

Original Article

Monitoring the morphological and functional state of students during the transition from middle to high school during the physical education process

OLENA ANDRIEIEVA¹, OLENA YARMAK², MARIIA PALCHUK³, OLENA HAURIK⁴, LIDIJA DOTSYUK⁵, ALEXANDR GORASHCHENCO⁶, IRYNA KUSHNI⁷, YAROSLAV GALAN⁸

^{1,3} National University of Ukraine on physical education and sport, Kyiv, UKRAINE

² Bila Tserkva National Agrarian University, Bila Tserkva, UKRAINE

^{4,5,7,8} Yuriy Fedkovych Chernivtsi National University, Chernivtsi, UKRAINE

⁶ The State University of Physical Education and Sport, Chisinau, MOLDOVA

Published online: July 31, 2020

(Accepted for publication: July 22, 2020)

DOI:10.7752/jpes.2020.s3284

Abstract

Background: This study substantiates and defines organizational and methodological conditions to ensure the continuity of the physical education process during the transition from middle to high school. **Materials and methods:** The purpose of this study was to develop organizational and methodological conditions to ensure the continuity of physical education of schoolchildren during the transition from middle to high school by taking into account the results of pedagogical control of their physical condition. To achieve set goals and objectives and to obtain accurate research results, the following research methods were applied: theoretical analysis, survey, anthropometric and physiological methods, methods for determining the physical performance level, method for estimating somatic health, pedagogical methods of research, and methods of mathematical statistics. **Results of the study:** On the basis of holistic scientific analysis and to adequately plan educational materials, the main approaches for the differentiation of physical education tools were identified according to the functional capabilities of students during the transition from middle to high school. It was established that after a long period of rest (i.e., summer vacation) there was a decrease in the indicators of the functional state of respiratory system (e.g., vital capacity of lungs and duration of breath-holding on inhalation and exhalation), physical qualities (strength, speed, endurance, speed-strength), and physical performance of schoolchildren. Therefore, it is necessary to improve the content and structure of physical education during the transition from educational (middle school) to the terminative stage of specific orientation (high school). **Conclusions:** A slowdown in age-related growth was revealed; in some cases, a decrease in absolute values was observed compared to previous measurements after winter and summer holidays.

Keywords: control, physical development, physical fitness, functional status, students of grades 9-10.

Introduction

The need to improve the modern system of physical education is caused by an increase in the number of pupils with low levels of physical health, which is growing (Arefiev, 2013; Cherepov, 2015; Azhippo, 2016; Nakonechnyi, 2017; Osipov et al., 2018; Bakayev, 2018; Dragutinovic et al., 2019; Leonenko et al., 2019).

School physical education is a compulsory, specially organized process that is carried out during the entire period of study at school.

Though, as the theoretical analysis of literary sources proves, nowadays there are two sequential stages of physical education functioning almost independently, that is, the educational stage (grades 5-9) and the effective stage of the particular orientation (grades 10-11). The proof of this opinion is the different orientation of curricula, and, respectively, different requirements for the level of physical fitness of pupils and the difference in the physical development of children of the middle and senior school age.

The scholars have focused extensive attention on the peculiarities of the organization of physical education during the transition of children from kindergarten to primary school (Krutsevich, 2003; Blagii, 2015; Koval, 2015; Tomenko et al., 2017). Unfortunately, in the available scientific literature, there are no works devoted to the study of the peculiarities of the organization of physical education of schoolchildren during the transition from middle school to senior school.

One of the ways to solve this problem is to improve pedagogical control, aimed at the systematic and timely provision of objective and reliable information about the state of physical development and health of pupils (Bar-Or, 2009; Radanovic, 2017; Prontenko et al., 2020).

Today, experts pay much attention to improving the monitoring of indicators of physical development of pupils in the process of physical education. Thus, the presented data reveal the program and regulatory

foundations of physical education for secondary and high school students, features of physical development of secondary and high school children, features of the use of various approaches to organization of monitoring, and modern approaches to address the issue of continuity in physical education. The study of literature showed that the continuity of physical education at different levels of education is based on the development of models, technologies, and programs with different focuses. However, these points need to be generalized and systematized to identify promising ways to ensure the continuity of physical education in secondary and high schools (Ademovic, 2013; Aoki, 2017; Galan et al., 2017; Andrieieva et al., 2019; Lebedinsky, 2020).

