

Original Article

Assessment of the physical health of students of middle and upper grades

IHOR BAKIKO¹, SERGEY SAVCHUK², VITALI DMITRUK³, OLEKSANDR RADCHENKO⁴, SERGEY NIKOLAEV⁵

^{1,2,3,4}Lutsk National Technical University, UKRAINE

⁵Lesya Ukrainka Eastern European National University, UKRAINE

Published online: February 29, 2020

(Accepted for publication: January 20, 2020)

DOI:10.7752/jpes.2020.s1039

Abstract:

Formulation of the problem. The problem of deterioration of the physical health of the population of Ukraine, and especially of the younger generation, remains urgent. In recent years, the health of children and adolescents is considered critical by professionals. According to them, one of the main reasons for this situation is the decrease in motor activity of students, which is progressing every year.

At the same time Krutsevich T. Yu. N. V. Moskalenko and others point out that the current system of physical education in secondary schools does not reach its goal - to strengthen the health of students, as there is an increase in children with chronic diseases. Therefore, the urgent issue of the theory and practice of physical education is the search for innovative technologies for the organization of physical education in general educational institutions, which will help preserve and enhance the physical health of students.

Approach. Analysis of scientific and methodological literature, express assessment of the level of physical health, methods of mathematical statistics. **Purpose.** The work was to determine the level of physical health of pupils of the 5th - 11th grades. **Result:** The research conducted gave grounds to establish that the level of physical health of schoolchildren by all features is low or lower than the average and during the studies in secondary school is deteriorating. The forecasted index of physical condition declined. **Conclusions:** therefore, in the course of the study, the level of physical health of boys and girls of the 5th - 11th grades was determined. It was found that 44.8% of boys have a low level of physical health, 27.0% are below the average and 28.2% have an average. Among the surveyed girls, 29.8% have a low level of physical health, 37.2% are below the average, 33.0% of girls who participated in the study, the level of physical health is average.

Key words: schoolchildren, health, anthropometric measurements, physical development, age standards.

Introduction

The problem of strengthening, preserving and improving health is becoming increasingly relevant due to lower physical and mental health indicators for children and young people, an increase in the number of pathological and hereditary diseases. The main methodological approach is screening, which reveals a "risk group" among a practically healthy population. Screening the health of the population is the first stage of the health promotion system. A significant contribution to the development of the doctrine of health is the definition of the concept of "quantitative health" by Amosov. Diagnosis of the level of health is the first step in preventing diseases and supporting the health improvement of the population (Apanasenko, H.L., 1992.).

Material and methods

Material: Students from 5 to 11 classes of school № 17 in Lutsk, boys and girls in the amount of 1,400 people participated in the research. All data was analyzed and processed using the method of mathematical statistics.

Methods: analysis of scientific and methodological literature, express assessment of the level of physical health, methods of mathematical statistics.

Theory / computing.

The basis of the method of quantitative express assessment of the level of physical health is the anthropometric indices: body length (cm); body weight (kg); vital capacity of the lungs (ml); Brigade dynamometer (kg); as well as the state of the cardiovascular system at rest (number of times), arterial pressure (mm Hg) (systolic and diastolic); Martine-Krushelevsky trial (time of restoration, min., C); Body Mass Index, Body-Mass-Index, which is evaluated by the BMI index; the state of the respiratory function, gives the so-called vital index (ZHI) - the ratio of the vital capacity of the lungs (LUE) to the weight of the body; power index (SI), that is, the ratio of the absolute index of force, recorded on the dynamometer, to the mass of the body; Robinson's index, which is the product of heart rate and arterial systolic blood pressure (IR). After obtaining each indicator, the total score is estimated by the level of physical health, where: low (less than 3), below average (4-6), average (7-11), above average (12 - 15), high (16 – 18).

Results.

