ORIGINAL SCIENTIFIC ARTICLE

PECULIARITIES OF MOTOR FITNESS STRUCTURE OF 9-YEAR-OLD GIRLS

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Purpose. To determine the peculiarities of 9-year-old girls' motor fitness structure.

Materials and methods. The study involved 35 9-year-old girls. The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment. The study used the following research methods: analysis of scientific and methodological literature, pedagogical observations, testing of motor fitness, probabilistic approach to assessing the learning process, methods of mathematical statistics.

Results. The level of fitness of the 9-year-old girls is homogeneous by the development of "agility" and "movement coordination", inhomogeneous – by the development of flexibility, arm strength, vestibular stability, and the level of proficiency in gymnastic exercises. A graphic representation of a two-factor model of testing results shows that the analysis identifies two sets of data with high correlation coefficients. The first set includes tests No. 12, 13, 14, and 7, which characterize the level of proficiency in gymnastic exercises and relative arm strength; the second – tests No. 1, 10, and 5, which characterize the level of movement coordination development.

Conclusions. Based on factor analysis, it was found that the level of proficiency in exercises determines the variation of testing results by 28.394 %, and the development of motor skills is a priority in the educational process at primary school.

The level of proficiency in gymnastic exercises shows that the exercises "Rope climbing in two steps", "Rope climbing in three steps", "One leg swing upward circle" are difficult for 9-year-old girls to perform. Based on the data analysis, it can be argued that the development of "arm strength" and "vestibular stability" ensures the formation of motor skills, and the improvement of their development level is the reserve in training girls aged 9 which will positively influence the formation of motor skills.

Keywords: 9-year-old girls, level of proficiency, motor fitness, motor skills.

Introduction

The importance of increasing schoolchildren's motor activity is pointed out by Krutsevich, Pangelova, and Trachuk (2019), Krutsevich, and Marchenko (2018). Motor activity is viewed as a condition for physical development and formation of cognitive functions (Junger, Salonna, Bergier, Junger, Frömel, Ács, & Bergier, 2019), Haverkamp, Wiersma, Vertesen, van Ewijk, Oosterlaan, and Hartman (2020).

Studies focus on substantiating the amount of motor activity (Kondakov, Voloshina, Kopeikina, & Kadutskaya, 2020); studying the impact of physical exercises on human cognitive functions (Quaney, Boyd, McDowd, Zahner, He, Mayo, & Macko, 2009); developing a technique for teaching physical exercises (Khudolii, Kaplan, Harkusha, Marchenko, & Veremeenko, 2020); a technique for motor abilities development in schoolchildren (Ivashchenko, Khudolii, Prusik, & Giovanis, 2020).

It was found that the positive effect of learning depends on the level of motor abilities development, consistent solving of learning tasks, and rational application of methods (Khudolii, 2019; Ivashchenko, 2020).

However, further research is needed to determine the leading role of motor skills development in the educational environment at primary school.

The study purpose was to determine the peculiarities of 9-year-old girls' motor fitness structure.

Materials and methods

Study Participants

The study involved 35 9-year-old girls. The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment.

Organization of the Study

The study used the following research methods: analysis of scientific and methodological literature, pedagogical observations, testing of motor fitness, probabilistic approach to assessing the learning process, methods of mathematical statistics.

The study recorded the indicators of height (cm), body weight (kg), as well as the results in tests No. 3 "Standing long jump (cm)", No. 4 "Middle- and long-distance running. 300 m running (s)", No. 5 "30 m sprint running from a standing start (s)", No. 6 "Seated forward bend (cm)", No. 7 "Mixed hang rope pull-ups (times)", No. 8 "Shuttle run 4×9 m (s)", No. 9 "Combined movements of arms, torso and legs (points)", No. 10 "Maintenance of stable posture – standing on one leg with closed eyes (s)", No. 11 "Walking along straight line after 5 rotations (deviations in cm)".

The study recorded the primary schoolchildren's level of proficiency in gymnastic exercises. The coefficient was determined by the formula: $p = (m/n) \times 100$, where p is the level of proficiency, m is the number of successfully performed exercises, n is the total number of attempts to perform the exercise. In the experiment, the study controlled the level of proficiency in the following exercises: "Rope climbing in two steps", "Rope climbing in three steps", "One leg swing upward circle".