However, according to, control of the individual morphological and functional features of modern schoolchildren and their dynamics during schooling is especially necessary for adolescence, characterized by a significant deterioration in the regulation of vital functions of organs and systems due to the activation of puberty.

Materials and Methods

The choice of the methods was determined by the need for systematic examination of various aspects of the subject of research, obtaining reliable data, and conducting quality work with correct mathematical analysis of research materials. To achieve the defined objectives, the following methods were used: theoretical analysis and generalization of literature and documentary materials; content-analysis of documentary materials; a questionnaire survey; system analysis method; comparison and contrast method; pedagogical methods (pedagogical observation and pedagogical experiment); structural-functional analysis method; and mathematical statistics methods.

In the research process, we applied the survey method, which was carried out in the form of questionnaires, aimed at studying the activities of schoolchildren in school and the after-school hours.

It was the summative pedagogical experiment, and it consisted in the phased measurement of somatometric indicators (body length, body weight, girth sizes of various parts of the body); somatotopic indicators (thickness of skin-fat folds); physiometric indicators of physical development (heart rate at rest (HR_{rest}), systolic blood pressure (SBP), diastolic blood pressure (DBP), vital capacity of lungs (VC), the duration of breath-holding on inhalation (the Shtange test) and exhalation (the Genchi test); the level of development of physical performance; physical qualities (strength, speed, endurance, flexibility, coordination, speed-strength), as well as the rapid assessment of somatic health according to the method of H. L. Apanasenko.

The above indicators were monitored during the academic year in the 9th grade (stage 1- September, stage 2 - November, stage 3 - December, stage 4 - January, stage 5 - March, stage 6 - May) and at the beginning of the school year in the 10th grade (stage 7 - September). The results were processed using methods of mathematical statistics.

Results

The obtained results of somatometric and somatoscopic indicators of the physical development of the studied cohort of children and their analysis allow us to state that, despite the heterogeneity of the sample under study, the physical development of schoolchildren conformed the age norms. The physiometric indicators testify that they are somewhat lower, but do not have significant differences with the accepted sex and age norms.

A study of the level of physical performance made it possible to determine that in 72.5 % (n = 29) of young men and 77.5 % (n = 31) of girls, its level is satisfactory. The average level of physical performance is inherent in 10.0 % (n = 4) of boys and 27.5 % (n = 11) of girls, and poor - 17.5 % (n = 7) of boys. The average group values of the Ruffier index in both sex and age groups have a satisfactory level of physical performance.

The distribution of schoolchildren by the state of physical health (SOH) allows us to state that 57.5 % (n = 23) of children have a low state of health, 25.0 % (n = 10) are below average and 17.5 % (n = 7) - average. The differentiation of girls indicates that 40.0 % (n = 16) of schoolgirls have a low SOH, 42.5 % (n = 17) - below average, and 7.5 % (n = 3) have average state of health. It is important to emphasize that among the girls who participated in the study, 10.0 % (n = 4) have a high state of health.

The analysis of the results of the questionnaire was aimed at studying the level of activities of pupils in extracurricular time indicates the disinterest of pupils in attending physical fitness activity classes in their free time, as well as during summer and winter holidays.

According to the data obtained, during the vacation periods, 55.0 % (n = 22) of young men and 72.5 % (n = 29) of girls do not engage in any type of physical fitness activity at all. The most popular types of activities of the schoolchildren, both in girls and boys, are as follows: communication with friends (60.0 % of boys (n = 24) and 50.0 % of girls (n = 20)) and watching television programmes (42,5 % (n = 17) of boys and 25.0 % (n = 10) of girls). During the summer holidays, pupils prefer activities such as attending a disco (65.0% of boys (n = 26) and 70.0 % of girls(n = 28)), sunbathing (47.5 % of boys(n = 19) and 80.0 % of girls (n = 32)), trips on excursions (12.5 % of boys(n = 5) and 42.5 % of girls(n = 17), reading books (10.0 % of boys (n = 4) and 7.5 % of girls (n = 3), and during winter holidays - TV shows (47.5 % of boys (n = 19) and 50.0 % of girls(n = 20) and computer games (42.5 % of boys (n = 17) and 27.5 % of girls (n = 11).

The data obtained indicate the need to study the dynamics of indicators of physical development of pupils

during the school year in the 9th grade and when moving to senior school to justify and develop organizational and methodological conditions for ensuring the continuity of physical education in the middle and senior schools.

At the same time, in the dynamics of somatoscopic indicators of physical development - the thickness of the skin-fat folds and such physiometric indicators as heart rate at rest, systolic blood pressure, diastolic blood pressure, there is a common inverse correlation with age both in young men and girls.