In tabl. 1 and tab. 2 shows the level of physical health of boys and girls of grades 5-11 in percentage terms. Thus, the low level of health in boys of the 5th grade is 91.0% of the students, below the average - 9.0%. In girls, this trend is similar. Only 75.0% of girls are below the average, 25.0% below the average. The low level of health in boys of the 6th grade is 88.0% of the students, 12.0% - below the average level. 62.0% of high-school girls have a low level of physical health, 25.0% are below average and 13.0% average. 81.0% of boys of the 7th grade have a low level and 19.0% of the average. 40.0% of girls have a low level, 60.0% - below average. 36.0% of boys of the 8th grade took a place in the graph - low and below average, 28.0% have an average level of somatic health. Girls of the 8th grade have the following tendency: the highest percentage of girls (71.0%) fell to the level below the average, 15.0% to the average and 14.0% to the low. 68.0% of boys of the 9th grade have an average level of physical health and 32.0% are below average. 46.0% of girls in this age group have an average level, 36.0% - below average and 18.0% - low. 63.0% of boys of the 10th grade have a level below the average, 19.0% are middle and 18.0% are low. In girls, the highest percentage (56.0%) fell on the graph - the average level and 44.0% - below the average. In the representatives of the graduation class, the highest percentage fell on the graph - the average (boys - 63.0%, girls - 100.0%). Such an indicator is determined by the average level of physical preparedness and working capacity of schoolchildren. 37.0% of boys have lower than average physical health.

Table 1
Level of physical health of pupils of grades 5 - 9,%

The level of physical health	Class									
	5		6		7		8		9	
	guys	girls	guys	girls	guys	girls	guys	girls	guys	girls
low	91,0	75,0	88,0	62,0	81,0	40,0	36,0	14,0	0	18,0
belowaverage	9,0	25,0	12,0	25,0	0	60,0	36,0	71,0	32,0	36,0
average	0	0	0	13,0	19,0	0	28,0	15,0	68,0	46,0
aboveaverage	0	0	0	0	0	0	0	0	0	0
high	0	0	0	0	0	0	0	0	0	0

Table 2
Level of physical health of pupils of grades 10 - 11,%

The level of physical health	Class			
	10		11	
	guys	girls	guys	girls
low	18,0	0	0	0
belowaverage	63,0	44,0	37,0	0
average	19,0	56,0	63,0	100,0
aboveaverage	0	0	0	0
high	0	0	0	0

One of the main physiological features of the process of physical development, which distinguishes the body of the child from the body of an adult, is the dominant value of body length in the overall assessment of the level of physical development. At school age, the pace of physical development is estimated by the body length indicator, which must correspond to certain body mass indexes and the value of other morphological indicators of the child's body, in accordance with age standards.

The length of the body was measured with a rostrum to with precision 0.1 cm. When measuring the survey, the vertical lathes of the instrument hit the hips, back and heels.

According to the results of our research, the length of the body in boys of the 5th grade varies from 134 cm to 143 cm, for girls - from 136 to 146 cm respectively; in boys of the 6th grade varies from 144 cm to 150 cm, in girls - from 147 to 154 cm respectively; in boys of the 7th grade varies from 151 cm to 158 cm, in girls - from 153 to 159 cm, respectively; in boys of the 8th grade varies from 157 cm to 165 cm, in girls - from 160 to 165 cm, respectively; in boys of the 9th grade varies from 166 cm to 173 cm, in girls - from 162 to 167 cm, respectively; in boys of the 10th grade varies from 171 cm to 176 cm, in girls - from 164 to 168 cm respectively; in boys of the 11th grade varies from 177 cm to 183 cm, in girls - from 165 to 170 cm, respectively. The results obtained by us in general correspond to the age norms and confirm the results of previous studies (Krutsevich, T.Yu., Vorobyov, M.I. and Bezverhnia, H.V., 2011).

The length of the student's body over the study period increases, but this change is heterokinetic (V.S. Ivanova., 1990.). For seven years, the length of the body of boys has increased by 7%, girls - by 4.8%. It should

be noted that the average body length is higher in girls than in boys up to the 8th grade. Starting from the 9th grade, this speaker is changing. The average body length is higher in males than in girls (Fig. 1).

