

Physical health of schoolchildren aged 14-15 years old under the influence of differentiated education

Masliak I.P.^{ABCDE}, Mameshina M.A.^{ABCDE}

Department of Theory and Methods of Physical Education, Kharkiv State Academy of Physical Culture, Ukraine

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

Abstract

Purpose: to determine the dynamics of indicators of schoolchildren physical health under the influence of a multilevel system of differentiated education.

Material: The study involved schoolchildren (n = 148, age 14-15 years). Two control groups and two experimental groups were formed. Quantitative assessment of physical health was carried out according to 5 indices.

Results: a low level of physical health of schoolchildren is established. The influence of the means of a multilevel system of differentiated education on the individual level of physical health of schoolchildren is determined. The most susceptible systems of the organism are determined to influence the differentiated training. An improvement in the adaptive capacity of the cardiovascular system during the recovery period after standard physical activity was revealed.

Conclusions: The marked decrease in the heart rate at rest and blood pressure is evidence of a better state of adaptation mechanisms. A significant increase in the vital capacity of the lungs and the delay in breathing testifies to the improvement of the functional capabilities of the respiratory system and the body's resistance to hypoxic phenomena. Improvement in the development of strength, speed, speed endurance of the muscles of the back and abdominal press indicates an increase in the specific intensity of the performed work.

Keywords: multi-level system of differentiated education, functional systems, constitution, physical development, schoolchildren.

Introduction

At present, there is a tendency in Ukraine to decrease the level of health and physical fitness of students. In a number of works is paid attention to deviations in the state of health, decrease in working capacity, initial disturbances in the activity of a number of functional systems of the organism of the younger generation. So, studies of Mameshina M. [1] have been established inadequate adaptive reserves of the cardiovascular and respiratory systems of schoolchildren of 13 years old. The necessity of correction of the indicated deviations by means of a purposeful influence is shown. In another study, a decrease was found in the majority of indicators of kinesthetic, orientational and reactive qualities in the learning process [2]. Podrigalo L. et al. [3] studied the relationship between mental performance and the physical state of students. The authors determined that the intensification of educational activity requires the mastery of a higher level of information and significantly increases the burden on the body. As a result, the young people are receiving prenosological disorders of the body. Other studies show the possibilities of physical education in strengthening the level of health of students [4]. The authors propose the correction of the component composition of the biological age of female students. Some authors note that a negative trend of decreasing the level of health of students is typical for all countries [5, 6]. The main goal of such research is to find ways to improve the health of students, develop certain sports, create favorable conditions for the formation of a positive attitude of young people to a healthy lifestyle. In other

studies [7, 8] there is a significant deterioration in the physical and psychological health of students. The authors point out the need to study the features of development the previous pedagogical systems of the health-improving orientation. This will allow to determine the ways of introducing health conservation measures in modern educational institutions.

According to a number of authors, the deterioration in the state of health and the reduction in the level of physical preparedness is due to the lack of motor activity of children aged 6-11 years old in the period of schooling in primary school [9, 10], the decrease in physical activity of schoolchildren between 11 and 15 years old [11, 12], insufficient motivation and a decrease in students' interest in physical education [13-15]. Studies have found that deficiency in motor activity adversely affects the adaptive capabilities of the body, the functioning of various systems, mental and physical performance: children aged 7-15 years [15, 16]; adolescents aged 11-16 years [17]; students [18, 19]; women aged 20-25 years [20]. As a result, the state of health deteriorates substantially.

Specialists in the field of physical education note that the standard organization and the typical content of the educational process do not compensate for the lack of motor activity of schoolchildren [21]. Therefore, the search for new, non-traditional approaches to the organization of physical education in educational institutions is relevant.

A number of authors indicate that one of the conditions for increasing the effectiveness of physical education is a differentiated approach. Issues of theory and technology of differential education of schoolchildren of different ages have been considered in many studies [22, 23]. Differentiated methods of physical education have been

developed and presented for different age groups: blind and visually impaired schoolchildren [24]; preschoolers [25]; children of primary school age [26-28]; adolescents [29].