It was established that the dynamics of somatometric indicators of physical development in students of grades 9-10 corresponded to the biological laws that are inherent in these students (Table 1).

Table 1. Dynamics of indicators of circumference body sizes in students of interest

Stages	Gender	Circumference, cm									
		Chest		Shoulder		Waist		Thigh		Neck	
		\bar{x}	S	\bar{x}	S	\bar{x}	S	\bar{x}	S	\bar{x}	S
1	B	81.8	3.12	27.5	2.04	73.8	4.08	87.9	4.45	30.7	0.87
	G	73.0	2.78	25.4	1.47	64.3	4.12	91.8	4.29	-	-
2	B	81.9*	3.54	27.6*	1.98	73.9	3.67	88.1*	4.34	30.7	0.87
	G	73.1	3.23	25.4	1.43	64.5*	3.13	91.9*	4.25	-	-
3	B	82.4*	4.11	27.9*	1.87	73.9	4.04	88.1	4.35	30.9	0.75
	G	73.9*	3.04	25.6*	1.42	64.7*	3.19	92.2*	4.08	-	-
4	B	82.6*	4.12	28.2*	1.89	74.3*	3.14	88.2	4.27	30.9	0.86
	G	74.1*	3.54	25.7	1.39	65.5*	3.21	93.0*	4.08	-	-
5	B	83.1*	4.13	28.5*	1.99	74.7*	4.16	88.3	4.19	31.0	0.68
	G	74.3*	3.10	26.1*	1.33	65.5	3.15	93.2*	4.1	-	-
6	B	83.3*	4.15	28.5	2.04	74.8*	3.19	88.3	4.21	31.1	0.71
	G	74.3	3.02	26.2*	1.32	65.5	4.24	93.1	3.94	-	-
7	B	83.6*	4.05	28.6	2.05	74.8	3.06	88.3	4.23	31.2	0.72
	G	75.0*	3.22	26.4*	1.28	65.5	3.76	93.0	3.86	-	-

Note: B - boys, G - girls, * - significant difference ($p < 0.05$) compared to the previous stage

At the same time, in the dynamics of somatoscopic indicators of physical development (e.g., thickness of skin-fat folds and physiometric indicators such as heart rate, $BP_{syst.}$, and $BP_{diast.}$), there is a common inverse relationship with age in both boys and girls (Table 2).

Table 2. Dynamics of indicators of cardiovascular fitness in students

Stage	Gender	Indicator							
		Heart rate, $beats \cdot min^{-1}$		$BP_{syst.}$, mm Hg		$BP_{diast.}$, mm Hg		Robinson index, cu	
		\bar{x}	S	\bar{x}	S	\bar{x}	S	\bar{x}	S
1	B	74.5	3.36	108.9	4.07	73.7	5.13	81.3	5.18
	G	71.7	3.75	109.0	4.72	73.4	6.11	78.2	5.03
2	B	72.9*	2.96	108.1	3.45	72.8	5.28	78.9*	4.41
	G	70.7*	2.55	107.3*	3.87	72.6	4.64	75.9*	4.06
3	B	73.2	3.08	106.8	3.12	71.7	3.43	78.2	3.75
	G	70.5	3.05	106.6	4.38	71.3	3.32	75.1	4.21
4	B	72.4*	3.12	103.7*	4.12	71.8	3.21	75.0*	4.45
	G	70.6	2.34	105.7	3.86	70.7	2.08	74.6	3.54
5	B	72.4	3.09	105.1	4.97	73.3	3.42	76.1	4.32
	G	70.2	2.04	105.1	4.97	71.1	2.46	73.8	3.24
6	B	71.3*	2.35	105.4	3.81	73.4	3.61	75.1	4.13
	G	70.4	2.18	105.6	4.76	71.0	2.43	74.3	3.28
7	B	70.4*	2.21	103.7	3.52	72.3	3.54	75.0*	3.51
	G	70.2	2.15	105.8	4.38	70.9	3.22	74.2	3.19

Note: B - boys, G - girls, * - significant difference ($p < 0.05$) compared to the previous stage

Analysing the dynamics of the indicators of the functional state of the respiratory system, we found a gradual improvement in their values during the school year and a sharp deterioration after long periods of rest, that is, winter and summer vacations (Table 3).

There is a decrease in the indicators of VC and the duration of breath-holding in the Shtange and Genchi tests.

