



ORIGINAL ARTICLES. PHYSICAL EDUCATION

Sports activities and professional specialty influence on psychophysiological functions and orthostatic reactions indicators of pedagogical universities students

Monika Bejtka^{1 ABCD}, Zhanneta Kozina^{2,3 ABCD}, Yurii Boychuk^{3,4 ABCD}, Iryna Garmash^{2,3 ACD},
Ganna Tamozhanska^{4 BCD}, Viktoriia Koveria^{2,3 BCD}, Valentyna Lysenko^{2,3 ACD}

¹Department of Human Physiology, Ludwik Rydygier Collegium Medicum in Bydgoszcz Nicolaus Copernicus University in Torun, Poland

²Department of Olympic and professional sports, sports games and tourism, H.S. Skovoroda Kharkiv ational Pedagogical University, Kharkiv, Ukraine

³Laboratory of biophysics, biomechanics and kinesiology, H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine

⁴H.S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine

⁵National university of pharmacy, Ukraine

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

DOI: <https://doi.org/10.34142/HSR.2022.08.03.01>

Corresponding author: Zhanneta Kozina, zhaneeta.kozina@gmail.com, <http://orcid.org/0000-0001-5588-4825>, Department of Olympic and professional sports, sports games and tourism, Laboratory of biophysics, biomechanics and kinesiology, H.S. Skovoroda Kharkiv National Pedagogical University, Altshevskih str. 29, Kharkiv, 61002, Ukraine

How to Cite

Bejtka M, Kozina Z, Boychuk Y, Garmash I, Tamozhanska G, Koveria V, Lysenko V. Sports activities and professional specialty influence on psychophysiological functions and orthostatic reactions indicators of pedagogical universities students. *Health, Sport, Rehabilitation*. 2022;8(3):8-26. <https://doi.org/10.34142/HSR.2022.08.03.01>

Abstract

Purpose: to identify the influence of the professional orientation of education and lifestyle (sports) on the indicators of psychophysiological functions and orthostatic reactions of students of various faculties of pedagogical universities.

Material and methods. 812 students of pedagogical institutions of higher education of Ukraine took part in the study: 88 students of the faculty of elementary education, 76 students of history, 130 of natural sciences, 131 of foreign philology, 93 of the faculty of preschool education, 198 of Ukrainian language, 25 of the faculty of physical education and sports, 24 students from the Faculty of Arts, 47 students from the Faculty of Psychology and Sociology. Psychophysiological testing was carried out according to the Psychodiagnostics program and involved determining the speed of a simple visual-motor reaction, determining the speed of a choice of two elements out of three. During psychophysiological testing, the reaction time and the number of errors were determined for each test.

The results. Students of the faculties of elementary education, preschool education, and the faculty of natural sciences have a significantly shorter reaction time in the test for a simple visual-motor reaction ($p < 0.05$), and, accordingly, the best indicators of the mobility of nervous processes in comparison with students of other faculties of pedagogical universities. These faculties have the largest number of errors in the test for the choice of two elements out of three ($p < 0.05$), and, accordingly, the lowest strength of nervous processes.

Conclusions. Sports have a positive effect on the indicators of the strength of nervous processes according to the results of the number of errors in the reaction test for choosing two items out of three ($p < 0.05$). Also, playing sports has a positive effect on the quality of vegetative regulation of vascular tone, which is reflected in lower values of the heart rate during the transition from a horizontal position of the body to a vertical one in students who play sports ($p < 0.05$).

Key words: sports, students, psychophysiological indicators, orthotest, heart rate, faculty



Анотація

Моніка Бейтка, Жаннета Козіна, Юрій Бойчук, Ірина Гармаш, Ганна Таможанська, Вікторія Коверя, Валентина Лисенко. Вплив занять спортом та професійної спеціалізації на показники психофізіологічних функцій і ортостатичних реакцій студентів педагогічних університетів

Мета: виявити вплив професійної спрямованості навчання та способу життя (занять спортом) на показники психофізіологічних функцій та ортостатичних реакцій студентів різних факультетів педагогічних університетів.

Матеріал і методи. В дослідженні взяли участь 812 студентів педагогічних закладів вищої освіти України: 88 студентів факультету початкового навчання, 76 студентів – історичного, 130 – природничого, 131 – іноземної філології, 93 – факультету дошкільної освіти, 198 – україномовного, 25 – факультету фізичного виховання і спорту, 24 – факультету мистецтв, 47 студентів – факультету психології та соціології. Психофізіологічне тестування проводилось за програмою «Психодіагностика» і передбачало визначення швидкості простої зорово-моторної реакції, визначення швидкості реакції вибору двох елементів з трьох. При психофізіологічному тестуванні за кожним тестом визначались час реакції та кількість помилок.

Результати. У студентів факультетів початкового навчання, дошкільної освіти та природничого факультету достовірно менший час реагування в тесті на просту зорово-моторну реакцію ($p < 0,05$), і, відповідно, найкращі показники рухливості нервових процесів у порівнянні зі студентами інших факультетів педагогічних університетів. У цих факультетів найбільша кількість помилок в тесті на реакцію вибору двох елементів з трьох ($p < 0,05$), і, відповідно, найменша сила нервових процесів.

Висновки. Заняття спортом позитивно впливають на показники сили нервових процесів за результатами кількості помилок в тесті на реакцію вибору двох елементів з трьох ($p < 0,05$). Також заняття спортом позитивно впливають на якість вегетативної регуляції судинного тону, що відображується в менших значеннях частоти серцевих скорочень при переході з горизонтального положення тіла у вертикальне у студентів, які займаються спортом ($p < 0,05$).

Ключові слова: спорт, студенти, психофізіологічні показники, ортопроба, частота серцевих скорочень, факультет

Аннотация

Моника Бейтка, Жаннета Козина, Юрий Бойчук, Ирина Гармаш, Анна Таможанская, Виктория Коверя, Валентина Лысенко. Влияние занятий спортом и профессиональной специализации на показатели психофизиологических функций и ортостатических реакций студентов педагогических университетов.

Цель: выявить влияние профессиональной направленности обучения и образа жизни (занятия спортом) на показатели психофизиологических функций и ортостатических реакций студентов разных факультетов педагогических университетов.

Материал и способы. В исследовании приняли участие 812 студентов педагогических заведений высшего образования Украины: 88 студентов факультета начального обучения, 76 студентов – исторического, 130 – естественнонаучного, 131 – иностранной филологии, 93 – факультета дошкольного образования, 198 – украиноязычного, 25 – факультета физического воспитания и спорта 24 – факультета искусств, 47 студентов – факультета психологии и социологии. Психофизиологическое тестирование проводилось по программе «Психодиагностика» и предполагало определение скорости простой зрительно-моторной реакции, определение скорости реакции выбора двух из трех элементов. При психофизиологическом тестировании по каждому тесту определялось время реакции и количество ошибок.

Результаты. У студентов факультетов начального обучения, дошкольного образования и естественного факультета достоверно меньшее время реагирования в тесте на простую зрительно-моторную реакцию ($p < 0,05$), и, соответственно, лучшие показатели подвижности нервных процессов по сравнению со студентами других факультетов педагогических университетов. У этих факультетов наибольшее количество ошибок в тесте на реакцию выбора двух элементов из трех ($p < 0,05$), и соответственно наименьшая сила нервных процессов.

Выводы. Занятия спортом оказывают положительное влияние на показатели силы нервных процессов по результатам количества ошибок в тесте на реакцию выбора двух элементов из трех ($p < 0,05$). Также занятия спортом положительно влияют на качество вегетативной регуляции сосудистого тону, отражающуюся в меньших значениях частоты сердечных сокращений при переходе из горизонтального положения тела в вертикальное у студентов, занимающихся спортом ($p < 0,05$).

