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Original Article

Interrelation of the indicators of the physical preparedness level and functional condition of junior schoolchildren organism

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Abstract:
Purpose: The aim of the work is to study the physical preparednes and functional condition of 7-10 year-old children's with different level of physical health organism while tested by the running ergometer. *Material:* The following methods were used to solve the tasks: anthropometry, standard method, tonometry, dynamometry, functional tests of the cardiopulmonary system, method of physical health assessment. The assessment of the efficiency and respiratory and cardiovascular responses was carried out using methods of ergometry, gas analysis, spirometry, pulsometry and timekeeping. *Results:* Most of the surveyed 7-10 year-old schoolchildren had a low or below average level of physical health, amongthem disharmonically developed children prevailed. The level of physical preparedness on the basis of the results of running and strength tests is better in children with average and upper average levels of physical health compared with children with low and below average physical health. In schoolchildren with average and upper average levels of physical health, fewer heart rate abnormalities were observed in rest, during tested by the running ergometer, and they were more likely to be restored comparing to children with low or below average levels of physical health. According to the results of the '500m run' and '600m run' tests, it is possible to characterize the level of functioning the organism's cardiovascular and respiratory systems, as evidenced by the significant correlation coefficients between the test results and the parameters of pulmonary ventilation, respiratory volume, respiratory rate, heart rate reductions, the level of oxygen consumption at different load levels when tested by the running ergometer. **Conclusions:** The peculiarities of functional condition and manifestation of motor qualities in junior schoolchildren's with different levels of physical health are revealed.
Keywords: physical preparedness, functional condition, level of physical health, junior scnoolchildren.

Introduction.

The 7-10 year-old children's health condition depends on their physical development and functional condition of the organism basic systems, which play an important role in adaptation to physical loads and to a large extent determine the level of physical preparedness and working capacity of elementary school aged children (Savieliev, Shiriaieva, 2001; Bezrukykh, Sonkin, Farber, 2003).

Therefore, the control of the level of junior pupils' physical health is important for planning and evaluating the effectiveness of the means used in the process of children and adolescents' physical education. For children studying in the elementary school, there characterized the simultaneous development of motor qualities, due to the anatomical and physiological characteristics of the junior schoolchildren's body and a number of features of their psychological state. According to many authors, the age range from 7 to 10 years is characterized by a rather rapid increase in body length, mass, body proportions, intense skeletal development, muscle and joint organ formation (Savieliev, Shiriaieva, 2001; Bezrukykh, Sonkin, Farber, 2003). In junior school age, regular motor activity is especially important, which promotes not only the optimal flow of transient processes, but also the correct formation of motor qualities, since it is precisely in this aged period of the child's life the health foundation of his organism is laid (Bezrukykh, 2000; Trachuk, 2011).

The researches conducted by a number of authors indicate an increase in the level of physical health in systematic physical and recreational classes and the use of various means of recovery (Krutsevych, 1999; Apanasenko, 2011; Krutsevych, Pangelova, Trachuk, 2019). It was also found that in the process of recreational lessons of different orientation and using different motor regimes, the level of developing motor qualities improves (Sonkin, 2007; Bar-Or, & Rowland, 2009; Apanasenko, 2011).

Schoolchildren's health is determined by the level of developing qualitative aspects of their physical activity. According to many authors, the more stable the health indicators are, the higher the level of functioning

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of the basic systems of the body and the better the level of development of motor qualities are. At the same time, it was noted that stable health indicators do not always provide a high level of junior pupils' physical preparedness (Apanasenko, 1992). Thus, for children with an upper average level of physical health, there may be a small motor experience, a reluctance to attend physical education and recreational classes, a low level of motor activity; while children with an average level of physical health can show high results in certain motor tests in comparison with their peers with a stable level of physical health.

But the excessively high results shown in the motor tests for the manifestation of junior schoolchildren's strength and endurance can even negatively affect their health, contribute to lower immunity and increased trauma of the musculoskeletal system. All above stipulates the necessity of studying the features of the morphofunctional condition and developing junior schoolchildren's motor qualities, depending on their level of physical health (Bezrukykh, 2000; Sapin, & Sivoglazov, 2002; Mykhailov, 2005; Rowland, 2005; Bojan Međedović etl, 2018).

