor fitness of the girls from 7-9 grades. *Journal of Physical Education and Sport*, 2017; 17(1): 254-261.

19. Khudolii OM, Iermakov SS, Prusik K. Classification of motor fitness of 7-9 years old boys. *Journal of Physical Education and Sport*, 2015; 15(2): 245-253. doi:10.7752/jpes.2015.02038

20. Lopatiev A, Ivashchenko O, Khudolii O, Pjanylo Y, Chernenko S, Yermakova T. Systemic approach and

mathematical modeling in physical education and sports. *Journal of Physical Education and Sport*, 2017; 17 (1):146–155.

21. Ivashchenko O. Methodological Approaches to Pedagogical Control of Motor Readiness of Girls Aged 6-10. *Teorìâ Ta Metodika Fìzičnogo Vihovannâ*, 2017; 17(3): 126-138. doi:10.17309/tmfv.2017.3.1197

22. Ivashchenko O, Kapkan O, Khudolii O, Yermakova T. Informative Indicators of 14-15 Years' Age Boys' Motor Fitness. *Teorìâ Ta Metodika Fìzičnogo Vihovannâ*, 2017; 17(2): 86-97. doi:10.17309/tmfv.2017.2.1193

23. Serhiienko LP. *Testing of motor abilities of schoolchildren.* Kiev: Olympic Literature; 2001. (in Ukrainian)

24. Veremeenko V. Strength Abilities: Features of Their Development in Girls of Middle School Age. *Teorìâ ta Metodika Fìzičnogo Vihovannâ*, 2018; 18(2): 78-85. (in Ukraine) doi:10.17309/tmfv.2018.2.04

25. Ivashchenko O, Khudolii O, Iermakov S, Prykhodko V, Cieslicka M. Movement Coordination: Identification of Age-Related Dynamics of its Development in Girls Aged 11-13. *Teorìâ Ta Metodika Fìzičnogo Vihovannâ*, 2018; 18(2): 93-99. doi:10.17309/tmfv.2018.2.06

26. Prykhodko VV. The Factor Structure of Coordination Abilities Development in 5th-7th Grade Boys. *Teorìâ Ta Metodika Fìzičnogo Vihovannâ*, 2017; 17(4): 191-200. (in Ukraine) doi:10.17309/tmfv.2017.4.1204

27. Blagrove RC, Howe LP, Cushion EJ, Spence A, Howatson G, Pedlar CR, Hayes PR. Effects of Strength Training on Postpubertal Adolescent Distance Runners. *Medicine and Science in Sports and Exercise,* 2018; 50(6): 1224-1232. doi:10.1249/mss.0000000000001543

28. James LP, Haff GG., Kelly VG, Connick MJ, Hoffman BW, Beckman EM. The impact of strength level on adaptations to combined weightlifting, plyometric, and ballistic training. *Scandinavian Journal of Medicine & Science in Sports,* 2018; 28(5): 1494-1505. doi:10.1111/sms.13045

29. Cirer-Sastre R, Beltran-Garrido JV, Corbi F. Contralateral Effects after Unilateral Strength Training: A Meta-Analysis Comparing Training Loads Response. *Journal of Sports Science and Medicine,* 2018; 17(1): 164-166.

30. Fisher JP. Contralateral Effects after Unilateral Strength Training: A Meta-Analysis Comparing Training Loads. *Journal of Sports Science and Medicine,* 2018; 17(1): 163-164.

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