Table 3. Analysis of indicators of the functional state of the respiratory system of schoolchildren during 7 stages

Stage	Gender	Number	Indicators values							
			VC, ml		Shtange test, sec		Genchi test, sec		Life index, nominal units	
			\bar{x}	S	\bar{x}	S	\bar{x}	S	\bar{x}	S
1	B	40	2,752.3	113.11	37.0	5.26	19.2	3.34	47.9	4.95
	G	40	2,389.6	121.04	31.6	6.12	16.3	4.56	45.7	4.78
2	B	40	2,819.9*	105.98	39.1*	4.35	22.7*	4.12	48.9*	7.12
	G	40	2,429.7*	106.03	33.2*	6.18	18.1*	2.42	45.6	6.02
3	B	40	2,911.7*	97.15	38.9*	4.46	21.9*	4.26	49.8*	7.08
	G	40	2,489.2*	127.82	33.2*	6.03	19.2*	2.94	47.1*	6.35
4	B	40	2,901.9	84.76	39.4*	4.11	21.8	2.95	49.7*	7.14
	G	40	2,501.9	118.90	32.7	4.98	19.7	2.78	47.3	6.43
5	B	40	2,966.2*	94.15	39.9*	4.15	22.8*	2.87	50.7*	7.46
	G	40	2,592.8*	118.86	34.2*	4.87	18.6*	2.95	47.9*	6.34
6	B	40	2,984.9*	81.93	39.8*	4.02	22.9*	2.78	50.8	5.90
	G	40	2,618.9*	108.28	35.1*	4.76	18.7*	2.47	49.2*	6.08
7	B	40	2,823.7*	108.72	38.9*	4.12	23.3*	2.84	49.0*	5.72
	G	40	2,537.1*	102.38	33.7	4.65	18.9	2.93	46.1*	4.96

Notes: B - boys, G- girls, * - the difference is statistically significant compared to the previous stage of the study at $p \leq 0.05$.

Analyzing the dynamics of physical fitness (Table 4) and the physical performance of the pupils observed, we found identical changes – its a statistically significant improvement ($p \leq 0.05$) during the school year in grade 9 and its deterioration during the summer holidays. After the summer holidays, it was observed the reduction of the results of the following tests: “Running 60 m” (from 10.1 s to 10.2 s in boys and 10.2 s to 10.3 s in girls), “Running 1,500 m” (from 7.15 minutes to 7.22 minutes in boys and from 8.09 minutes to 8.16 minutes in girls), “Standing long jump” (from 180.6 cm to 184.8 cm in boys and from 163.7 cm to 167.1 cm in girls), “Pulling up on the crossbar” (from 10.2 times to 9.7 times in boys), “Flexion and extension of arms in the front lying support” (from 12.0 times to 14.6 times in girls) and “Shuttle running 4 × 9 m” (from 10.8 s to 11.7 s in girls).

Table 4. Analysis of indicators of physical fitness of pupils during 7 stages

		Stages						
		I	II	III	IV	V	VI	VII
		$\bar{x} \pm S$	$\bar{x} \pm S$	$\bar{x} \pm S$	$\bar{x} \pm S$	$\bar{x} \pm S$	$\bar{x} \pm S$	$\bar{x} \pm S$
1	B	10.1±0.71	-	-	-	-	10.2*±0.64	10.2±0.59
	G	10.2±0.32	-	-	-	-	10.2±0.31	10.3±0.19
2	B	7.15±0.38	-	-	-	-	7.22*±0.39	7.21*±0.38
	G	8.09±0.30	-	-	-	-	8.16*±0.28	8.14±0.41
3	B	10.6±0.57	10.8*±0.57	10.7±0.62	10.7±0.59	10.7±0.56	10.7*±0.57	9.7±0.57
	G	10.8±0.51	11.8±0.51	11.7*±0.51	11.8*±0.4	11.7*±0.51	11.7*±0.52	11.7±0.53
4	B	180.6±7.92	182.8*±6.92	183.8*±6.83	183.8±7.2	184.3*±6.95	184.5*±6.98	184.8*±6.94
	G	163.7±13.0	165.8±11.87	166.9*±12.0	165.9±11.2	166.9±12.1	168.5*±11.9	167.1±11.96
5	B	7.2±1.98	7.3±1.89	7.6*±1.82	7.6±1.83	7.8*±1.58	7.8*±1.73	8.0±1.75
	G	12.5±2.95	12.6*±3.04	12.7±3.06	12.7±3.01	13.1*±2.97	13.5*±3.03	13.5±2.93
6	B	10.2±0.88	10.6±1.12	10.2*±0.69	10.1*±0.9	10.3±0.89	10.4±0.79	9.7*±0.79
	G	12.0±3.07	12.6*±2.68	13.4*±2.64	13.4±2.38	13.8*±2.52	14.5*±2.38	14.6*±2.28