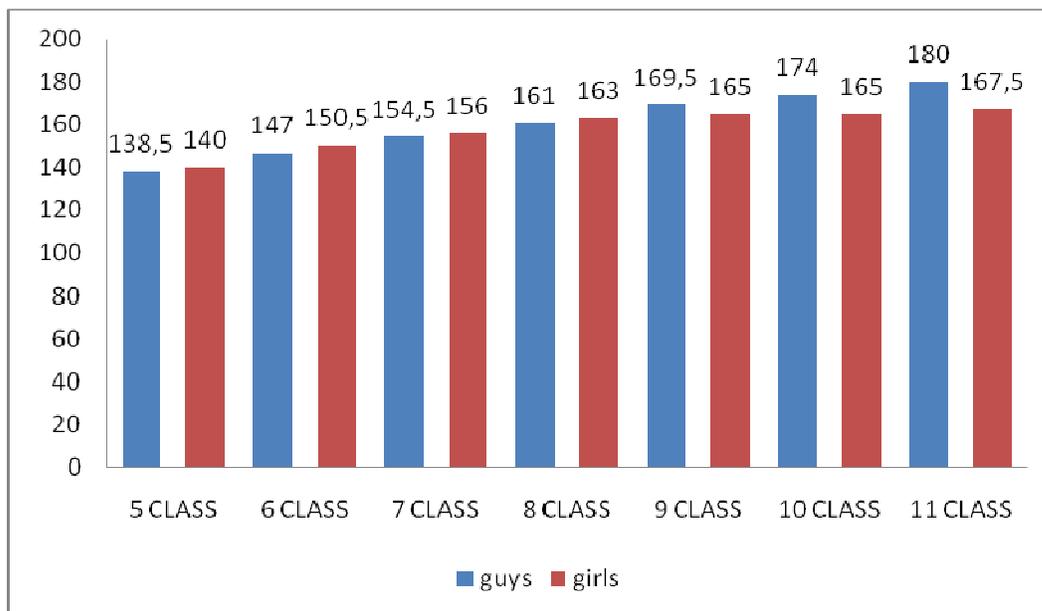


Fig. 1. The age dynamics of body length in schoolchildren

Weight of the body - a sufficiently objective indicator of the physical development of the child, the adequacy of its nutrition, the course of individual diseases. This indicator is often used to assess the body's water balance: the state of dehydration or fluid retention in the body (Apanasenko, H.L., 1985.).

The results of our studies have shown that the average body mass index of high school students is in the 5th grade boys from 30 kg to 34 kg, in girls - from 30 to 35 kg, respectively; in boys of the 6th grade from 32 kg to 36 kg, in girls - from 32 to 37 kg, respectively; in boys of the 7th grade from 35 kg to 40 kg, in girls - from 36 to 43 kg, respectively; in boys of the 8th grade from 40 kg to 48 kg, in girls - from 41 to 52 kg, respectively; in boys of the 9th grade from 47 kg to 56 kg, in girls - from 47 to 56 kg, respectively. As for the students of the high school, the average body mass index is as follows: in boys of the 10th grade from 52 kg to 59 kg, in girls - from 52 to 58 kg, respectively; in boys of the graduation class from 58 kg to 61 kg, in girls - from 53 to 59 kg, respectively.

During school time, the weight of the body increased in boys by 45.5%, in girls - by 44.5%. In girls, the average body mass index is slightly higher than that of the boys up to the 9th grade. In the 9th grade, the figures were equalized. Starting from the 10th grade, the average body mass index is higher in boys than in girls.

The life capacity of lungs of school-age children in the period from the 5th to the 11th grade is 1.46 - 3.52 liters. During this period, the average values of this indicator increase with $p \geq 0,05$.

The vital capacity of the lungs characterizes the degree of anatomical development of the body, determines the maximum possible depth of respiration and serves as an important indicator of the functional capabilities of the respiratory apparatus (Nechitaylo, Yu.M., 2002). It depends on the total capacity of the lungs, the strength of the respiratory muscles, the resistance of the chest and lungs to their stretching and obliteration. The lung capacity of the lungs depends on sex, age, body size and training (Romanyuk, V.P. and Derkach, Y., 2008).

Thus, in spite of the randomness of the sample of the studied children, changes in the vital capacity of the lungs in the age aspect remain the pattern of gradual increase with age. The range of magnitudes of the lung capacity of children in grades 5-11 is between 1460 and 3520 ml.

The development of the muscle strength of the brush was measured by the brush dynamometer, using the generally accepted technique (Izaak, S.I., Panasyuk and T.V., Tambovtseva, R.V., 2005).

It should be noted that the average indicators of the brush dynamometer (kg) are as follows: (boys of the 5th grade) - the left hand - 5.11 kg, right hand - 7.22 kg; (girls of the 5th grade) - the left hand is 3.37 kg, the right hand is 5.37 kg; (boys of the 6th grade) - left hand - 5,0 kg, right hand - 12,12 kg; (girls of the 6th grade) - left hand - 6.0 kg, right hand - 10.12 kg; (boys of the 7th grade) - left hand - 11.66 kg, right hand - 18.44 kg; (girls of the 7th grade) - left hand - 11.0 kg, right hand - 15.18 kg; (boys of the 8th grade) - left hand - 20.45 kg, right hand - 28.27 kg; (girls of the 8th grade) - left hand - 15.71 kg, right arm - 20.0 kg; (boys of the 9th grade) - left hand - 28.22 kg, right hand - 34.88 kg; (girls of the 9th grade) - left arm - 22.16 kg, right hand - 30.16 kg; (boys of the 10th grade) - left hand - 36,0 kg, right hand - 41,0 kg; (girls of the 10th grade) - left hand - 30.2 kg,

right hand - 35.8 kg; (guys of the 11th class) - left hand - 38.2 kg, right arm - 43.2 kg; (girls of the 11th grade) - left hand - 35.0 kg, right hand - 40.0 kg.