The purpose of the work is to study the physical preparedness and functional condition of the 7-10 year-old schoolchildren's with different levels of physical health organism when tested by the running ergometer.

Material and method.

The following methods were used to solve the problems: anthropometry, standard method, tonometry, dynamometry, functional tests of the cardiorespiratory system, method for assessing physical health (Apanasenko, 1999; Hopkins, 2000; Friel, 2006).

The assessment of the efficiency and respiratory and cardiovascular responses was carried out using methods of ergometry, gas analysis, spirometry, pulsometry and timekeeping.

7-10 year-old schoolchildren participated in the study, the total number of schoolchildren is 121. All students belonged to the main medical group, that is, they had no chronic and acute illnesses.

The test loads were carried out by the running ergometer.

The 7-10 year-old schoolchildren in number of 121 executed three loads using the ergometer, which gradually increased at speed. The installed on the running ergometer the feedback unit provided operational information on the load power (W, W), running speed (V, km/h^{-1}) and duration of operation (t, c).

During having physical loads, using pulsed ventilation (VE, l-min-^{1}), respiration rate (fT, min^{-1}), respiratory air volume (VT l), , the level of consumption of O2 per kg of body weight (VO2 / kg, ml · min $^{-1}$ · kg^{-1}) and the allocation of CO2 / kg of body weight (VCO2 / kg, ml · min $^{-1}$· kg^{-1}) were recorded by the automated gas analyzer complex "Oxycon Alpha" of the firm "Jaeger" (Germany) with a discreteness of 10 seconds.

The reaction of the cardiovascular system was carried out by the telemetric frequency recorder "TR 300 Pulse Meter" (Finland). The testing program was constructed on the consistent performance of the battery of special loads. The pupils performed three loads of 3 minutes each, which gradually increased at speeds from 3km/h^{-1} to 5 km/h^{-1}, and then to 7 km/h^{-1}.

For evaluating junior schoolchildren's high-speed possibilities there were used: 30m run, hand motion frequency, 10×5 m run. The power of children of junior school age was evaluated according to the results shown in the following tests: hands bending – extending lying down, laying on folded hands, rise in the saddle for 30 seconds, tightening on the crossbar. The assessment of dexterity was carried out according to the results of a test shuttle run of 4×9 m. The level of endurance development was determined by running at 500 m, 600 m and 1000 m.

The statistical processing was carried out using the Statistica 6.0 software package. The methods of mathematical statistics were used (Spirman correlation analysis, Mann-Whitney criterion).

Results.

One of the tasks of physical education is to achieve a high level of children and adolescents' physical health as the basis of their life, which should meet their personal needs and promote the implementation of social functions. The concept of 'health' is associated with the optimal course of the body's processes of life, which indicates the normal state of a man. A healthy body provides optimal functioning of its systems when changing environmental factors.

The level of physical health of the examined schoolchildren was determined by the method of G.L. Apanasenko (1992), which is one of the most applied systems for assessing the level of physical condition in the practice of physical education, since it includes most of its parameters, which include functional indicators, indicators of physical development, efficiency, physical preparedness.

In determining the level of physical health of the surveyed students, it was found that most of them had low and below average levels of physical health, as they scored less than 6 points in the five indicators, children from the middle with 6 to 10 points scored the level of physical health and more than 11 points – with an upper average level of physical health (fig.1). At the same time, a safe level of health (upper average) was typical only for 9-10 year-old children.