Ключевые слова: спорт, студенты, психофизиологические показатели, ортопроба, частота сердечных сокращений, факультет



Introduction

At present, the world is going through great trials. This is related to both pandemics [1, 2, 3] and wars, and everything that follows from this: economic difficulties, difficulties in medical care, and in all other areas, in particular, in education. One of the most important components of education is physical education. The future of education, in general, and physical education, in particular, is in the individualization of the learning process [4, 5]. And the trend towards an individual approach is actualized at the current stage due to the large number of online classes [6, 7]. Thus, at the present time, the world is witnessing changes that involve a transition from a mass approach in education, oriented to the mind of the crowd, to an individually oriented one, aimed at the maximum disclosure of the gifts laid down in each person by nature.

This tendency is manifested in everything: in the economy, science, society, and, accordingly, in educational activities. Physical education and sports are no exception. An individual approach in the physical education of university students involves several directions [4]. First of all, it is giving students the opportunity to choose a sport for classes. This presupposes the availability of the appropriate material base at the university. In addition, a diagnosis of the functional, physical and psychophysiological capabilities of students is needed to identify their individual characteristics in relation to a certain type of sport. It is also necessary to have an individual approach in physical education classes to the dosage of physical exertion, the selection of exercises and training methods in accordance with the individual characteristics of students.

Currently, all these directions are particularly relevant in connection with online education [8, 9]. This is connected with the current circumstances in the world. After all, physical education in the online mode involves the main share of classes by students themselves. And that is why it is important to choose the nature of the classes, the specifics of the workload for each student in such a way that the classes give him great pleasure. A person gets the most satisfaction when the type of activity corresponds to his natural abilities. Natural endowments can be determined by various methods. One of these methods is the determination of psychophysiological functions [10, 11, 12]. Psychophysiological functions reflect the speed of conduction of impulses by the nervous system [13, 14, 15]. Determining these indicators in different testing modes makes it possible to detect the mobility

and strength of the nervous system. Mobility and strength of the nervous system are often prerequisites for choosing a field of activity and, accordingly, a specialty for study [14, 15, 16]. Thus, the chosen specialty for study is often based on hereditary properties of the nervous system. On the other hand, psychophysiological properties can change within a genetically determined range [13, 14, 15]. And therefore, on the contrary, the type of activity or study specialty can affect psychophysiological indicators.

To select individual exercises and their dosage, it is also necessary to take into account the state of the cardiovascular system [17, 18]. One of the indicators of the state of the cardiovascular system is the quality of vegetative regulation of vascular tone when the body position changes from horizontal to vertical [19, 20, 21]. A resting heart rate of 50-60 bpm indicates an above-average cardiovascular condition, a resting heart rate above 90 bpm indicates a below-average cardiovascular condition [22, 23, 24]. When the position of the body changes from horizontal to vertical, blood flows from the head to the lower extremities under the influence of gravity. As a result, the brain can be in a state of lack of blood, and, accordingly, oxygen and nutrients. To avoid such a condition, the body reacts to a change in body position by regulating vascular tone, which allows blood to be directed from the lower extremities to the brain. In addition, heart rate increases as a compensatory mechanism for insufficient regulation of vascular tone. It is believed that the more the heart rate increases when the body position changes from horizontal to vertical, the lower the quality of vascular regulation [22, 23, 24].

To develop individual recommendations for the use of physical exercises online, it is necessary, first of all, to determine the features of the nervous and cardiovascular systems - systems that provide regulatory functions of the entire body [25, 26]. For this, it is relevant to determine whether the chosen specialty for study affects psychophysiological indicators and orthostatic reactions (i.e., reactions to a change in body position from horizontal to vertical). Also, determining the impact of lifestyle, in particular, sports, on indicators of psychophysiological functions and orthostatic reactions [27, 28] is also an urgent task. Based on the above, the hypothesis was put forward in the study: 1 - there is a relationship between the specialty chosen by students for professional improvement and indicators of psychophysiological functions and orthostatic reactions; 2 - practicing any kind of sport has a positive effect on psychophysiological indicators and the state of vascular tone regulation.



Purpose: to identify the influence of the professional orientation of education and lifestyle (sports) on the indicators of psychophysiological functions and orthostatic reactions of students of various faculties of pedagogical universities.

Material and methods

Participants

812 students of pedagogical institutions of higher education of Ukraine took part in the study: 88 students of the faculty of elementary education, 76 students of history, 130 of natural sciences, 131 of foreign philology, 93 of the faculty of preschool education, 198 of Ukrainian language, 25 of the faculty of physical education and sports, 24 students from the Faculty of Arts, 47 students from the Faculty of Psychology and Sociology. All experimental students took part in the tests to determine psychophysiological functions. 404 students took part in orthostatic reaction tests, including: 44 students of the Faculty of Elementary Education, 40 students of the Faculty of History, 53 students of the Faculty of Natural Sciences, 50 of the Faculty of Foreign Philology, 90 of the Faculty of Preschool Education, 31 of the Faculty of Ukrainian Language, 25 of the Faculty of Physical Education and Sports, 24 - Faculty of Arts, 42 students - Faculty of Psychology and Sociology. Student testing was conducted in classes on the subject "Health Care Technologies" from 8:00 a.m. to 9:00 a.m. in September - October 2021.

Procedure

The testing was conducted on the basis of the laboratory of biophysics, biomechanics and kinesiology of Kharkiv National Pedagogical University named after H.S. Frunze.

Testing was conducted in each academic group of students separately. From 5 to 20 people were tested at one time.

Students were tested as follows. On the first day, students were tested on orthostatic stability. The next day, the students underwent a psychodiagnostic test to determine the speed of reaction in different modes of signal appearance.

Method of psychophysiological testing

When conducting psychophysiological testing, students were first explained the essence of the tests and the peculiarities of working with the Psychodiagnostics program, according to which the

testing was conducted, then they made 1-3 attempts to master the tests, and passed the testing. The program "Psychodiagnostics" [13, 14, 15] provides for the determination of reaction speed in the following modes: determination of the speed of a simple visual-motor reaction, determination of the reaction speed of choosing one element from three, determination of the reaction speed of choosing two elements from three. The program works as follows. After filling out a special form with the subject's data, a window with the names of the tests appears on the screen. The subject chooses a test that will be used to determine reaction speed. After that, different images appear on the screen. When determining the speed of a simple visual-motor reaction, the subject presses the left mouse button as soon as he sees any image on the screen. When determining the reaction speed of choosing one element out of three, the subject reacts only to images of geometric shapes and animals by pressing the left mouse button. The subject does not react to all other images.

When determining the reaction speed of choosing two elements out of three, the subject reacts to images of geometric figures by pressing the left mouse button and to images of animals by pressing the right mouse button. The subject does not react to all other images.

During psychophysiological testing, the following indicators were determined for each test: reaction time, mean square deviation, number of errors. The shorter the reaction time, the higher the mobility of nervous processes, which is also related to the activity of the sympathetic division of the autonomic nervous system. The smaller the number of errors in the reaction test of choosing two elements out of three, the higher the strength of nervous processes, which is also associated with the activity of the parasympathetic department of the autonomic nervous system [13, 14, 15].