It is worth saying that with the age the dynamics of the gradual increase of brush dynamometry is maintained. In addition, average indicators of brush dynamometry in boys are higher than that of girls. It is noted that the stronger hand in both sexes is right.

The cardiovascular system of the body plays an important role in the exercise of school leavers, it provides homeostasis and the energy of working muscles (Palchuk, M.B., 2014).

To evaluate the functional capabilities of the cardiovascular system of schoolchildren, we recorded the heart rate at rest (heart rate, ud / min), systolic (SAT, mm Hg) and diastolic blood pressure (DAT, mm Hg).

We found that the heart rate at rest for 1 min. in boys (middle and upper grades) varies from 65.4 to 79.0 beats per minute, in girls - from 72.4 to 80.25 beats per minute. There was no significant difference between the boys and girls testing indices. During the school hours, the heart rate decreases, which indicates the improvement of the heart's activity at rest.

According to the results of our research, the indicators of systolic and diastolic blood pressure of schoolchildren of grades 5-11 did not have statistically significant differences. The mean values of systolic blood pressure were 106.18 to 117.8 mm. htst., diastolic - 70,0 - 77,5 mm. ht Art. (Table 3 and table 4).

Table 3
Functional state of the cardiovascular system of school children, $X \pm Sx$

Indicator	sex	Class				
		5 n=100	6 n=100	7 n=100	8 n=100	9 n=100
Heart rate at rest, ah. min.	guys	77,55±8,5	76,5±7,4	77,11±6,3	72,81±8,1	69,55±7,4
	girls	80,25±8,3	77,5±5,7	74,4±7,1	70,0±8,0	79,33±7,7
Systolic arterial pressure mm.rt.st.	guys	111,22±6,5	115,5±6,5	114,33±6,5	106,18±6,5	112,33±6,5
	girls	110,25±7,0	104,5±7,0	112,2±7,0	111,0±6,5	111,83±6,5
Diastolic arterial pressure mm.rt.st.	guys	73,66±6,0	73,5±5,5	76,88±5,0	75,0±5,0	73,88±5,0
	girls	76,12±6,5	77,5±6,5	75,0±7,0	73,42±7,5	74,0±8,5

Table 4
Functional state of the cardiovascular system of school children, $X \pm Sx$

Indicator	sex	Class	
		10 n=100	11 n=100
Heart rate at rest, ah. min.	guys	65,4±7,0	79,0±6,8
	girls	72,4±6,9	76,66±6,6
Systolic arterial pressure mm.rt.st.	guys	112,0±7,0	113,2±12,0
	girls	117,8±7,0	108,0±12,0
Diastolic arterial pressure mm.rt.st.	guys	73,0±10,0	72,0±10,0
	girls	73,0±9,6	70,0±9,6

The maximum (systolic) and minimal (diastolic) pressure were determined. Studies have shown that arterial pressure systolic is within the range of 111.22 - 113.2 mm. ht Art. (guys), 110.25 - 108.0 mm. ht Art. (girls), diastolic - 73.66 - 72.0 mm. ht Art. (guys), 76.12 - 70.0 mm. ht Art. (girls). The obtained data showed that students did not significantly differ in systolic and diastolic blood pressures.

In general, these indicators correspond to age standards. One of the causes of insignificant changes in the heart rate and its minor changes in the average school age is the gradual improvement of the regulatory mechanisms of the functioning of the heart and puberty of adolescents.

The Martine-Kushelevsky trial is 20 sit-ups in 30 seconds. Count the pulse for 10 s in the sitting position, waiting for its stable values. In 30 s 20 squats are made, lifting hands forward. Then sitting, the time of recovery of pulse to the original values is fixed. Take into account the time to restore pulse rate after the standard load: 59 s or less - high; 1 min - 1 min 29 s - above average; 1 min 30 sec - 1 min 59 s are considered to be middle level; 2 - 3 min. - below average; 3 min and more - low.