The review of scientific and methodical literature showed the existence of a number of works devoted to differentiated teaching. They discussed the issues of differentiation of physical education, taking into account the level of physical preparedness [24]; features of the physical development of schoolchildren aged 6-11 years [26]; adolescents of 13 years old [29]; differentiated application of information and computer technologies in the physical education of preschool children (5-6 years) and schoolchildren (11-16 years) [21, 30]; the level of physical health of schoolchildren aged 13-14 years [31].

At the same time, the issue of the differentiation of the educational process, taking into account the functional state of students aged 14-15 years, has not been studied. In our opinion, such an organization of the educational process for physical education will positively affect the state of physical health of schoolchildren aged 14-15 years.

An aim of the study is to determine the dynamics of indicators of physical health of schoolchildren aged 14-15 years as a result of applying a multilevel system of differentiated education.

Material and methods.

Participants: The study involved 148 schoolchildren aged 14-15 (n = 78 - boys, n = 70 - girls), assigned to the main medical group. All participants received informed consent to participate in the study.

Organization of the study:

The research was carried out on the basis of the general school No. 150 (Kharkov, Ukraine). Two experimental and two control groups were formed from the study participants. The students of the experimental groups were divided into homogeneous subgroups, taking into account their level of physical health. The content of the program material of physical education lessons in these groups consisted of two levels: basic and variable. The basic level was based on the types of motor activity typical for general educational institutions. Lessons of basketball, football, volleyball, gymnastics, athletics were held. The content of the variational level was developed by us and was based on a differentiated approach, taking into account the individual characteristics of the students. So, for each subgroup a system of physical exercises was developed and implemented. This system is aimed at increasing the functional state of those systems of the body, which, according to the results of primary research, had an insufficient level of development. The first complex included exercises and modified mobile games aimed at improving the regulation of the cardiovascular system. The second complex included exercises to increase the functionality of the respiratory system. The third complex included exercises for the development of strength, speed and speed endurance of the muscles of the back and abdominal press. The developed system of physical

exercises of differentiated education was also included in the system of independent studies and was offered as homework assignments.

The level of physical health was determined [32]. Quantitative assessment of physical health was carried out according to 5 indices. To calculate the indices were determined: length and weight of the body; vital capacity of the lungs (VCL); blood pressure (BP); time of breath retention on usual inhalation (Stange's test); heart rate (HR) at rest and after a dosed physical exercise (30 sit-ups in 45 seconds); the number of torso lifts in the saddle from the supine position for 60 seconds (NTL). Determined:

1) mass-growth Kettle index 2, characterizing the degree of harmony of physical development and constitution. Calculated by the formula: body weight (kg) / body length² (m²);

2) Robinson index, characterizing the state of regulation of the cardiovascular system. Calculated by the formula: HR (bpm) x BP systolic (mm Hg) / 100

where, BP systolic – blood pressure systolic;

3) Skibinski index, characterizing the functional capabilities of the respiratory system and the body's resistance to hypoxic phenomena. Calculated by the formula: VCL (ml) x Stange test (c) / HR (bpm);

4) Shapovalova index, characterizing the development of strength, speed and speed endurance of the muscles of the back and abdominal press. Calculated by the formula: (body weight (g) / body length) x (NTL/60);

5) Ruffier index, characterizing the reaction of the cardiovascular system to the standard physical load. Calculated by the formula: $4 \times (P_1 + P_2 + P_3) - 200/10$.

Where P₁ – HR for 15 s at rest, P₂ – HR for the first 15 seconds of the recovery period after the load, P₃ – HR for the last 15 seconds from the first minute of recovery.

The obtained results were compared with the scale and evaluated by a certain number of points. The amount of points was determined by the level of physical health.

Statistical analysis:

The research materials were processed using Excel. Calculated:

- arithmetic mean \bar{X} - to characterize the population by separate parameters;

- standard error of the mean (m) - to determine the deviation of the arithmetic mean from the corresponding parameters of the population;

- the reliability of the differences (p) - was calculated in order to determine the degree of change in the mean values of the studied characteristics after the experiment using the Student's parametric criterion (t) with a significance level of at least 0.05.