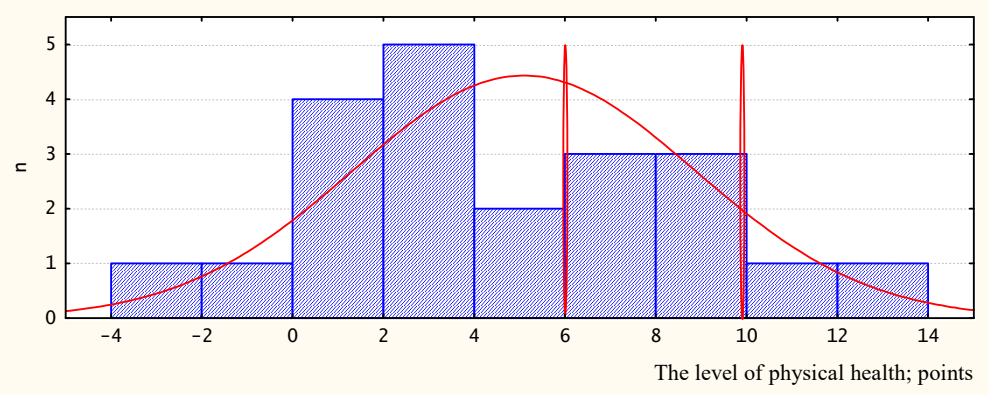

Fig.1 Distribution of surveyed schoolchildren according to the level of physical health (n = 121)

Testing the level of junior scholchildren's physical preparedness was conducted. Table 1 presents the results depending on the level of physical health of the examined schoolchildren.

Table 1. Results of motor tests of examined 7-10 year-old schoolchildren with different levels of physical health

Motion tests	Level of physical health	
	Average and upper average (n=45)	Low and below average (n=76)
	Me [l.quartile; h. quartile]	Me [l.quartile; h. quartile]
Frequency of hands motion, s	15.9 [15.4, 16.5]**	14.35 [12.25, 15.75]
10×5m run, s	19.5 [18.9, 22.0]**	21.7 [20.65, 23.15]
Laying on folded hands, s	8.0 [6.61, 10.0]*	3.5 [1.5, 6.8]
Hands bending – extending lying down, time	9.0 [7.0, 13.0]**	6.5 [5.5, 8.5]
Tightening, time	1.0 [1.0, 2.0]**	0.62 [0.25, 1.5]
Rise in the saddle for 30 s, time	10.0 [9.0, 11.0]**	7.5 [7.0, 10.5]
4×9м shuttle run, s.	11.8 [11.6, 11.9]*	12.5 [12.0, 12.95]
1000м run, min	5.28 [5.15, 5.50]*	6.54 [6.22, 7.05]

Note. *p< .05(**p< 0.1) in comparison with low and below average level of physical health (by Mann-Whitney criterion)

The level of developing junior schoolchildren's motor activity is related to the level of physical health, as evidenced by statistically significant correlation coefficients between the levels of physical health and the results of pedagogical testing (4 × 9m run r = -0.446; 500m run r = -0.470; 60 m run r = -0.667; 1000m run r = -0.509; 30m run r = -0.469). For all running tests, the negative correlation is characteristic – the higher the level of physical health is, the less time it takes to overcome a certain distance (Fig. 2).

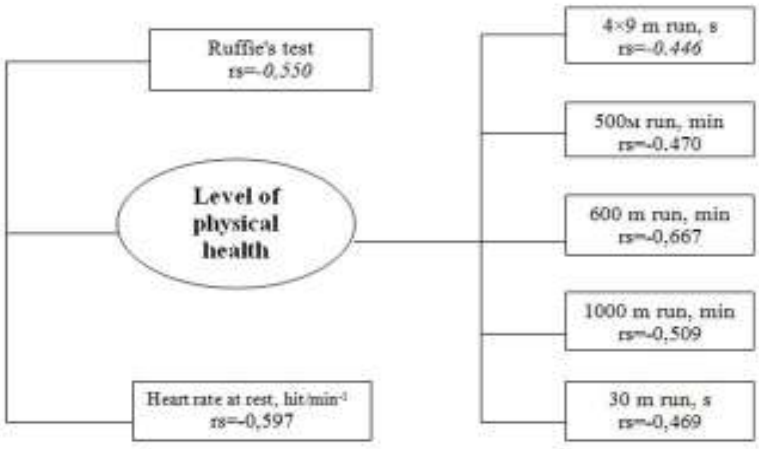

Fig.2 Scheme of correlation interactions of the physical health of the examined children with the results of motor tests (p < .05, n = 121, rs)

When tested by the running ergometer, students performed 3 gradually increasing loading speeds (3 km/h^{-1}, 5 km/h^{-1}, 7 km/h^{-1}) for a duration of 3 minutes each. The choice of the test to characterize the tolerance of the functional systems of the body to the dosage loads was largely determined by the skills already acquired by junior schoolchildren in running.