Orthotest

Orthostatic reactions were determined by the results of heart rate in the supine position and in the standing position using Polar devices (fitness - watches) and analyzed using the Polar flow applications on the phone and on the computer. Testing was carried out as follows. In a special auditorium for massage, students put on fitness watches and lay quietly on their backs on massage tables for 10 minutes to stabilize their heart rate. Then a special mode of orthostatic testing was set on the watch, heart rate was measured in the lying position for 30 seconds. Then the students got up, and heart rate was measured again for 30 seconds. Average heart rate values for 30 s in the lying



position and in the standing position were recorded, which were automatically calculated using Polar flow applications in computers and phones. Heart rate values greater than 80 bpm-1 were considered indicators of inefficient work of the cardiovascular system. The difference between heart rate in lying and standing positions of more than 30 bpm-1 was regarded as an indicator of difficult adaptation of the body to a change in body position.

Statistical analysis

During the statistical processing of the research results, the normality of the distribution of each sample was first checked using the Kolmogorov-Smirnov test. If the samples obeyed a normal distribution, parametric processing methods (one-factor analysis of variance) were used. The influence of sports on the indicators of psychophysiological functions and orthostatic reactions of students was carried out according to the results of univariate analysis of variance (ANOVA). The influence of studying at a certain faculty of a pedagogical institution of higher education on indicators of psychophysiological functions and orthostatic reactions of students was also carried out by one-way analysis of variance (ANOVA) using the Duncan test for comparing more than 2 samples.

Results

First, all samples were tested for normal distribution for all indicators. The test was carried out using the one-sample Kolmogorov-Smirnov test. No significant differences were found between the obtained distribution and the normal one ($p > 0.05$). Thus, a conclusion was made about the possibility of using one-factor variance analysis to determine the influence of the faculty at which students study and sports activities on indicators of psychophysiological functions and orthostatic reactions of students of pedagogical institutions of higher education.

We conducted a study to clarify the question: whether lifestyle, in particular, sports, affects the indicators of psychophysiological functions and the state of the vegetative-vascular regulation of cardiac activity and orthostatic reactions. To clarify this issue, we conducted a univariate analysis of variance (ANOVA) to identify the impact of sports on indicators of psychophysiological functions and vegetative-vascular regulation of cardiac activity and orthostatic reactions. As a result of variance analysis, it was found that playing sports has a significant effect on the number of errors in the reaction time test for choosing 2 items out of 3 ($p < 0.05$), on the heart rate in the standing position and on the difference between the heart rate in the standing position and in the lying position ($p < 0.05$) (Table 1).

Table 1

The influence of sports on the indicators of psychophysiological functions and orthostatic reactions of students of pedagogical universities according to the results of univariate analysis of variance (ANOVA) (indicators that have significant differences among students of different faculties are given)

Indicators	Factor*	N	\bar{x}	S	m	95% confidence interval for the mean		Minimum	Maximum	Middle square	F	p
						Lower limit	Upper limit					
Errors in the reaction time test for choosing 2 elements from 3, quantity	0	675	8.69	11.71	0.99	6.73	10.64	0	88	504.208	4.279	0.04
	1	137	4.58	6.74	1.09	2.36	6.79	0	22	117.835		
	In total	812	7.81	10.96	0.82	6.19	9.43	0	88			
Heart rate in a standing position, bpm	0	336	90.22	13	1.33	87.57	92.87	66	126	130.533	4.826	0.035
	1	68	87.69	10.80	2.12	83.33	92.06	72	126	157.949		
	In total	404	89.68	12.56	1.14	87.42	91.94	66	126			
The difference between the heart rate in the	0	336	18.19	10.32	1.05	16.11	20.27	0	46	403.507	4.088	0.048
	1	68	13.68	13.02	2.60	8.31	19.05	-18	36	119.101		
	In total	404	17.26	11.02	1	15.29	19.24	-18	46			



standing position and in the lying position, bpm												
--	--	--	--	--	--	--	--	--	--	--	--	--

Notes: * - 0 – do not play sports; 1 - do sports

Students who play sports make significantly fewer errors in the reaction time test for choosing 2 out of 3 items compared to students who do not play sports. Also, in students who play sports, the difference between the values of heart rate in the standing position and in the lying position is

significantly smaller compared to students who do not play sports. This confirms the fact that playing sports contributes to the economy of the work of the cardiovascular system and the improvement of orthostatic regulation (Fig. 1).

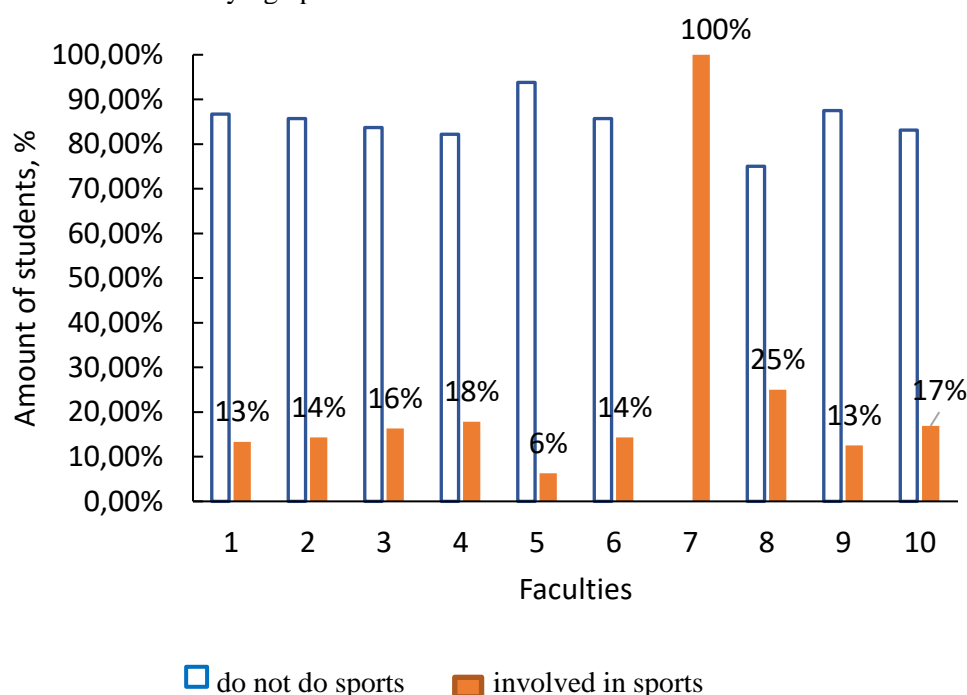


Fig. 1. The number of students (as a percentage of the total number of students at the faculty) who play sports:

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

The results of a univariate variance analysis of the influence of the faculty where the students study on the indicators of psychophysiological functions and on the indicators of the orthostatic test showed that studying at a certain faculty reliably affects the indicators of the time of a simple visual-motor reaction, the number of errors when performing a test of a simple visual-motor reaction, on the number of errors when performing the test for the choice of two elements out of three, on the heart rate in the standing position and on the difference in the heart rate between the standing position and the lying position (tables 2, 3).

According to the results of the Duncan test of variance analysis, according to the indicator of the time of a simple visual-motor reaction, the students were divided into groups with no significant differences between the averages, but significant differences were found between the groups (Table 4, Fig. 2). A total of two groups were formed. The first group consists of the following faculties: Elementary Education, Natural Sciences, Preschool Education, Psychological, Historical, Physical Education and Sports. The second group consists of the faculties: Foreign Philology and Ukrainian Language.