Results.

The analysis of the primary indicators of physical health indicates the identity of the control and experimental groups (p>0.05). A comparison of the results obtained with the scoring scale [32] showed "below average" level of physical health of students aged 14-15 years. The exception is the boys of 14 years old of control groups who have an "average" level (Table 1).

After introduction of the multilevel system of differentiated education (Table 2-3), the results of schoolchildren of experimental groups showed positive changes in all parameters ($p < 0.05-0.001$). The only exception is P_1 (girls of 14 years) and P_2 (boys of 14 years and girls of 15 years): the changes are not reliable ($p > 0.05$).

The data of the schoolchildren of the control groups did not change significantly ($p > 0.05$). The exception is the mass-growth indicators of schoolchildren of 14 and boys of 15 years: changes are significant ($p < 0.05-0.001$).

Comparing repeated results with the scoring scale [32], there was no significant change in the indices of the Kettle index. In schoolchildren of 14 years (experimental groups) and 14-15 years (control groups), these indicators correspond to harmonious constitution (3 points). In schoolchildren of 15 years of experimental groups correspond to inharmonious constitution (with a body weight deficit - 2 points). The Robinson index established an increase in the score on 1 point for schoolchildren in experimental groups. As a result, the level of regulation of the cardiovascular system increased from "low" to

Table 1. Assessment of physical health of schoolchildren aged 14-15 years before the experiment

Age	Boys	Points	Girls	Points
Level of physical health				
<i>Experimental group</i>				
14 years old	«Below average»	13	«Below average»	12
15 years old	«Below average»	11	«Below average»	11
<i>Control group</i>				
14 years old	«Average»	14	«Below average»	12
15 years old	«Below average»	12	«Below average»	12

Table 2. Physical health indicators of boys of experimental groups before and after the experiment

Indicators		Before experiment	After experiment	t	p
		$\bar{x} \pm m$			
14 years old (n=29)					
Body length (cm)		1619,66±9,42	1639,91±9,42	10,40	<0,001
Body mass (kg)		50,97±0,97	52,90±0,96	8,12	<0,001
Heart rate (bpm ¹)		88,00±3,10	76,14±1,06	5,08	<0,001
Vital capacity (ml)		2124,14±71,37	2544,83±57,94	16,20	<0,001
Systolic blood pressure (mm Hg)		120,38±2,16	102,34±1,24	11,98	<0,001
Diastolic blood pressure (mm Hg)		77,07±1,71	68,76±0,68	6,59	<0,001
Time of breath-holding (s)		32,41±1,85	41,21±1,70	11,08	<0,001
Heart rate in 15 seconds (number of times)	P_1	20,86±1,13	18,28±0,30	3,21	<0,01
	P_2	31,93±1,16	32,76±0,53	1,59	>0,05
	P_3	25,03±1,27	20,86±0,32	6,34	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)		37,41±1,86	39,28±1,70	8,05	<0,001
15 years old (n=19)					
Body length (cm)		1727,37±21,81	1748,95±21,18	15,62	<0,001
Body mass (kg)		57,26±2,92	59,58±2,75	8,38	<0,001
Heart rate (bpm ¹)		86,37±1,64	76,79±0,68	8,61	<0,001
Vital capacity (ml)		2826,32±124,68	3278,95±137,57	13,11	<0,001
Systolic blood pressure (mm Hg)		124,26±2,38	109,37±1,68	9,43	<0,001
Diastolic blood pressure (mm Hg)		82,05±1,78	71,05±0,82	7,77	<0,001
Time of breath-holding (s)		33,63±2,91	44,32±2,28	11,48	<0,001
Heart rate in 15 seconds (number of times)	P_1	22,84±1,10	19,47±0,76	7,32	<0,001
	P_2	33,42±1,37	32,00±0,68	2,95	<0,05
	P_3	25,58±1,01	21,74±0,77	5,57	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)		28,16±1,22	32,58±1,22	15,84	<0,001

Note. P_1 is the heart rate in 15 seconds at rest, P_2 is the heart rate in the first 15 seconds of the recovery period after the load, P_3 is the heart rate in the last 15 seconds of the first minute of recovery.