There were no statistically significant differences in heart rate, pulmonary ventilation, respiratory volume, respiratory rate, oxygen consumption at rest, at different load levels, and in recovery period in the groups of examined boys and girls.

The analysis of the frequency of heart rate on the proposed load revealed the peculiarities of the reaction of the schoolchildren's body depending on the level of the physical health (Table 2).

Table 2. Indicators of heart rate during tested by the running ergometer for schoolchildren with different levels of physical health

Level of physical health	Heart Rate Indicators		
	1-3 min. of the test	4-6 min. of the test	7-9 min. of a test
	Me [l.quartile; h. quartile]	Me [l.quartile; h. quartile]	Me [l.quartile; h. quartile]
Average and upper average (n=45)	111.4 [107.3, 113.9]*	125.5 [114, 131.7]*	125.1 [117.5, 132.8]*
Low and below average (n=76)	124.7 [117.9,128.3]	140 [135.7, 150.4]	156.1 [145.6, 164.1]

Note. * $p < .05$ compared to low and below average levels of physical health (by Mann-Whitney criterion)

The results of testing the level of endurance development correlate with the results of schoolchildren tested by the running ergometer (Fig. 3).

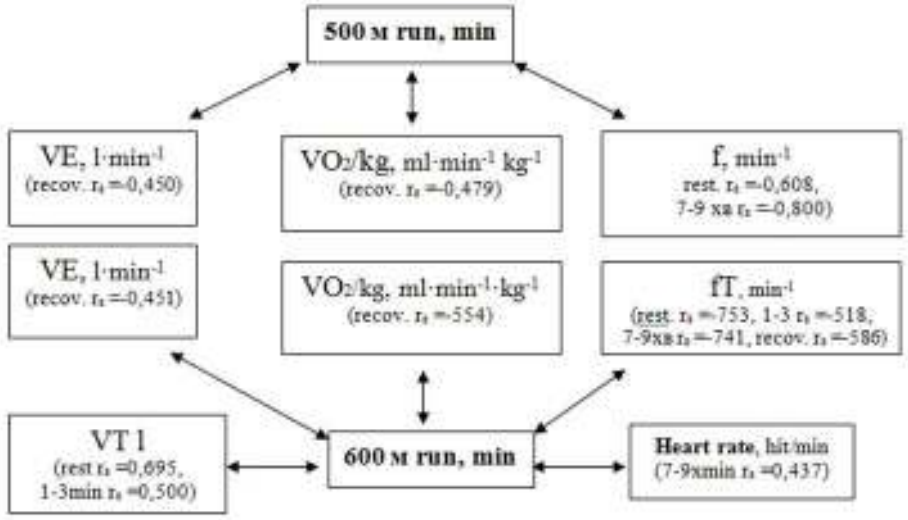

Fig.3 The scheme of interrellation between the results of running at 500 m and 600 m and the results tested by the running ergometer (n = 121, $p < .05$, rs)

During the 1st degree of loading, the schoolchildren overcame the 150 m distance at the speed of 3 km/h^{-1}, during the 2nd stage – the 250 m distance at the speed of 5 km/h^{-1} and for the 3rd stage – 350 m at the speed of 7 km/h^{-1}, that is during the 1st and 2 nd stages of the loading the surveyed overcame the distance of 400 m, and during the 3 rd degree – 750 m.

When the scholchildren loaded by the running ergometer, 24 % of children refused to perform 3 load levels (at the speed of 7 km/h^{-1}). All of these children having the low and below average levels of physical health were 7-8 years old. That is, almost the one third of 7-8 year-old schoolchildren with low and below average levels of physical health were able to overcome the distance of only 400 m when tested by the running ergometer.

Discussion.

According to the somatometric indicators, the majority of surveyed junior schoolchildren (56.2 %, n = 68) have the average level of physical development, 26.4% (n = 32) – above average and 17.4% (n = 21) – high level of physical development. There were no children with low and below average levels of physical development in our sample.