Statistical Analysis

The study materials were processed using the IBM SPSS 20 statistical analysis software. Factor analysis was performed. In the factor analysis, the study used the model of principal components with the rotation method: Varimax with Kaiser Normalization.

The study protocol was approved by the Ethical Committee of the 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.

Results

Table 1 shows the results of testing the 9-year-old girls' motor fitness.

The analysis of the coefficients of variation of testing results showed that the 9-year-old girls' fitness is homogeneous by the following tests No. 1 "Height, cm" (3.67%); No. 5 "30 m running from a standing start, s" (4.71%); No. 8 "Shuttle run 4×9 m, s" (5.78%); No. 9 "Combined movements of arms, torso and legs, points" (8.64%); No. 3 "Standing long jump, cm" (10.92%); No. 4 "300 m running, s" (14.14%); No. 2 "Body weight, kg" (17.75%).

The inhomogeneity in the level of the girls' fitness is observed in the results of tests: No. 6 "Seated forward bend, cm" (37.04%); No. 10 "Maintenance of stable posture – standing on one leg with closed eyes, s" (56.61%); No. 7 "Mixed hang rope pull-ups, times" (57.89%); No. 11 "Walking along straight line after 5 rotations, deviations in cm" (73.54%).

The coefficient of variation in terms of the level of proficiency in the exercises "Rope climbing in two steps, level of proficiency" (87.5%); "Rope climbing in three steps, level of proficiency" (90.65%); "One leg swing upward circle, level of proficiency" (93.23%) shows that the exercises are difficult to perform.

Table 1. The results of testing the 9-year-old girls' motor fitness ($n = 35$)

No.	Tests	X	s	V, %
1	Height, cm	133.6	4.9	3.67
2	Body weight, kg	32.1	5.7	17.75
3	Standing long jump, cm	119.0	13.0	10.92
4	300 m running, s	113.9	16.1	14.14
5	30 m running from a standing start, s	6.8	0.32	4.71
6	Seated forward bend, cm	8.1	3.0	37.04
7	Mixed hang rope pull-ups, times	1.9	1.1	57.89
8	Shuttle run 4×9 m, s	12.8	0.74	5.78
9	Combined movements of arms, torso and legs, points	8.1	0.7	8.64
10	Maintenance of stable posture – standing on one leg with closed eyes, s	18.9	10.7	56.61
11	Walking along straight line after 5 rotations, deviations in cm	88.8	65.3	73.54
12	Rope climbing in two steps, level of proficiency	24.0	21.0	87.5
13	Rope climbing in three steps, level of proficiency	24.6	22.3	90.65
14	One leg swing upward circle, level of proficiency	25.1	23.4	93.23

Thus, the level of fitness of the 9-year-old girls is homogeneous by the development of "agility" and "movement coordination", inhomogeneous – by the development of flexibility, arm strength, vestibular stability, and the level of proficiency in gymnastic exercises.

Table 2 shows the results of factor analysis. The analysis identified five factors that explain 74.773% of the variation of results.

The first factor has a weight of 28.394%. With the factor, the greatest correlation is in the level of proficiency in exercises: No. 12 "Rope climbing in two steps, level of proficiency" ($r = 0.983$); No. 13 "Rope climbing in three steps, level of proficiency" ($r = 0.984$); No. 14 "One leg swing upward circle, level of proficiency" ($r = 0.987$). The factor is called the level of proficiency in gymnastic exercises.

The second factor has a weight of 15.346%. With the factor, the greatest correlation is in: No. 1 "Height, cm" ($r = 0.843$); No. 2 "Body weight, kg" ($r = 0.816$); No. 8 "Shuttle run 4×9 m, s" ($r = 0.688$). The factor is called physical development.

The third factor has a weight of 11.567%. With the factor, the greatest correlation is in: No. 5 "30 m running from a standing start, s" ($r = 0.833$); No. 4 "300 m running, s" ($r = 0.722$); No. 10 "Maintenance of stable posture – standing on one leg with closed eyes, s" ($r = 0.438$). The factor is called the level of general physical fitness.