“average”.

The schoolchildren of the control groups did not show significant changes in the evaluation scale. In the Skibinsky index, an increase in the results of schoolchildren of experimental groups was established the following: in boys (14 years) and girls (15 years) - 1 point; boys (15 years) and girls (14 years) - 2 points. As a result, the level of development of the respiratory system has increased as follows: from “low” to “below average” - in boys (14 years); from “below average” to “average” - in girls (15 years); from “low” to “average” - for girls (14 years) and boys (15 years).

The schoolchildren of the control groups have not established any significant changes. In Shapovalova index, the results were increased on 1 point in girls (14 years) and boys (15 years) (experimental groups). As a result, the level of development of strength, speed, speed endurance of the muscles of the back and abdominal press increased from “low” to “below average”. The figures for boys (14 years) and girls (15 years) also increased. However, these changes were not reflected in the overall assessment. A similar comparison of the data of students

in the control groups revealed a lack of significant changes after the experiment. The only exception is the results of boys (15 years): unreliable improvements. The boys’ points increased on 1 point and became “below average” level.

A comparison of Ruffier index revealed an increase in the results of girls (14 years) and boys (15 years) in experimental groups on 1 point. As a result, the level of adaptive capacity of the cardiovascular system in girls (14 years) has become “above average”. The boys (15 years) – “average”. Improvement in the indicators of boys (14 years) and girls (15 years) on the scoring scale is not affected. According to the evaluation criteria, significant changes were not detected in schoolchildren of control groups. The exception is the results of girls (14 years), who rose by 1 point. The results began to correspond to the “average” level. And boys (15 years), the results dropped from “average” to “below average” level.

The general level of physical health of the schoolchildren of the experimental groups was determined after the experiment (Table 4). Its increase from “below average” to “average” has been established.

Table 3. Indicators of the physical health of girls of experimental groups before and after the experiment

Indicators	Before experiment		t	p	
	$\bar{x} \pm m$	After experiment			
14 years old (n=23)					
Body length (cm)	1595,65±18,10	1614,78±16,95	9,66	<0,001	
Body mass (kg)	48,57±1,04	50,52±1,05	9,18	<0,001	
Heart rate (bpm ¹)	90,91±3,50	76,48±1,15	5,62	<0,001	
Vital capacity (ml)	2113,04±75,60	2504,35±61,15	9,28	<0,001	
Systolic blood pressure (mm Hg)	122,22±2,03	104,26±1,37	12,83	<0,001	
Diastolic blood pressure (mm Hg)	77,70±1,45	68,83±0,73	8,44	<0,001	
Time of breath-holding (s)	32,61±2,50	42,83±1,84	10,06	<0,001	
Heart rate in 15 seconds (number of times)	P ₁	18,09±0,79	17,26±0,32	2,00	>0,05
	P ₂	30,78±1,27	32,43±0,54	2,36	<0,05
	P ₃	21,61±1,07	19,61±0,32	3,09	<0,01
Lifting the trunk into the seat in 1 minute (the number of times)	34,57±0,66	38,70±1,15	3,28	<0,01	
15 years old (n=23)					
Body length (cm)	1642,17±13,17	1661,30±12,99	14,03	<0,001	
Body mass (kg)	48,91±1,64	50,61±1,08	10,87	<0,001	
Heart rate (bpm ¹)	86,30±4,22	76,43±1,27	3,63	<0,01	
Vital capacity (ml)	2321,74±73,56	2760,87±66,10	14,07	<0,001	
Systolic blood pressure (mm Hg)	121,13±2,52	106,30±1,63	10,99	<0,001	
Diastolic blood pressure (mm Hg)	80,57±1,81	70,13±0,99	8,77	<0,001	
Time of breath-holding (s)	32,52±2,47	44,04±1,99	13,63	<0,001	
Heart rate in 15 seconds (number of times)	P ₁	18,30±1,10	17,26±0,54	2,10	<0,05
	P ₂	29,83±1,46	30,00±0,60	0,25	>0,05
	P ₃	23,22±0,84	19,48±0,57	7,54	<0,001
Lifting the trunk into the seat in 1 minute (the number of times)	25,91±0,81	29,57±0,78	25,08	<0,001	

Note. P₁ is the heart rate in 15 seconds at rest, P₂ is the heart rate in the first 15 seconds of the recovery period after the load, P₃ is the heart rate in the last 15 seconds of the first minute of recovery.