Notes: 1- running 60 m, s; 2 - running 1,500m, min; 3-shuttle running 4x9 m, s; 4- standing long jump, cm; 5- bending forward from the sitting position, cm; 6 - pulling up on a high crossbar, number of times; 7- flexion and extension of arms in the front lying support, the number of times.

Notes: B-boys, G-girls, * - the difference is statistically significant compared to the previous stage at $p < 0.05$.

The most significant changes are observed in the indicators of the Ruffier index. The average result in girls at the beginning of the school year at grade 10, significantly ($p \leq 0.05$), worsened compared to the end of the school year at grade 9 from 10.6 nominal units up to 10.9 nominal units.

The change in the percentage distribution of schoolchildren by the SOH that we found during the study allowed us to determine a positive trend, expressed in an increase in the number of ninth-grade pupils who have

an average and above-average SOH by the end of the school year, and a negative trend - an increase in the percentage of pupils who are outside the safe level of physical health at the beginning of the school year in grade 10. So, at the end of the school year, 15.0 % of boys (n = 6) boys and 17.5 % (n = 7) girls had a low SOH, and 52.5 % of boys (n = 21) and 32.5 % of girls (n = 13) had a below the average SOH; while at the beginning of the school year 20.0% (n = 8) boys and 17.5 % of girls (n = 7) had a low SOH and 57.5 % of boys (n = 23) and 55.0% of girls (n = 22) had a below the average SOH. The revealed changes in the SOH of schoolchildren largely depend on the indicators of the Ruffier index, life and strength indices, since we found their statistically significant changes ($p \leq 0.05$) in almost each of the stages of the study.

The factor analysis of the indicators of physical development of schoolchildren made it possible to establish 5 factors common for boys and girls, the contribution of each of which in the overall structure of physical development during different periods of the school year changed: "somatometric components of physical development" (24.5-28.4 % in boys and 23.9-26.7 % in girls); "the content of the fat component in body weight" (15.2-18.6 % in boys, 1 and 4.4-17.7 % in girls); "functional state of the cardiovascular system" (10.0-12.6 % in men, 14.3-16.1 % in girls); "the functional state of the respiratory system" (9.0-11.9 % in boys and 10.1-12.0 % in girls), "physical fitness" (8.5-11.4 % in boys and 11.0-12.7 % in girls), which indicates a change in the importance of morphological and functional indicators.

The research results indicate that a peculiar feature of the continuity of physical education is that its provision requires coverage not only of the school year but also of winter and summer vacation periods. Given this, ensuring the continuity of the physical education of educational and productive stages of a particular orientation requires the consolidation of efforts of teachers and pupils.

In our opinion, the basis of the professional activity of physical education teachers aimed at improving the continuity of physical education is rationally organized pedagogical control, which, in its turn, should be algorithmized.

Considering the results of the data obtained by us during the experiment, indicating the importance of taking into account changes in physical development indicators both during the school year and during the winter and summer holidays, it is necessary to perform pedagogical control 4 times during the school year in at grade 9 and at the beginning of the school year in grade 10.

The implementation of pedagogical control at the beginning of the second academic semester is due to the results of factor analysis, which indicate an increase in the contribution of factors "the functional state of the cardiovascular system" (from 10.0 % to 10.9 % in boys and from 14.4 % to 14.9 % in girls), "functional state of the respiratory system" (from 9.0 % to 9.9 % in boys and from 10.5 % to 12.0 % in girls) and "physical fitness" (from 8.50 % to 9.4 % in boys and from 11.2 % to 11.6 % in girls), which indicates negative changes in the indicators of the cardiovascular and respiratory systems and physical fitness and the need for the distribution of physical education means aimed at their improvement.

Conducting the final pedagogical control at the end of the school year in the 9th grade will enable the teacher to analyze in detail the changes that have occurred in the body of schoolchildren during the school year, draw conclusions about the effectiveness of pedagogical actions, and also develop a program for further actions for the summer vacation period.