The assessment of the harmony of physical development found that only 37.2 % (n = 45) of the examined schoolchildren were harmoniously developed, and 62.8 % (n = 76) had disharmonious physical development. Under disharmonious physical development, it is commonly understood to be the sharp inconsistency of the body weight to its length, as well as the inconsistency of the coverage dimensions to the lengthwise ones.

It should be noted that among the schoolchildren with average and upper average levels of physical health there were no children with a delay in physical development and those who are ahead of it. All of these children had an average level of physical development. Advancement of physical development is characteristic for junior students with low and below average levels of physical health. It has been established that children with the average and upper average physical health levels had better physical preparedness according to motor test results than children with low and below average levels of physical health.

Children and adolescents with average and upper average levels of physical health usually have a higher endurance than their peers with low or below average levels of physical health. This situation was observed among the students of our sample as evidenced by statistically significant differences in the results of the test '1000 m run' in children with different levels of physical health ($p < .05$) (Table 1). The speed of a simple motor reaction based on the results of the 'hands motion frequency' test was better in children with low and below average levels of physical health ($p < 0.1$), and the results in the tests for the manifestation of strength were better in schoolchildren with an average and higher than mean 'Level of Physical Health' ($p < .05$, $p < 0.1$) (Table 1).

In the examined 7-10 year-old schoolchildren there was a weak correlation between the strength of the hand with functional characteristics (r = 0.380-0.491) and high – with somatometric (r = 0.569-0.843). Also correlated with the strength of the hand, the level of developing physical qualities, especially the power (r = 0.474-0.569). The negative (negative) correlation was observed between the force of the hand and the results of motor speed tests – 10 × 5 m run and the frequency of hand motions.

The average indicators of the frequency of heart rate in the state of relative rest to loading tended ($p < .05$) to decrease with the increase of the physical health level: 106.4 [102.7, 117.8] hit/min^{-1} - at low and below average levels of physical health; 96.2 [90.6. 98.4] bpm – with average and upper average levels of physical health. Smaller heart rate indicators are observed in schoolchildren with average and upper average levels of physical health during the entire load on the running ergometer ($p < .05$). The registration of heart rate in the first 3 minutes of recovery allowed to establish that students with average and upper average physical health levels recovered faster than students with low and below average physical health ($p < .05$).

However, in 3 minutes, during which the heart rate was recorded after loading, none of the children returned to the baseline level, which confirms the peculiarities of the junior schoolchildren's organism reaction to the ability to tolerate long cyclic stresses. Recovery of the heart rate occurred within 8-10 minutes after the end of the load (Volkov, 2003).

The interrelation of the 500m run results and indicators: pulmonary ventilation (VE), respiration frequency (fT), level of oxygen consumption (VO2) at different load levels were revealed.

600m run results are interrelated with the highest number of indicators of the cardiovascular and respiratory systems of junior schoolchildren who have been tested by the running ergometer: the parameters of pulmonary ventilation (VE), respiratory volume (VT), respiration rate (fT), consumption level oxygen (VO2), heart rate at different load levels (Fig.3).

There is practically no correlation between the results of the race for the 1000m distance and the results of testing the junior schoolchildren by the running ergometer.

Conclusions.

Most of the surveyed 7-10 year-old schoolchildren had low and below average levels of physical health, among which disharmonically developed children prevailed. The level of physical preparedness on the basis of the results of running and strength tests is better in children with average and upper average levels of physical health compared with children with low and below average levels of physical health.

In schoolchildren with average and upper average levels of physical health, fewer heart rate abnormalities were observed in rest, during testing by the running ergometer, and they were more likely to be recovered compared to children with low or below average levels of physical health. According to the results of the tests '500m run' and '600m run' you can characterize the level of functioning of the cardiovascular and respiratory systems of the body, as evidenced by significant correlation coefficients between the test results and indicators of pulmonary ventilation, respiratory volume, respiratory rate, the frequency of heart rate, the level of oxygen consumption at different load levels when tested by the running ergometer.

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Conflict of interest.

There were no conflicts of interest.

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