Table 2

Indicators of psychophysiological functions and orthostatic reactions of students of different faculties of pedagogical universities (indicators that have significant differences in students of different faculties are given)

Indicators	Faculties	N	\bar{x}	S	m	95% confidence interval for the mean		Minimum	Maximum
						Lower limit	Upper limit		
Time of a simple visual-motor reaction, ms	1	88	338.6	34.52	8.91	319.47	357.72	293	423
	2	76	393.15	67.22	18.6	352.52	433.77	293	550
	3	130	367.04	94.1	9.97	347.21	386.87	238	670
	4	131	414.51	117.16	12.41	389.83	439.19	233	882
	5	93	375.56	72.65	18.16	336.84	414.27	278	516
	6	198	421.94	120.5	20.66	379.89	463.98	248	696
	7	25	403.75	152.44	76.22	161.16	646.33	256	615
	8	24	509.5	141.26	70.63	284.2	734.27	306	615
	9	47	393	117.60	41.57	294.68	491.31	257	622
	In total	812	393.01	106.56	6.46	380.29	405.73	233	882
Errors in the reaction time test for choosing 2 elements from 3, quantity	1	88	19.4	4.04	1.04	17.15	21.64	10	24
	2	76	12.12	3.18	1.12	9.46	14.78	8	18
	3	130	2.27	2.78	0.65	0.89	3.66	0	10
	4	131	6.48	6.92	0.81	4.85	8.11	0	36
	5	93	12.67	20.61	5.32	1.25	24.08	1	81
	6	198	6.72	15.25	2.65	1.32	12.13	0	88
	7	25	1.25	0.81	0.40	0.70	3.29	1	3
	8	24	2	1.25	0.62	-0.75	3.25	0	3
	9	47	7.5	8.14	2.87	0.69	14.30	0	20
	In total	812	7.80	10.98	0.82	6.17	9.43	0	88
Heart rate in a standing position, bpm	1	44	100.5	27.57	19.5	-147.27	348.27	81	120
	2	40	82.25	12.71	6.35	62.02	102.48	66	97
	3	53	90.83	13.77	1.89	87.03	94.63	72	126
	4	50	95.1	15.36	4.85	84.11	106.09	80	126
	5	90	91.22	11.63	3.87	82.28	100.17	78	114
	6	31	87.61	7.96	1.43	84.69	90.53	74	118
	7	25	79.67	6.65	3.84	63.13	96.21	72	84
	8	24	84	10.39	6	58.18	109.82	72	90
	9	42	88	14.24	5.81	73.06	102.94	73	114
	In total	404	89.68	12.55	1.14	87.42	91.94	66	126
The difference between the heart rate in the standing position and in the lying position, bpm	1	44	29	22.62	16	-174.3	232.3	13	45
	2	40	15	4.76	2.38	7.42	22.58	12	22
	3	53	18.37	13.59	1.88	14.58	22.15	-18	46
	4	50	25	9.38	2.9	18.29	31.71	14	42
	5	90	17.4	10.39	3.28	9.96	24.84	0	30
	6	31	13.61	5.01	0.9	11.77	15.45	6	24
	7	25	12	9.01	5.20	-7.74	37.07	6	24
	8	24	14.67	8.48	4.24	-1.5	25.5	0	18



	9	42	15.83	7.44	3.03	8.02	23.64	10	30
	In total	404	17.26	11.02	0.99	15.29	19.24	-18	46

Notes: Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

Table 3

The influence of studies at different faculties on indicators of psychophysiological functions and orthostatic reactions of students of pedagogical universities according to the results of one-factor analysis of variance (ANOVA) (indicators that have significant differences among students of different faculties are given)

Indicators	Calculation	Sum of squares	Degrees of freedom	Middle square	F	Significance
Time of a simple visual-motor reaction, ms	Between groups	233646	8	29205.75	2.701	0.007
	Within groups	2843663	263	10812.41		
	In total	3077309	271			
Errors in the test for the reaction time of choosing 2 elements from 3, ms, number	Between groups	3541.211	8	442.651	4.201	0.000
	Within groups	17700.59	168	105.361		
	In total	21241.8	176			
Heart rate in a standing position, bpm	Between groups	1387.231	8	173.404	2.107	0.044
	Within groups	17539.2	112	156.6		
	In total	18926.43	120			
The difference between the heart rate in the standing position and in the lying position, bpm	Between groups	1514.294	8	189.287	2.623	0.026
	Within groups	13181.31	113	116.649		
	In total	14695.61	121			

According to the results of the Duncan test of variance analysis, according to the indicator of the time of a simple visual-motor reaction, the students were divided into groups with no significant differences between the averages, but significant differences were found between the groups (Table 4, Fig. 2). A total of two groups were formed. The first

group consists of the following faculties: Elementary Education, Natural Sciences, Preschool Education, Psychological, Historical, Physical Education and Sports. The second group consists of the faculties: Foreign Philology and Ukrainian Language.

Table 4

Intergroup and intragroup differences according to the results of testing students of different faculties according to the indicator of simple visual-motor reaction time

Duncan a,b	N	Subset for alpha = 0.05		Validity of differences between groups of faculties	
Faculty					
Groups of faculties		1	2	F	p
1	88	338,6		2.701	0.007



3	130	367.0449		
5	93	375.5625		
9	47	393		
2	76	393.1538		
7	25	403.75		
4	131		414.5169	
6	198		421.9412	
8	24		509.5	
Intragroup significance		0.127	0.051	

Means for groups in homogeneous subsets are derived.

a Uses the harmonic mean sample size = 10.193.

b Non-identical group sizes. The harmonic mean of the group sizes is used. Type I error rates are not guaranteed.

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education;

6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

In the first group, the time of a simple visual-motor reaction is significantly shorter compared to the second group. We believe that this is due to the greater mobility of the nervous processes of students who chose the faculties of the first group to study. In addition, pedagogical activity generally requires high mobility of nervous processes. Students of foreign philology faculties have a significantly longer simple visual-motor reaction time than students of other

faculties (Table 4, Fig. 2). We can explain this by the fact that students of these faculties are inclined not only to teaching activities, but also to work as translators. The work of a translator requires thoughtful concentration without switching attention. This leads to an increase in response time not only to objects that need to be selected, but also to any objects.

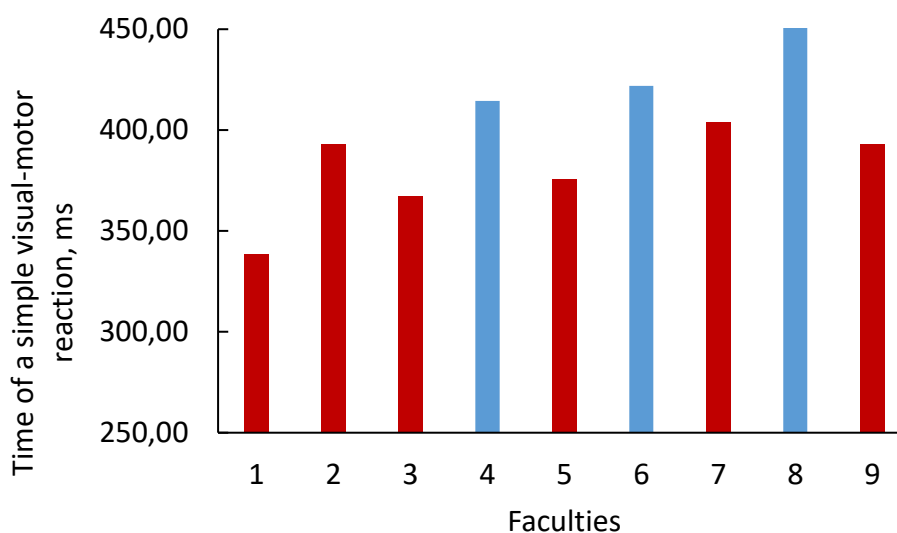


Fig. 2. Results of testing students of various faculties of pedagogical universities according to the time indicator of a simple visual-motor reaction:

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

■ - group 1; ■ - group 2

At the same time, according to the strength of nervous processes, which is determined by the number of errors in the test for the choice of two elements out of three, students of different faculties

were divided into three groups according to the results of the Duncan variance analysis test. There are no significant differences in the middle of the groups, but significant differences were found



between the groups (Table 5). The first group consists of one faculty - physical education and sports. Students of this faculty have the lowest number of errors in the reaction time test for choosing 2 items out of 3. This testifies to the greatest strength of the nervous processes of the students of this faculty. This is primarily due to the fact that playing sports contributes to increasing the

strength of nervous processes within the genetic range. And this is reflected in the decrease in the number of errors in the reaction time test for choosing 2 elements from 3. The second group included students of the faculties of Arts, Natural Sciences, Foreign Philology, Ukrainian Language, and Psychology (Table 5, Fig. 3).