Table 4. Assessment of physical health of schoolchildren aged 14-15 years after the experiment

Age	Boys	Points	Girls	Points
	<i>Experimental groups</i>			
14 years old	«Average»	17	«Average»	17
15 years old	«Average»	15	«Average»	15
	<i>Control groups</i>			
14 years old	«Average»	14	«Below average»	13
15 years old	«Below average»	12	«Below average»	12

In schoolchildren of control groups, the level of physical health has not changed.

Thus, the author’s system of differentiated education and the methodology for its implementation proved to be reliably effective in the majority of the studied indicators.

Discussion.

Analysis of the study data revealed the natural character of changes in the mass-growth indicators of schoolchildren aged 14-15 years: during the pedagogical experiment, the indicators significantly increased in the experimental and control groups ($p < 0.05-0.001$). The obtained dynamics of results agrees with the data of a number of researchers. In other studies, certain physical exercises (elements of cheerleading [33, 34], tourism [35]) did not have a significant impact on the body structure of adolescents. We have not found any work devoted to the study of the effect of differentiated education on the constitution of schoolchildren aged 14-15 years.

Analysis of the data of the functional state of the cardiovascular system revealed their significant improvement in schoolchildren of experimental groups ($p < 0.01, 0.001$). So, after introduction of the differentiated training it is established the tendency to decrease in blood pressure and frequency of warm reductions at teenagers of 14-15 years old. In our opinion, the introduction of specially designed exercises widens the range of functionalities of the circulatory system. Such exercises also improve the nervous regulation of the cardiovascular system. The results obtained are in agreement with the data of a number of authors. Other studies have established an improvement in the functional capabilities of the cardiovascular system under the influence of cheerleading in schoolchildren aged 13-15 years [33] and girls aged 16-18 years [36, 37], tourism classes [35], and differential education [31]. The schoolchildren of the control groups also improved. However, these changes are not significant and are not reliable ($p > 0.05$). Our research proves that the differentiation of the educational process, taking into account the individual characteristics of those involved, positively influenced the functional state of the cardiovascular system of students aged 14-15 years.

Analysis of the results of the functional state of the respiratory system made it possible to establish that in schoolchildren of experimental groups they significantly improved after the experiment ($p < 0.001$). In schoolchildren of control groups, no significant and significant changes were detected ($p > 0.05$). In our

opinion, positive changes are the result of modification of the lessons of physical culture. At the heart of this lesson is the differentiation of education, taking into account the individual characteristics of schoolchildren. In our opinion, this is explained by an increase in the vital capacity of the lungs, improvement in pulmonary ventilation, and increased oxygen saturation of the blood. Accordingly, the functional capabilities of the respiratory system are increased. The data obtained are consistent with a number of studies. The authors found a positive effect on the functions of the respiratory system of cheerleading exercises in schoolchildren [35, 36].

Thus, in our study, the positive effect of differentiated education on the level of physical health of schoolchildren in experimental groups was established: an increase in indicators from “below average” to “average”. During the research, the data of other authors [17, 38, 39] were supplemented, which indicate a low level of physical health of schoolchildren. Our data confirm the results of Dumich O. et al. [23] about the positive influence of the differentiated approach in the process of physical education of schoolchildren of lower grades; Podoliaka A.Ie. [25] – senior preschoolers; Ierakova L. [24] – blind and visually impaired; Mameshina M.A. et al. –13-14 years old schoolchildren [31].