The fourth factor has a weight of 10.608%. With the factor, the greatest correlation is in: No. 3 "Standing long jump, cm" ($r = 0.731$); No. 11 "Walking along straight line after 5 rotations, deviations in cm" ($r = -0.694$); No. 10 "Maintenance of stable posture – standing on one leg with closed eyes, s" ($r = 0.482$). The factor is called vestibular stability.

The fifth factor has a weight of 8.858%. With the factor, the greatest correlation is in tests: No. 9 "Combined movements of arms, torso and legs, points" ($r = 0.820$); No. 6 "Seated forward bend, cm" ($r = -0.599$). The factor is called movement coordination.

Table 2. The results of factor analysis. Girls aged 9 (n = 35)

No.	Test	Factor					h ²
		1	2	3	4	5	
1	Height, cm		0.843				0.821
2	Body weight, kg		0.816				0.715
3	Standing long jump, cm				0.731		0.719
4	300 m running, s	-0.330		0.722			0.675
5	30 m running from a standing start, s			0.833			0.755
6	Seated forward bend, cm		-0.346			-0.599	0.628
7	Mixed hang rope pull-ups, times	0.920					0.858
8	Shuttle run 4×9 m, s		0.688				0.508
9	Combined movements of arms, torso and legs, points					0.820	0.772
10	Maintenance of stable posture – standing on one leg with closed eyes, s			0.438	0.482		0.538
11	Walking along straight line after 5 rotations, deviations in cm				-0.694		0.551
12	Rope climbing in two steps, level of proficiency	0.983					0.972
13	Rope climbing in three steps, level of proficiency	0.984					0.978
14	One leg swing upward circle, level of proficiency	0.987					0.978
	%	28.394	15.346	11.567	10.608	8.858	74.773

The analysis of similarities made it possible to identify the most informative indicators that determine the level of motor fitness of the 9-year-old girls:

- No. 12 “Rope climbing in two steps, level of proficiency” ($r = 0.972$);
- No. 13 “Rope climbing in three steps, level of proficiency” ($r = 0.978$);
- No. 14 “One leg swing upward circle, level of proficiency” ($r = 0.978$);
- No. 7 “Mixed hang rope pull-ups, times” ($r = 0.858$).

The graphic representation of a two-factor model of testing results shows that the analysis identifies two sets of data with high correlation coefficients. The first set includes tests No. 12, 13, 14, and 7, which characterize the level of proficiency in gymnastic exercises and relative arm strength; the second – tests No. 1, 10, and 5, which characterize the level of movement coordination development (see Fig. 1).

Thus, the motor fitness of 9-year-old girls is determined by the level of development of arm strength, vestibular stability, and the level of proficiency in gymnastic exercises.

Discussion

The paper assumed that motor skills occupy a prominent place in the structure of motor fitness of 9-year-old girls. So, the level of proficiency in exercises determines the variation of testing results by 28.394%. Thus, the study's findings make it possible to accept the research hypothesis on the leading role of motor skills development in the educational process at primary school.

The analysis of the coefficients of variation points to heterochrony in the development of the 9-year-old girls' motor abilities. The level of proficiency in gymnastic exercises indicates that the exercises are impossible for 9-year-old girls to perform. Based on the data analysis, it can be argued that the development of “arm strength” and “vestibular stability” ensures the formation of motor skills, and the improvement of their development level is the reserve in training girls aged 9 which will positively influence the educational process effectiveness.

The obtained results supplement the data on the relationship between the level of proficiency in physical exercises and

Fig. 1. The graphic representation of a two-factor model of testing results: 1 – height (cm), 2 – body weight (kg), 3 – “Standing long jump (cm)”, 4 – “Middle- and long-distance running. 300 m running (s)”, 5 – “30 m sprint running from a standing start (s)”, 6 – “Seated forward bend (cm)”, 7 – “Mixed hang rope pull-ups (times)”, 8 – “Shuttle run 4×9 m (s)”, 9 – “Combined movements of arms, torso and legs (points)”, 10 – “Maintenance of stable posture – standing on one leg with closed eyes (s)”, 11 – “Walking along straight line after 5 rotations (deviations in cm)”, 12 – “Rope climbing in two steps, level of proficiency”, 13 – “Rope climbing in three steps, level of proficiency”, 14 – “One leg swing upward circle, level of proficiency”

the level of motor abilities development (Ivashchenko, Be-rezhna, & Cieślicka, 2020; Ivashchenko & Sirichenko, 2020).