Table 5

Intergroup and intragroup differences according to the results of testing students of different faculties according to the rate of errors in the test for the reaction to the choice of 2 elements from 3

Duncan a,b	N	Subset for alpha = 0.05			Validity of differences between groups of faculties	
Faculty						
Groups of faculties		1	2	3	F	p
7	25	1.25			4.201	0.000
8	24		2			
3	130		2.2778			
4	131		6.4861			
6	198		6.7296			
9	47		7.5			
2	76			12.125		
5	93			12.6667		
1	88			19.4		
Significance of differences in the middle of the group		0.05	0.055	0.155		

Means for groups in homogeneous subsets are derived.

a Uses the harmonic mean sample size = 9.155.

b Non-identical group sizes. The harmonic mean of the group sizes is used. Type I error rates are not guaranteed.

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

These are mostly students with an average strength of the nervous system. The third group included students of the following faculties: History, Preschool Education, Elementary Education. These are mostly students with a weak but more sensitive nervous system. It should be noted that students of the faculty of elementary education showed the best indicators in the mobility of the nervous system and in general reactivity. But at the same time, students of the faculty of primary education are the most sensitive, which is reflected in the increase in the number of errors in the test, which requires attention for a certain time. It is known that the mobility and strength of nervous processes are often in an antagonistic relationship. This can explain the obtained results. This also applies to students of the Faculty of Preschool Education. Since working with

children of preschool and junior school age requires a high degree of attention switching, and, accordingly, the mobility of nervous processes, students who have chosen these faculties to study, by their hereditary qualities, are mainly mobile, but at the same time - sensitive (weak) nervous system. The third group also included students of the Faculty of History. We believe that in this case such a factor as the purely humanitarian orientation of the history faculty could have influenced. As shown by our previous research and the research of other scientists, the students who study in humanities majors have the lowest strength of neural processes and the greatest mobility of neural processes. This study confirmed the previously obtained results.

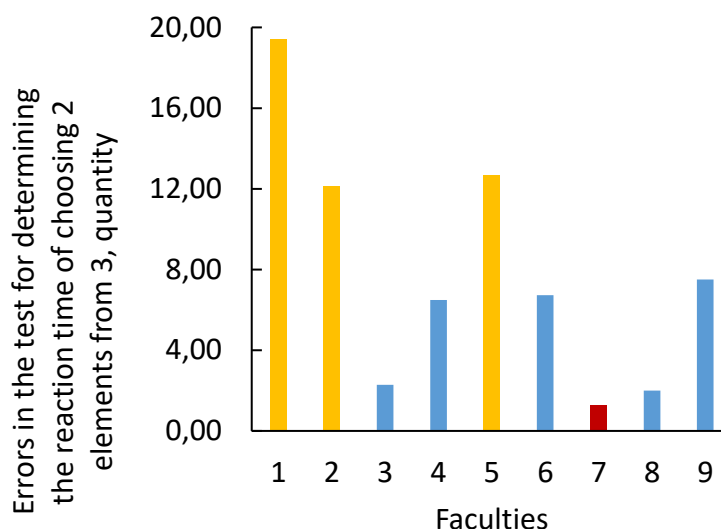


Fig. 3. The results of testing students of different faculties of pedagogical universities according to the error rate in the test for determining the reaction time of choosing 2 elements from 3

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

■ - group 1; ■ - group 2; ■ - group 3

As for orthostatic responses, the Duncan test of variance analysis showed the presence of two groups based on the results of heart rate in the standing position and the difference between the heart rate between the standing position and the standing position. The first group, similar to the test

on the number of errors in the test on the time to choose 2 elements from 3, included students of the Faculty of Physical Education and Sports (Table 6, 7, Fig. 4, 5).

Table 6

Intergroup and intragroup differences according to the results of testing students of different faculties according to the heart rate indicator in the standing position

Duncan a,b	N	Subset for alpha = 0.05		Validity of differences between groups of faculties	
Faculty					
Groups of faculties		1	2	F	p
7	25	79.67		4.024	0.000
2	40		82.25		
8	24		84		
6	31		87.61		
9	42		88		
3	53		90.83		
5	90		91.22		
4	50		95.1		
1	44		100.5		
Significance of differences in the middle of the group		0.104	0.053		

Notes: Means for groups in homogeneous subsets are derived.

a Uses the harmonic mean sample size = 4.877

b Non-identical group sizes. The harmonic mean of the group sizes is used. Type I error rates are not guaranteed.

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological



The second group included students of all other faculties. This is quite logical, since sports help to improve orthostatic reactions. This is expressed in a smaller increase in heart rate when moving from a

lying position to a standing position. The fact that the students of the Faculty of Physical Education and Sports proved to be more resistant to changing the position of the body is a proof of this position.

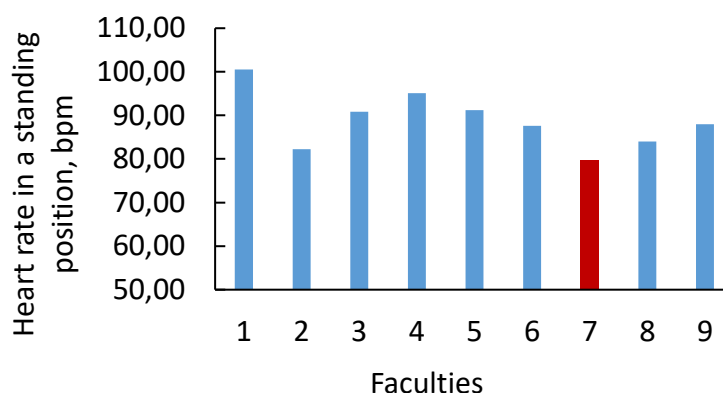


Fig. 4. Results of testing students of various faculties of pedagogical universities according to the heart rate indicator in a standing position

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

■ - group 1; ■ - group 2

Table 7

Intergroup and intragroup differences according to the results of testing students of different faculties according to the indicator of the difference in heart rate in the standing position and in the lying position

Duncan a,b	N	Subset for alpha = 0.05		Validity of differences between groups of faculties	
Faculty					
Groups of faculties		1	2	F	p
7	25	12		2.623	0.026
6	31		13.61		
8	24		14.67		
2	40		15		
9	42		15.83		
5	90		17.4		
3	53		18.37		
4	50		25		
1	44		29		
Significance of differences in the middle of the group		0.103	0.052		

Notes: Means for groups in homogeneous subsets are derived.

a Uses the harmonic mean sample size = 5.138.

b Non-identical group sizes. The harmonic mean of the group sizes is used. Type I error rates are not guaranteed.

Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological

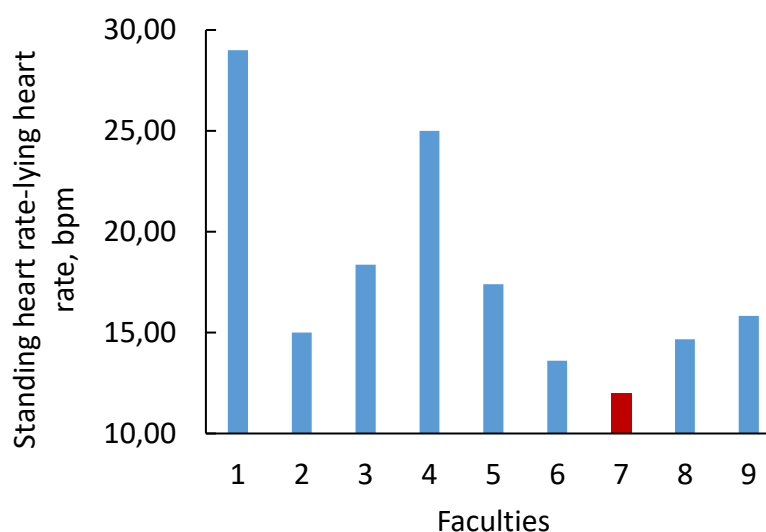


Fig. 5. The results of testing students of various faculties of pedagogical universities according to the indicator of the difference between heart rate in a standing position and heart rate in a lying position: Faculties: 1 - Elementary education; 2 – Historical; 3 – Natural; 4 - Foreign philology; 5 - Preschool education; 6 – Ukrainian-speaking; 7 - Physical education; 8 – Arts; 9 – Psychological
■ - group 1; ■ - group 2

It should be noted that in this study we did not differentiate between the types of sports played by students, and the differences in their impact on indicators of psychophysiological functions and orthostatic reactions. As for orthostatic reactions, we adhered to the principle that engaging in any physical activity has a positive effect on indicators of cardiovascular activity on changes in body position in space. Regarding psychophysiological indicators, in this study it was important to determine whether any physical exercises affect psychophysiological functions, which are a reflection of neurodynamic processes.

Discussion

The hypothesis put forward in this study was partially confirmed. The first position of the hypothesis regarding the existence of a relationship between the indicators of psychophysiological functions and the professional specialization that students choose for study was confirmed in relation to the indicators of the time of a simple visual-motor reaction and errors in the reaction of choosing 2 elements out of 3. The indicator of a simple reaction to an object reflects the speed of conduction of impulses through the neurons of the brain. This indicator also indirectly indicates the mobility of nervous processes. This indicator turned out to be the

best among students of the faculties of elementary education (that is, for future teachers of junior grades), preschool education, and natural sciences (that is, for future teachers of biology). We can explain this by the fact that students who choose these specialties to study have hereditary predispositions to work with young children, which requires a high level of mobility of nervous processes. This group also included future biology teachers. The specificity of their work requires the ability to observe animals and plants. This requires both the mobility of nervous processes to quickly respond to changes in the behavior of animals, and the strength of the nervous system to be able to concentrate to observe various objects of living nature.

As for the relationship between the specialty chosen by the students for study and the orthostatic test indicators, in this case the hypothesis was partially confirmed: only the faculty of physical education and sports had a reliable influence on the orthostatic test indicators. This is explained by the fact that practicing any kind of sport contributes to improving the quality of autonomic regulation of vascular tone. The same applies to the second position of the proposed hypothesis regarding the influence of sports on the quality of vascular tone regulation. The relationship between sports activities by students of different faculties and the psychophysiological function indicator, which reflects the strength of nervous processes - errors in



the reaction time test for choosing two items out of three - was also revealed. The obtained fact can be explained by the fact that playing any kind of sport has a positive effect on the strength of nervous processes. The strength of nervous processes, i.e. the ability to withstand long enough intense work without mistakes, is a hereditary quality, but it can vary in a certain genetically determined range. It can be concluded that playing sports has a positive effect on the development of the strength of the nervous system. This position is also confirmed by the fact that students of the Faculty of Physical Education and Sports have significantly higher indicators of the strength of the nervous system, which is reflected in a smaller number of errors in the test on the speed of the reaction of choosing 2 elements out of 3.

Based on the obtained results, we can provide the following recommendations for physical exercise classes for students of various faculties of pedagogical universities. For students of the faculties of elementary education, preschool education and the faculty of science, we recommend more use of mobile games. This follows from the obtained facts regarding greater mobility of the nervous system and less strength in students of these faculties compared to others. Movement games are most suitable for people with high mobility of nervous processes, as they require quick reaction and speed of switching attention from one object to another. It is advisable to use mobile games in the fresh air. This will contribute to increasing the strength of the nervous system and its stability. This also follows from the study of Lundvall, Maivorsdotter [28], who showed the effectiveness of classes while staying in a favorite place outdoors.

We can recommend walking, running, cycling and other cyclic exercises to students of the faculties of foreign philology, Ukrainian language, history, psychology and the faculty of arts. These recommendations are based on the fact that students of these faculties have a greater strength of the nervous system compared to other students. Namely, cyclic exercises require the strength of nervous processes [13, 14, 15]. In addition, these recommendations build on the research of Banville et.al. [5], in which it was shown that physical education teachers in US universities emphasize the use of team sports, and the majority of students indicate that they use cyclical exercises more at home. All students can also be recommended to use rhythmic exercises as homework. This coincides with the data of Garcia and Custodio [27], which showed the effectiveness of using rhythmic exercises in quarantine conditions. We also recommend that all students improve their knowledge in the field of sports education. This is due to the fact that the

knowledge of how to build a sports training, how to use means of recovery of working capacity, helps a conscious attitude towards physical exercises [25, 26]. This increases the effectiveness of physical education and sports classes [25, 26]. We recommend that students of the faculties of physical education continue to improve in the chosen sport in combination with mastering other sports at the basic level according to the recommendations of universities, as well as use means of injury prevention [29, 30].

Conclusions

1. It was found that students of different faculties differ among themselves in terms of psychophysiological indicators. It is shown that students of the faculties of elementary education, preschool education and the faculty of natural sciences have a significantly shorter reaction time in the test for a simple visual-motor reaction ($p < 0.05$), and, accordingly, the best indicators of the mobility of nervous processes in comparison with students of other faculties of pedagogical universities. It was also determined that the students of these faculties have the largest number of errors in the test for the choice of two elements out of three ($p < 0.05$), and, accordingly, the lowest strength of nervous processes.

2. It was determined that sports have a positive effect on the indicators of the strength of nervous processes according to the results of the number of errors in the test for the reaction of choosing two elements out of three ($p < 0.05$). Also, playing sports has a positive effect on the quality of autonomic regulation of vascular tone, which is reflected in lower values of the heart rate during the transition from a horizontal position of the body to a vertical one in students who play sports ($p < 0.05$).

3. Recommendations regarding the use of physical exercises by students of various faculties of pedagogical universities:

- students of the faculties of elementary education, preschool education and the faculty of natural sciences - to use more mobile games;
- for students of the faculties of foreign philology, Ukrainian language, history, psychology and the faculty of arts - classes in walking, running, cycling and other cyclical exercises;
- to all students - to use rhythmic exercises as homework and to increase their level of knowledge in the field of physical education and sports;
- for students of physical education faculties
- to continue improving in the chosen sport in



combination with mastering other sports at the basic level according to the recommendations of universities, as well as to use means of injury prevention.