For the first time, the influence of the means of a multilevel system of differentiated education on the individual level of physical health of schoolchildren aged 14-15 years was determined. Also the most susceptible systems of the organism are established to influence differentiated learning.

Conclusions:

The application of the experimental model of organization of multilevel lessons of physical culture on the basis of differentiation of teaching positively influenced the level of physical health of schoolchildren of 14-15 years old. After the application of differentiated training, the adaptation capabilities of the cardiovascular system were improved during the recovery period after the standard physical load. The marked decrease in the heart rate at rest and blood pressure is evidence of a better state of adaptation mechanisms. A significant increase in the vital capacity of the lungs and the delay in breathing testifies to the improvement of the functional capabilities of the respiratory system and the body’s resistance to hypoxic phenomena. Improvement in the development of strength, speed, speed endurance of the muscles of

the back and abdominal press indicates an increase in the specific intensity of the work performed.

Thus, our studies allow us to recommend to teachers of physical culture of general educational institutions to supplement the content of the educational process of the differentiated training system developed by us. This allows to increase the level of physical health of schoolchildren.

Acknowledgements.

The research was carried out in accordance with the Thematic Plan of the Kharkov State Academy of Physical Culture on the topic “Improving the process of physical education in educational institutions of various profiles” for years 2016-2020. (State Registration Number 011U00754).

Conflict of interest.

The authors report that there is no conflict of interest.