According to the results of our research, the average indicators of evaluation of restorative processes of the cardiovascular system after physical activity showed that the boys of the 5th grade recovered for 2 minutes, girls - by 2.12 minutes. in accordance; boys of the 6th class - for 2 minutes, girls - for 2,12 minutes. in accordance; boys 7th grade - for 2 minutes, girls - for 2,2 min. in accordance; boys of the 8th class - for 2,09 minutes, girls - for 2,14 minutes. in accordance; 9th grade boys - 2.11 min., girls - 2.33 min. in accordance; boys of the 10th grade - for 2,2 min., girls - for 3,0 minutes. in accordance; boys of the 11th class - 1.50 min., girls - 2.33 min. in accordance. There were isolated cases when the students recovered to the first minute.

Determination of conformity of the parameters of length and weight of the body showed that the average value of the body mass index in schoolchildren is within the normal range: in boys - 21.42 kg / m², in girls - 21.38 kg / m² (normative values 18.6 - 24.9 kg / m²). However, an individual analysis of the results showed that in 11,36% of schoolchildren there is a shortage of body weight, and 3.79% overweight, whereas in girls the figures are 14.39% and 10.61%, respectively. One boy and two girls from the total number of students examined according to the body mass index are obese and degree. The high body mass index is associated with an increased risk of cardiovascular disease and diabetes (Sergienko, V.M., 2009).

The vital index is an important criterion for the provision of external respiration functions and is determined by the ratio of the lumen vital capacity (LU) to body weight. The average value of the living index is within the age range, but 46 males (34,9%) and 44 girls (33,3%) out of the total number of subjects surveyed this figure is lower than normal.

The study of the strength index (the ratio of the dynamometry of the stronger hand to body weight) revealed the level of development of the muscular system in young men at the lower limit and less than the mean, whereas in girls the average value corresponds to below the average.

The Robinson Index is an indicator of the reserve and cost-effectiveness of the cardiovascular system. The average value of the Robinson index was 88.4 in the boys. in girls, 87.65 UM, indicating the average level of this indicator.

Discussion

Summing up the scores for each indicator, we received the index of physical health of schoolchildren, whose average value in boys was 3.33 ± 0.33 points, which corresponds to the level at the lower and lower mean, in girls - 2.95 ± 0.31 scores pointing to a low level.

Conclusions

In the course of the study, the indicators of physical health of boys and girls of the 5th - 11th grades were determined. It was found that 44.8% of boys have a low level of physical health, 27.0% are below the average and 28.2% have an average. Among the surveyed girls, 29.8% have a low level of physical health, 37.2% are below the average, 33.0% of girls who participated in the study, the level of physical health is average.

The proposed method of express assessment of the level of physical health of schoolchildren can be used by school physicians during annual dispensary inspections, in medical-health clinics, health centers, children's sanatoria and sanitary-type camps for the purpose of improving motor activity.

Conflicts of interest. No conflict of interest.

References

- Apanasenko, H.L., 1992. The evolution of bioenergy and human health. - St. Petersburg : MPP Petropolis, - 120 p.
- Apanasenko, H.L., 1985. About the possibility of quantitative assessment of human health. Hygiene and Sanitation.- № 6. - pp. 55 – 58.
- Fundamentals of Mathematical Statistics / ed. V.S. Ivanova. - Moscow: Physical Culture and Sport, 1990. - 176 p.
- Izaak, S.I., Panasyukand T.V., Tambovtseva, R.V., 2005. Physical development and bioenergetics of schoolchildren's muscular activity. - Moscow-Orel: Publishing house ORAGS. - 224 p.
- Krutsevich, T.Yu., Vorobyov, M.I. and Bezverhnia, H.V., 2011. The control of the phyticvihovanni children, pidlitkiv and young. Kiev, Olympic literature. - 224 p.
- Nechitaylo, Yu.M., 2002. Methods for the assessment of physical development in children. Clinical anatomy and operative surgery. - pp. 75 - 77.
- Palchuk, M.B., 2014. Control of Physical Development of Students in the transition from secondary to high school in the conditions of the educational process of physical education. Kiev. - 20 p.
- Romanyuk, V.P. and Derkach, Y., 2008. Complex assessment of the functional capabilities of the volleyball breathing system. Physical education, sport and health culture in modern society. - pp. 321 - 325.
- Sergienko, V.M., 2009. Health and physical development of student youth. Physical education, sports and health culture in modern society: collection of sciences. works - Lutsk: VNU them. Lesia Ukrainka, - pp. 79 - 82.