Acknowledgments

The authors are very grateful to all the students and teachers who took part in the experiment. The authors are very grateful to Iryna Borysenko and Valentyn Kozin for the help of collecting materials.

The study was conducted according to: research work on the topic of the Department of

Olympic and Professional Sports, Sports Games and Tourism of H.S. Skovoroda Kharkiv National Pedagogical University for 2021-2026: "Development and substantiation of technologies for health promotion and harmonious development of people of different ages and social groups" (№ state registration: 0121U110053).

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. El-Sobkey SB. Experience of the Egyptian Physical Therapy Educators on the Online Teaching During COVID-19 Outbreak 2021. *Med Educ Online*. 2022 Dec;27(1):2073861. doi: 10.1080/10872981.2022.2073861. PMID: 35549657; PMCID: PMC9116250.
2. Plummer L, Belgen Kaygısız B, Pessoa Kuehner C, et al. Teaching online during the COVID-19 pandemic: a phenomenological study of physical therapist faculty in Brazil, Cyprus, and the USA. *Educ Sci*. 2021;11:130.
3. El-Sayad G, Md Saad NH, Thurasamy R. Nor Hasliza Md Saad, Ramayah Thurasamy. How higher education students in Egypt perceived online learning engagement and satisfaction during the COVID-19 pandemic. *J Comput Educ*. 2021;8:527–550.
4. Kozina Z, Korobeinik V, Safronov D, Xiaofei W. Effect of the individual approach application during the training of future physical education teachers on the degree of student satisfaction with the learning process in the People's Republic of China. *Journal of Physical Education and Sport*, 2021; 21(5): 2524-2531 DOI:10.7752/jpes.2021.05339
5. Banville D, Marttinen R, Kulinna PH, Ferry M. Curriculum decisions made by secondary physical education teachers and comparison with students' preferences. *Curriculum Studies in Health and Physical Education*. 2021;12(3):199-216.
6. Rossetini G, Turolla A, Gudjonsdottir B, et al. Digital entry-level education in physical therapy: a commentary to inform post-COVID-19 future directions. *Med Sci Educ*. 2021;31(6):2071–2083.
7. Rossetini G, Geri T, Turolla A, et al. Online teaching in physical therapy education during COVID-19 pandemic in Italy: a retrospective case-control study on students' satisfaction and performance. *BMC Med Educ*. 2021;21(1):456. [Crossref], [Google Scholar]
8. Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta BioMed*. 2020;91:157–18. [Google Scholar]
9. Sahu P. Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): impact on Education and Mental Health of Students and Academic Staff. *Cureus*. 2020;12:e7541. [Web of Science ®], [Google Scholar]
10. Shadmehr R, Wise S. *The computational neurobiology of reaching and pointing: a foundation for motor learning*. Cambridge, Mass.: MIT Press. 2005. ISBN 978-0-262-19508-9. OCLC 54529569.
11. Paul M, Ganesan S, Sandhu JS, Simon JV. Effect of sensory motor rhythm neurofeedback on psychophysiological, electro-encephalographic measures and performance of archery players. *Ibnosina J. Med. Biomed. Sci*. 2011:32–39.
12. Deary IJ, Der G, Ford G. Reaction times and intelligence differences; a population-based cohort study. *Intelligence*. 2001;29(5):389–399. doi:10.1016/S0160-2896(01)00062-9.
13. Korobejnikov GV, Korobejnikova LG, Kozina ZL. *Evaluation and correction of physiological states in sports*, Kharkiv, KNPU, 2012.
14. Korobeynikov G, Korobeynikova L, Romanyuk L, Dakal N, Danko G. Relationship of psychophysiological characteristics with different levels of motivation in judo athletes of high qualification. *Pedagogics, psychology, medical-biological problems of physical training and sports*. 2017;21(6):272-8. https://doi.org/10.15561/18189172.2017.0603 doi:10.15561/18189172.2017.0603
15. Lyzohub V, Nechyporenko L, Pustovalov V, Suprunovych V. Specialized training and bioenergy state of football players with different typological properties of the higher parts of the nervous system. *Science and Education*. 2016;8:107–112; doi: 10.24195/2414-4665-2016-8-21.
16. Hedayatpour N, Falla D. Physiological and Neural Adaptations to Eccentric Exercise: Mechanisms and Considerations for Training. *BioMed Research*



- International*. 2015;(15):7.
<https://doi.org/10.1155/2015/193741>.
17. Vesterinen V, Nummela A. Nocturnal Heart Rate Variability and Morning Orthostatic Test as Tools to Monitor Training Load. *Medicine and Science in Sports and Exercise*, 2018;50(5):118-119.
 18. Rodrigues GD, Goncalves TR, De Souza SC, Da Silva Soares PP. Comparison of Cardiac Vagal Modulation From the Orthostatic Stress Test Between Untrained Individuals and Athletes. *Medicine and Science in Sports and Exercise*, 2014;46(5):341-342. doi:10.1249/01.mss.0000494205.70884.8a
 19. Rodriguez FA, Iglesias X, Feriche B, Calderon C, Abalos X, Vazquez J, et.al. Effects of Altitude Training on Heart Rate Variability in Orthostatic Test in Elite Swimmers. *Medicine and Science in Sports and Exercise*, 2012;44:364-364.
 20. Schafer D, Olstad BH, Wilhelm M. Can Heart Rate Variability Segment Length During Orthostatic Test Be Reduced To 2 Min? *Medicine and Science in Sports and Exercise*, 2015;47(5):48-48. doi:10.1249/01.mss.0000476531.84848.dd
 21. Pavy-Le Traon A, Sigaud D, Vasseur P, Maillet A, Fortrat JO, Hughson RL et.al. Cardiovascular responses to orthostatic tests after a 42-day head-down bed-rest. *European Journal of Applied Physiology*, 1998;77(1-2): 50-59.
 22. Wolthuis RA, Hull DH, Fischer JR, McAfoose DA, Curtis JT. Blood-pressure variability of the individual in orthostatic testing. *Aviation Space and Environmental Medicine*, 1979;50(8):774-777.
 23. Kozin SV, Safronov DV, Kozina ZL, Kniaz HO, Proskurnia O, Prontenko K, Lahno O, Goncharenko V, Kholodniy A, Comparative biomechanical characteristics of one-arm hang in climbing for beginners and qualified athletes, *Acta Bioeng Biomech*, 2020;22(1): 57-67, <https://doi.org/10.37190/ABB-01440-2019-03>.
 24. Kozina Z, Borysenko I, Grynyova V, Masych V, Ushmarova V. Influence of sports specialization and body length on orthostatic test indicators of students majoring in "Physical Education and Sports". *Journal of Physical Education and Sport*. 2021; 21 (3): 1580 - 1586
 25. Bezeau D, Turcotte S, Beaudoin S, Grenier J. Health education assessment practices used by physical education and health teachers in a collaborative action research. *Physical Education and Sport Pedagogy*. 2020;25(4):379-93.
 26. Choi SM, Sum KWR, Leung FLE, Wallhead T, Morgan K, Milton D, et al. Effect of sport education on students' perceived physical literacy, motivation, and physical activity levels in university required physical education: a cluster-randomized trial. *Higher Education*. 2021;81(6):1137-55.
 27. Garcia MA, Custodio ER. Home quarantine - based rhythmic exercises: new fitness assessment and intervention in teaching physical education. *Physical Education of Students*. 2021;25(1):51-7.
 28. Lundvall S, Maivorsdotter N. Environing as Embodied Experience-A Study of Outdoor Education as Part of Physical Education. *Frontiers in Sports and Active Living*. 2021;3:25-34
 29. Kozin S, Cretu M, Kozina Z, Chernozub A, Ryepko O, Shepelenko T, Sobko I, Oleksiuk M. Application closed kinematic chain exercises with eccentric and strength exercises for the shoulder injuries prevention in student rock climbers: A randomized controlled trial. *Acta of Bioengineering and Biomechanics*, 2021, 23(2). <https://doi.org/10.37190/ABB-01828-2021-01>
 30. Muszkieta R, Napierała M, Cieślicka M, Zukow W, Kozina Z, Iermakov S, et al. The professional attitudes of teachers of physical education. 2018. *Journal of Physical Education and Sport*. 2019;19:100-7. <https://doi.org/10.7752/jpes.2019.s1014>