References

- Mameshina Margarita. Condition of physical health of pupils of the 7th-8th classes of the comprehensive school. *Slobozhanskyi herald of science and sport*, 2016;5(55):47–52. doi:10.15391/sns.v.2016-5
- Cieszczyk P, Zarebska A, Jastrzebski Z, Sawczyn M, Kozakiewicz-Drobnik I, Leonska-Duniec A, et al. Does the MTHFR A1298C Polymorphism Modulate the Cardiorespiratory Response to Training? *Journal of Human Kinetics*. 2016;54(1):43-53. doi:10.1515/hukin-2016-0055
- Podrigalo L, Iermakov S, Rovnaya O, Zukow W, Nosko M. Peculiar features between the studied indicators of the dynamic and interconnections of mental workability of students. *Journal of Physical Education and Sport*, 2016;16(4): 1211-1216. doi:10.7752/jpes.2016.04193
- Jagiello W, Sawczyn S, Jagiello M. The subjective profile of positive health and survival abilities in women differing as to physical activity. *Archives of Budo*. 2012;8(4):219-24.
- Jagiello M, Iermakov SS, Nowinski M. Differentiation of the somatic composition of students physical education specialising in various sports. *Archives of Budo Science of Martial Arts and Extreme Sports*. 2017;13:63-70.
- Kriventsova I, Pashkevych S, Iermakov S, Bartik P, Michal J, Nosko M, Yermakova T. Fitness – aerobic training of 15 – 17 years’ age girl students, who have significant risk of deviations in backbone functional state. *Journal of Human Sport and Exercise*, 2017;12(4), 1289-1297. doi:10.14198/jhse.2017.124.15
- Kozina Z, Iermakov S, Bartik P, Yermakova T, Michal J. Influence of self-regulation psychological and physical means on aged people’s functional state. *Journal of Human Sport and Exercise*, 2018;13. doi:10.14198/jhse.2018.131.10
- Doroshenko EY, Svatyev AV, Iermakov SS, Jagiello W. The use of cardio training facilities in training 7-9 year old judo athletes. *Archives of Budo Science of Martial Arts and Extreme Sports*. 2017;13.
- Maslyak I. Influence of specially directed exercises on separate functions of sensor-based systems of pupils of junior classes. *Slobozhanskyi herald of science and sport*, 2015;5(49):48–51. doi:10.15391/sns.v.2015-5.010
- Agüero SD, Rivera PH. Association between the amount of sleep and obesity in Chilean schoolchildren. *Archivos Argentinos De Pediatría*. 2016;114(2):114-119. doi:10.5546/aap.2016.eng.114
- Maslyak I, Mameshina M. A., Zhuk V. O. The state of application of innovation approaches in physical education of regional education establishments *Slobozhanskyi herald of science and sport*, 2014;6(44):72–76. doi:10.15391/sns.v.2014-6.013
- Esteban-Cornejo I, Martinez-Gomez D, Garcia-Cervantes L, Ortega FB, Delgado-Alfonso A, Castro-Pinero J, et al. Objectively Measured Physical Activity During Physical Education and School Recess and Their Associations With Academic Performance in Youth: The UP&DOWN Study. *Journal of Physical Activity & Health*. 2017;14(4):275-282. doi:10.1123/jpah.2016-0192
- Gu XL, Solmon MA. Motivational processes in children’s physical activity and health-related quality of life. *Physical Education and Sport Pedagogy*. 2016;21(4):407-424. doi:10.1080/17408989.2015.1017456
- Liu Y, Tang Y, Cao ZB, Chen PJ, Zhang JL, Zhu Z, et al. Results From Shanghai’s (China) 2016 Report Card on Physical Activity for Children and Youth. *Journal of Physical Activity & Health*. 2016;13(11):S124-S128. doi:10.1123/jpah.2016-0362
- Wilcox BR, Lewandowski HJ. Open-ended versus guided laboratory activities: Impact on students’ beliefs about experimental physics. *Physical Review Physics Education Research*. 2016;12(2). doi:10.1103/PhysRevPhysEducRes.12.020132
- Maslyak IP, Shesterova LYe, Kuzmenko IA, Bala TM, Mameshina MA, Krivoruchko NV, Zhuk VO. The Influence of the vestibular analyzer functional condition on the physical fitness of school-age children. *Sport science. International scientific journal of kinesiology*, 2016;9 (2): 20-27.
- Azhippo OIu, Mameshina MA, Masliak IP. Assessment of physical health of middle school students. *XVI International Scientific and Practical Conference “Physical Culture, Sport and Health”*, Kharkiv. Kharkiv; 2016. p. 3-6. (in Ukrainian)
- Winther A, Jorgensen L, Ahmed LA, Christoffersen T, Furberg AS, Grimnes G, et al. Bone mineral density at the hip and its relation to fat mass and lean mass in adolescents: the Tromso Study, Fit Futures. *Bmc Musculoskeletal Disorders*. 2018;19. doi:10.1186/s12891-018-1933-x
- Ruivo RM, Carita AI, Pezarat-Correia P. The effects of training and detraining after an 8 month resistance and stretching training program on forward head and protracted shoulder postures in adolescents: Randomised controlled study. *Manual Therapy*. 2016;21:76-82. doi:10.1016/j.math.2015.05.001
- Farland LV, Missmer SA, Bijon A, Gusto G, Gelot A, Clavel-Chapelon F, et al. Associations among body size across the life course, adult height and endometriosis. *Human Reproduction*. 2017;32(8):1732-1742. doi:10.1093/humrep/dex207
- Borisova IuIu. *Differentiated approach in physical education of schoolchildren on the basis of computer technologies*. Cand. Diss., Dnipropetrovsk; 2009. (in Ukrainian)
- Glazirin ID. *Fundamentals of differentiated physical education*, Cherkasy: Echo-Plus; 2003. (in Ukrainian)
- Dumich O, Porod’ko M, Zvarich M. Organizational-methodical aspects of application of individual and differentiated approach in physical education of pupils of junior school age. *Moloda sportivna nauka Ukraini*, 2015;2:75-80. (in Ukrainian)
- Ierakova L. Differentiated physical education of blind and