The results of factor analysis confirm the integrity of the process of motor skills formation and motor abilities development in children and supplement the data of Khudolii, Ivashchenko, and Chernenko(2015); Ivashchenko, Iermakov, Khudolii, Cretu, and Potop (2017).

The study results highlight the need to select teaching techniques taking into account the peculiarities of motor abilities development (Ivashchenko, Khudolii, Iermakov, Chernenko, & Holovko, 2015), the educational process organization (Hellin, Garcia-Jimenez, & Garcia-Pellicer, 2019a; Hellin, Garcia-Jimenez, & Garcia-Pellicer, 2019b; Groffik, Mitáš, Jakubec, Svozil, & Frömel, 2020), and optimization of exercise modes (Ivashchenko & Cieśllicka, 2017; Cieśllicka & Ivashchenko, 2017; Marchenko & Kovalenko, 2020).

Thus, the motor fitness of 9-year-old girls is determined by the level of development of arm strength, vestibular stability, and the level of proficiency in gymnastic exercises.

Conclusions

Based on factor analysis, it was found that the level of proficiency in exercises determines the variation of testing results by 28.394%, and the development of motor skills is a priority in the educational process at primary school.

The level of proficiency in gymnastic exercises shows that the exercises “Rope climbing in two steps”, “Rope climbing in three steps”, “One leg swing upward circle” are difficult for 9-year-old girls to perform. Based on the data analysis, it can be argued that the development of “arm strength” and “vestibular stability” ensures the formation of motor skills, and the improvement of their development level is the reserve in training girls aged 9 which will positively influence the formation of motor skills.

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Conflict of Interests

The authors declare no conflicts of interest.

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ОСОБЛИВОСТІ СТРУКТУРИ РУХОВОЇ ПІДГОТОВЛЕНOSTІ ДІВЧАТОК 9 РОКІВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 5 с., 2 табл., 1 рис., 22 джерела.

Мета дослідження – визначити особливості структури рухової підготовленості дівчаток 9 років.

Матеріали і методи. У дослідженні прийняли участь 35 дівчаток 9 років. Діти та їхні батьки були інформовані про всі особливості дослідження і дали згоду на участь в експерименті. У дослідженні використані такі методи дослідження як аналіз наукової та методичної літератури, педагогічні спостереження, тестування рухової підготовленості, ймовірнісний підхід до оцінки процесу навчання, методи математичної статистики.

Результати. За рівнем підготовленості дівчатка 9 років є однорідними за розвитком «пружкості» і «координації рухів», неоднорідними – за розвитком гнучкості, сили рук і вестибулярної стійкості, рівнем навченості гімнастичних вправ. Графічне відображення двохфакторної моделі результатів тестування дає уявлення про те, що в аналізі виділяються з високими коефіцієнтами кореляції дві плеяди даних. У першу плеяду включені тести No 12, 13, 14 і 7, які

характеризують рівень навченості гімнастичних вправ та відносну силу м'язів рук; у другу – тести No 1, 10, і 5, які характеризують рівень розвитку координації рухів.

Висновки. На основі факторного аналізу встановлено, що рівень навченості вправам на 28.394% визначає варіацію результатів тестування, а формування рухових навичок має пріоритет в освітньому процесі у молодшій школі.

Рівень навченості гімнастичних вправ свідчить про те, що вправи лазіння по канату у 2 прийоми, лазіння по канату у 3 прийоми, підйом переворотом в упор махом однією є мало доступними для дівчаток 9 років. На основі аналізу даних можна стверджувати, що розвиток «сили рук» і «вестибулярної стійкості» забезпечує формування рухових навичок, а підвищення рівня їх розвитку є тим резервом у підготовці дівчаток 9 років який дозволить позитивно впливати на формування рухових навичок.

Ключові слова: дівчатка 9 років, рівень навченості, рухова підготовленість, рухові навички.

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