Information about authors

Monika Bejtka

monika.bejtka@cm.umk.pl

<http://orcid.org/0000-0002-2240-4896>

Department of Human Physiology, Ludwik Rydygier Collegium Medicum in Bydgoszcz,
Nicolaus Copernicus University in Torun
Karłowicza 24, 85-092 Bydgoszcz, Poland

Zhanneta Kozina

zhanneta.kozina@gmail.com

<http://orcid.org/0000-0001-5588-4825>

Department of Olympic and professional sports, sports games and tourism, Laboratory of biophysics, biomechanics and kinesiology, H.S. Skovoroda Kharkiv National Pedagogical University
Altshevskih str. 29, Kharkiv, 61002, Ukraine

Yurii Boychuk

rector@hnpu.edu.ua

<https://orcid.org/0000-0002-4891-769X>



H.S. Skovoroda Kharkiv National Pedagogical University
Altshevskih str. 29, Kharkiv, 61002, Ukraine

Iryna Garmash

garmash.irina1@gmail.com

<https://orcid.org/0000-0003-0838-2843>

Department of Olympic and professional sports, sports games and tourism, Laboratory of biophysics, biomechanics and kinesiology, H.S. Skovoroda Kharkiv National Pedagogical University
Altshevskih str. 29, Kharkiv, 61002, Ukraine

Ganna Tamozhanska

kulichka79@ukr.net

<https://orcid.org/0000-0003-2430-8467>

Department of Physical therapy and health, National university of pharmacy
Pushkinskaya str., 53, 61002, Kharkiv, Ukraine

Viktoriia Kovieria

viktoriya.kovieria@hnpu.edu.ua

<https://orcid.org/0000-0002-2439-4468>

Department of Olympic and professional sports, sports games and tourism, Laboratory of biophysics, biomechanics and kinesiology, H.S. Skovoroda Kharkiv National Pedagogical University
Altshevskih str. 29, Kharkiv, 61002, Ukraine

Valentyna Lysenko

lysenkov2171@gmail.com

<https://orcid.org/0000-0002-9765-1808>

Department of Olympic and professional sports, sports games and tourism, H.S. Skovoroda Kharkiv National Pedagogical University
Altshevskih str. 29, Kharkiv, 61002, Ukraine

Інформація про авторів

Моніка Бейтка

monika.bejtka@cm.umk.pl

<http://orcid.org/0000-0002-2240-4896>

Кафедра фізіології людини, Медичний колегіум Лдвика Ридигшра в Бидгощі,
Університет Миколи Коперника в Торуні
Карловиця, 24, 85-092 Бидгощ, Польща

Жаннета Козіна

zhanneta.kozina@gmail.com

<http://orcid.org/0000-0001-5588-4825>

Кафедра олімпійського і професійного спорту, спортивних ігор та туризму, лабораторія біофізики, біомеханіки та кінезіології, Харківський національний педагогічний університет імені Г.С. Сковороди
Вул. Алчевських, 29, Харків, 61002, Україна

Юрій Бойчук

rector@hnpu.edu.ua

<https://orcid.org/0000-0002-4891-769X>

Харківський національний педагогічний університет імені Г.С. Сковороди
Вул. Алчевських, 29, Харків, 61002, Україна

Ірина Гармаш

garmash.irina1@gmail.com

<https://orcid.org/0000-0003-0838-2843>

Кафедра олімпійського і професійного спорту, спортивних ігор та туризму, лабораторія біофізики, біомеханіки та кінезіології, Харківський національний педагогічний університет імені Г.С. Сковороди
Вул. Алчевських, 29, Харків, 61002, Україна



Ганна Таможанська

kulichka79@ukr.net

<https://orcid.org/0000-0003-2430-8467>

Кафедра фізичної терапії та здоров'я, Національний фармацевтичний університет
вул. Пушкінська, 53, 61002, м. Харків, Україна

Вікторія Коверя

viktoriya.kovieria@hnpu.edu.ua

<https://orcid.org/0000-0002-2439-4468>

Кафедра олімпійського і професійного спорту, спортивних ігор та туризму, Харківський національний педагогічний університет імені Г.С. Сковороди
Вул. Алчевських, 29, Харків, 61002, Україна

Валентина Лисенко

lysenkov2171@gmail.com

<https://orcid.org/0000-0002-9765-1808>

Кафедра олімпійського і професійного спорту, спортивних ігор та туризму, Харківський національний педагогічний університет імені Г.С. Сковороди
Вул. Алчевських, 29, Харків, 61002, Україна

Информация об авторах

Моника Бейтка

monika.bejtka@cm.umk.pl

<http://orcid.org/0000-0002-2240-4896>

Кафедра физиологии человека, Медицинский колледж Людвика Ридигшера в Бидгоше,
Университет Николая Коперника в Торуне
Карловица, 24, 85-092 Бидгош, Польша

Жаннета Козина

zhanneta.kozina@gmail.com

<http://orcid.org/0000-0001-5588-4825>

Кафедра олимпийского и профессионального спорта, спортивных игр и туризма, лаборатория биофизики, биомеханики и кинезиологии, Харьковский национальный педагогический университет имени Г.С. Сковороды
Ул. Алчевских, 29, Харьков, 61002, Украина

Юрий Бойчук

rector@hnpu.edu.ua

<https://orcid.org/0000-0002-4891-769X>

Харьковский национальный педагогический университет имени Г.С. Сковороды
Ул. Алчевских, 29, Харьков, 61002, Украина

Ирина Гармаш

garmash.irina1@gmail.com

<https://orcid.org/0000-0003-0838-2843>

Кафедра олимпийского и профессионального спорта, спортивных игр и туризма, лаборатория биофизики, биомеханики и кинезиологии, Харьковский национальный педагогический университет имени Г.С. Сковороды
Ул. Алчевских, 29, Харьков, 61002, Украина

Анна Таможанська

kulichka79@ukr.net

<https://orcid.org/0000-0003-2430-8467>

Кафедра физической терапии и здоровья, Национальный фармацевтический университет
ул. Пушкинская, 53, 61002, г. Харьков, Украина



Виктория Коверя

viktoriya.kovieria@hnpu.edu.ua

<https://orcid.org/0000-0002-2439-4468>

Кафедра олимпийского и профессионального спорта, спортивных игр и туризма, Харьковский национальный педагогический университет имени Г.С. Сковороды
Ул. Алчевских, 29, Харьков, 61002, Украина

Валентина Лысенко

lysenkov2171@gmail.com

<https://orcid.org/0000-0002-9765-1808>

Кафедра олимпийского и профессионального спорта, спортивных игр и туризма, Харьковский национальный педагогический университет имени Г.С. Сковороды
Ул. Алчевских, 29, Харьков, 61002, Украина

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) (CC BY 4.0)

Received: 2022-08-05 Accepted: 2022-09-20 Published: 2022-09-25