- visually impaired pupils. *Moloda sportivna nauka Ukraini*, 2005;9(2): 137-142. (in Ukrainian)
25. Podoliaka AYe. *Differentiation of mobile games in the physical education of preschoolers 5-6 years by means of information technologies. Cand. Diss.*, Kharkiv; 2011. (in Ukrainian)
26. Beets MW, Okely A, Weaver RG, Webster C, Lubans D, Brusseau T, et al. The theory of expanded, extended, and enhanced opportunities for youth physical activity promotion. *International Journal of Behavioral Nutrition and Physical Activity*. 2016;13. doi:10.1186/s12966-016-0442-2
27. Clemes SA, Barber SE, Bingham DD, Ridgers ND, Fletcher E, Pearson N, et al. Reducing children's classroom sitting time using sit-to-stand desks: findings from pilot studies in UK and Australian primary schools. *Journal of Public Health*. 2016;38(3):526-533. doi:10.1093/pubmed/fdv084
28. Fernandez-Rio J, Suarez C. Feasibility and students' preliminary views on parkour in a group of primary school children. *Physical Education and Sport Pedagogy*. 2016;21(3):281-294. doi:10.1080/17408989.2014.946008
29. Sitovs'kij AM. *Differentiated approach in the physical education of adolescents with different rates of biological development (for example, pupils of the 7th grade) Cand. Diss.*, Lviv; 2008. (in Ukrainian)
30. Ashanin VS, Podoliaka AYe. Differential approach with the use of information technology in the physical education of children of senior preschool age. *Slobozhans'kij naukovno-sportivnij visnik*, 2010; 3:120-123. (in Ukrainian)
31. Mameshina MA., Masliak IP. The level of physical development of students 7-8 grades. *Fizichne vikhovannia, sport i zdorov'ia liudini*, 2017;10:312-322. (in Ukrainian)
32. Poliakov SD, Khrushchev SV, Korneeva IT. *Monitoring and correction of physical health of schoolchildren*, Moscow: Iris Press; 2006. (in Russian)
33. Bala TM, Masliak IP. Changing the level of physical health of schoolchildren 7-9 classes under the influence of exercises of cheerleading. *Sportivnij visnik Pridniprov'ia*, 2011; 2:21-23. (in Ukrainian)
34. Gerdin G, Larsson H. The productive effect of power: (dis) pleasurable bodies materialising in and through the discursive practices of boys' physical education. *Physical Education and Sport Pedagogy*. 2018;23(1):66-83. doi:10.1080/17408989.2017.1294669
35. Mazurek-Kusiak A, Soroka A, Wojciechowska-Solis J. Importance of the forest environment on the psychophysical development of Polish pupils. *Sylvan*. 2016;160(7):609-616.
36. Crutcher PA, Naseem S. Cheerleading and cynicism of effective mentoring in current empirical research. *Educational Review*. 2016;68(1):40-55. doi:10.1080/00131911.2015.1058749
37. Hardy I, McFaul SR, Beaudin M, St-Vil D, Rousseau E. Cheerleading injuries in children: What can be learned? *Paediatrics & Child Health*. 2017;22(3):130-133. doi:10.1093/pch/pxx048
38. Kuz'menko I. The level of physical development of students 7-8 grades. *Sportivna nauka Ukraini*, 2017; 1(77):34-37. (in Ukrainian)
39. Aghyppo Alexandr, Tkachov Sergij, Orlenko Olena. Role of physical education on the formation of a healthy lifestyle outside of school hours. *Journal of Physical Education and Sport*. 2016; 16(2): 335-339.

Information about the authors:

Masliak I.P.; (Corresponding author); <http://orcid.org/0000-0003-1306-0849>; irina.maslyk@ukr.net; Department of Theory and Methods of Physical Education, Kharkiv State Academy of Physical Culture; Klochkivska str. 99, Kharkiv, 61058, Ukraine.

Mameshina M.A.; <http://orcid.org/0000-0001-7397-3805>; mameshina.rita@gmail.com; Department of Theory and Methods of Physical Education, Kharkiv State Academy of Physical Culture; Klochkivska str. 99, Kharkiv, 61058, Ukraine.

Cite this article as: Masliak IP, Mameshina MA. Physical health of schoolchildren aged 14-15 years old under the influence of differentiated education. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2018;22(2):92-98. doi:10.15561/18189172.2018.0205

The electronic version of this article is the complete one and can be found online at: <http://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (<http://creativecommons.org/licenses/by/4.0/deed.en>).

Received: 17.11.2017

Accepted: 08.12.2017; Published: 30.04.2018