The implementation of pedagogical control at the beginning of the school year in grade 10 is necessary for assessment and analysis of the changes in physical development indicators during the summer holidays and determine the readiness of pupils to master the senior school program.

An increase in the contribution of the factors "functional state of the cardiovascular system" (from 10.7 % to 12.6 % in young men and from 14.3 % to 14.6 % in girls), "functional state of the respiratory system" (from 9.8 % to 11.9% in young men and from 11.5 % to 11.9 % in girls), as well as "physical fitness" (from 8.9 % to 10.5 % in young men and from 11.3 % to 12.23 % in girls) after the summer holidays indicates the need for redistribution of physical education tools aimed at improving indicators of the above systems and physical fitness of pupils.

The data obtained by us during the study indicate that vacation periods, especially summer, due to its considerable duration, negatively affect the physiometric indicators of the physical development of schoolchildren, among which the results of physical fitness are of particular concern. The foregoing indicates the need for organized physical fitness activity of pupils during the holidays in secondary schools, due to the functioning of summer school camps. This, in turn, allows you to use the school's material and technical equipment and carry out the process of continuous physical education under the guidance of qualified specialists, as well as use auxiliary means of physical education: hygiene factors and the forces of nature - next to the principal means of physical education - physical exercises.

Effective implementation of the process of physical education during the vacation periods will make it possible to mitigate the deterioration in the level of physical development of schoolchildren as a whole, physical fitness - in particular.

Considering the data we have obtained, which testify to the negative dynamics of the indicators of physical development of schoolchildren after the summer holidays, that is, the schoolchildren are not ready to fulfil the requirements of the senior school curriculum to ensure adaptation of the body for the first 3-4 weeks

(September) of the school year in grade 10, physical education classes should have a recreational and health-improving nature with a moderate load.

During the next two months (in October and November) the principal part (50-60 %) should be assigned to the invariant module "general physical preparation".

In November, it is necessary to carry out a targeted increase in the contribution of means aimed at the development of physical qualities. Observance of the above conditions will help physical education teachers specify the goals and objectives of physical education for pupils in grades 9-10, choose the most effective means and methods of solving these problems, determine the sequence of studying educational material throughout the year, evaluate the effectiveness of their pedagogical actions that will be expressed in ensuring continuity of physical education of middle and senior school pupils.

Discussion

A generalization of the data obtained during the study allowed us to divide them into three groups: those that confirm, supplement the available data and completely new data on the research problem.

The results of our studies confirm the data on the low level of physical health (Palchuk, 2013; Arefiev, 2013; Azhippo, 2015; Lovric, 2018; Blagii et al., 2018; Pasichnyk et al., 2018; Cronin, 2020) and physical fitness for schoolchildren aged 14-16 years. We supplemented the data on the features of the physical development of schoolchildren aged 14-16 (Paliichuk et al., 2018; Galan et al., 2019).

It is supplemented with data (Marchenko, 2014; Vaskan et al., 2018) on the low level of motor activity of middle and senior school pupils, as well as on the types of their employment in their free time and during vacation periods.

We supplemented the data on the decrease in the indicators of the functional state of the respiratory system (VC, the duration of the breath-holding on inhalation and exhalation), physical qualities (strength, speed, endurance, speed-strength), and the physical performance of schoolchildren after long periods of rest - summer and winter holidays. The main approaches to the differentiation of physical education are substantiated. We defined and formulated the organizational and methodological conditions for ensuring the continuity of the process of physical education during the transition from middle school to senior school.

Conclusions

In the process of stage-by-stage monitoring of indicators of physical development and physical fitness, it was revealed a slowdown of the age-related growth, and in some cases - a decrease in absolute values if compared to previous measurements after winter and summer holidays. It concerns the vital capacity of the lungs, the volume of which significantly ($p \leq 0.05$) decreases during the summer holidays in children. The results of almost all motor tests in both sex groups significantly worsened. Despite the absence of statistically significant changes ($p \geq 0.05$), a worsening of the physiometric indicators was also found in girls in tests with breath-holding on inhalation and exhalation. It is probably due to a decrease in the physical activity of schoolchildren during the holidays because of the lack of systematic physical exercises and the preferential spending of free time in a state of low and sitting levels of physical activity.

The practical significance of the obtained results is to develop recommendations for the organization of 9th grade students assessment aimed at studying the indicators of physical development. The results of the assessment became the basis for planning tools, methods, and physical loads in PE sessions for 10th grade students.

Conflict of Interest

The authors declare that there are no conflicts of interest.

References

- Ademovic, M. (2013). Morphological characteristics transformation under the influence of programmed work with 16-year-old students. *Sport Mont*, XI (37-38-39), 542-546.
- Andrieieva, O., Kashuba, V., Carp, I., Blystiv, T., Palchuk, M., Kovalova, N., & Khrypko, I. (2019). Assessment of emotional state and mental activity of 15-16 year-old boys and girls who had a low level of physical activity. *Journal of Physical Education and Sport*, 19, 1022-1029. <https://doi.org/10.7752/jpes.2019.s3147>
- Aoki, M. S., Arruda, A. F., Freitas, C. G., Miloski, B., Marcelino, P. R., Drago, G., . . . Moreira, A. (2017). Monitoring training loads, mood states, and jump performance over two periodized training mesocycles in elite young volleyball players. *International Journal of Sports Science & Coaching*, 12(1), 130-137.
- Arefiev V.G. (2013). Physical abilities of students in general education schools of different levels of physical development. *Bulletin of the T.H. Shevchenko Chernihiv State Pedagogical University. Series: Pedagogical Sciences. Physical Education and Sport*, 120 (1), 120-125.
- Arefiev, V.G. (2013). Modern methodology for assessing the level of physical development of pupils in secondary schools. *Scientific journal M.P. Drahomanov. Problems of physical culture*, 29(4), 31-36.

- Azhippo, A.Yu., Druz, V.A., Dorofeeva, T.I., Pugach, Ya.I., Buren, N.V., Nechitaylo, M.V., Zhernovnikova, Ya.V. (2015). Individual features of physical development and advent of biological maturity of morphofunctional structures of an organism. *Slobozhansky Scientific and Sport Newsletter*, 50(6), 11-19.
- Azhippo, O.Yu., Mameshina, M.A. & Masliak, I.P. (2016). Assessment of physical health of middle school students. *Materials of the XVI International Scientific and Practical Conference. Physical Culture, Sports and Health*, 3-6.
- Bakayev V., Vasilyeva V., Kalmykova S., & Razinkina E. (2018). Theory of physical culture - a massive open online course in educational process. *Journal of Physical Education and Sport*, 18(1), 293-297.
- Bar-Or O., Rowland T. (2009). Children's Health and Motion Activity: From Physiological Fundamentals to Practical Application. Translation from English by I. Andryev. *Olympic Literature*, 528 p.
- Blagii, O., Berezovskiy, V., Balatska, L., Kyselytsia, O., Palichuk, Y., & Yarmak, O. (2018). Optimization of psychophysiological indicators of adolescents by means of sport orienteering. *Journal of Physical Education and Sport*, 18, 526–531. <https://doi.org/10.7752/jpes.2018.s175>
- Blagii, O.L., Yachnyuk, M.Yu. (2015). Analysis of indicators of physical condition of student youth. *Bulletin of Chernigiv National Taras Shevchenko University. Physical education and sports*, 129(3), 27-32.
- Cherepov, E.A., Tseylikman, O.B. (2015). Dynamics of stress tolerance of pupils within sportized physical education. *Teoriya i Praktika Fizicheskoy Kultury*, 9, 97-99.
- Cronin, L. Marchant, D., Johnson, L., Huntley, E., Kosteli, M.C., Varga, J., Ellison, P. (2020). Life skills development in physical education: A self-determination theory-based investigation across the school term. *Psychology of Sport and Exercise*, 49, 101711. <https://doi.org/10.1016/j.psychsport.2020.101711>
- Dragutinovic, K., & Mitrovic, M. (2019). Differences in the attitudes of fourth grade pupils of the elementary school according to the teaching of physical education in terms of gender. *Journal of Anthropology of Sport and Physical Education*, 3(1), 29-34. <https://doi:10.26773/jaspe.190106>
- Galan, Y., Andrieieva, O., Yarmak, O. (2019). The relationship between the indicators of morpho-functional state, physical development, physical fitness and health level of girls aged 12-13 years. *Journal of Physical Education and Sport*, 19 (2), 1158-1163.
- Galan, Y., Nakonechnyi, I., Moseichuk, Y., Vaskan, I., Paliichuk, Y., Yarmak, O. (2017). The analysis of physical fitness of students of 13-14 years in the process of physical education. *Journal of Physical Education and Sport*, 17 Supplement issue 5, 2244-2249.
- Galan, Y., Ivanchuk, M., Kushnir, I., Svarychevska, A., Koshura, A., Baidiuk, M., Yarmak, O. (2019). The factor structure of the physical condition of the 13 year-old young men going in orienteering. *Journal of Physical Education and Sport*, 19(2), 1236-1241.
- Koval, V.Y. (2015). Development of coordination abilities of middle school age children in physical education lessons. *Bulletin of Kamyanets-Podilskiy Ivan Ogiyenko National University. Physical education, sports and human health*, (8), 182-188.
- Krutsevich, T.Y. (2003). Motor activity and health of children, adolescents. *Theory and methodology of physical education*, (2), 8-20.
- Lebedinsky, V., Kuzmina, O., Kudryavtsev, M., Gruzenkin, V., & Arutunian, T. (2020). Health monitoring of students of the III functional group for controlling and designing educational environment (physical education) in a non-sport university. *Human. Sport. Medicine*, 19(4), 78-91. <https://doi.org/10.14529/hsm190410>
- Leonenko, A., Tomenko, O., Bondarenko, Y., Brizhatyi, O. & Loza, T. (2019). Effect of recreation-oriented tourism program on physical health of middle school-aged children. *Journal of Physical Education and Sport*, 17 (Supplement issue 1), 121-125.
- Lovric, F., Mandic Jelaska, P., & Bilic, Z. (2018). Physical activity cannot be treated as a predictor of anthropological status among six-year-old children. *Montenegrin Journal of Sports Science and Medicine*, 7(1), 53-57. <https://doi.org/10.26773/mjssm.180307>
- Marchenko, S.I. (2014). Peculiarities of development of coordination of elementary school students. *Theory and methodology of physical education*, (4), 32-36. <http://dx.doi.org/10.17309/tmfv.2014.4.1115>
- Nakonechnyi I., Galan Y. (2017). Development of behavioural self-regulation of adolescents in the process of mastering martial arts. *Journal of Physical Education and Sport*, 17 Supplement issue 3, 1002-1008. <https://doi:10.7752/jpes.2017.s3154>
- Osipov, A., Zhavner, T., Batunova, I., Filonchik, O., Starova, O., Malakhova, A., ... Fedorova, P. (2018). Physical education and sports achievement ratings as a significant factor to increase the level of physical activity of students and staff in high school. *Journal of Physical Education and Sport*, 18(2), 592-599. <https://doi.org/10.7752/jpes.2018.02086>
- Palchuk M. B. (2013). Dynamics of indicators of physical development and physical fitness of girls during the transition from high school to high school. *Young sports science of Ukraine*, 17, 131-137.

- Paliichuk, Y., Dotsyuk, L., Kyselytsia, O., Moseychuk, Y., Martyniv, O., Yarmak, O., & Galan, Y. (2018). The influence of means of orienteering on the psychophysiological state of girls aged 15-16-years. *Journal of Human Sport and Exercise*, 13(2), 443–454. <https://doi.org/10.14198/jhse.2018.132.16>
- Pasichnyk, V., Pityn, M., Melnyk V., Karatnyk, I., Hakman, A., Galan, Y. (2018). Prerequisites for the physical development of preschool children for the realization of the tasks of physical education. *Physical Activity Review*, 6, 117-126. <https://doi:10.16926/par.2018.06.16>
- Prontenko, K., Griban, G., Bloschynskyi, I. Melnychuk, I., Popovych, D., Nazaruk, V., Yastremska, S., Dzenzeliuk, D., Novitska, I. (2020). Improvement of students' morpho-functional development and health in the process of sport-oriented physical education. *Wiadomości Lekarskie*, 73 (1), 161-168. <https://doi:10.36740/WLek202001131>
- Radanovic, D., Stajer, V., Popovic, B., & Madic, D. (2013). Differences between 11-12 year-old boys and girls in success of gymnastic exercises adoption. *Sport Mont*, XI(37-38-39), 137-144.
- Tomenko, O., Kirichenko, L., Skripka, I., Kopytina, Y., Burla, A. (2017). Effect of recreational taekwondo training on musculoskeletal system of primary school age children. *Journal of Physical Education and Sport*, 17(3), 1095-1100.
- Vaskan, I., Moseychuk, Y., Koshura, A., Kozhokar, M., Tsybanyuk, O., Yarmak, O., Galan, Y. (2018). Comparative analysis of indicators of the morpho-functional condition of the young men aged 15-16 years during the process of physical education. *Journal of Physical Education and Sport*, 18(4), 2504-2508. <https://doi:10.7752/jpes.2018.04375>