



ORIGINAL ARTICLES. PHYSICAL EDUCATION

Vegetative regulation of vascular tone and features of the nervous system of pedagogical universities students. Is there a relationship with professional specialization?

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Abstract

Purpose. To select recommendations on the use of physical culture means for students of future teachers, it is necessary to identify their functional features and genetically determined properties of the nervous system. Purpose: to reveal the relationship between the performance of the nervous system, orthostatic test and professional specialization of students of pedagogical universities.

Material and methods. Students from 9 different faculties of Ukraine's leading pedagogical institute took part in the study. The total number of subjects was 841 people. Soon the reactions were determined by the program "Psychodiagnostics". Vegetative regulation of vascular tone were determined by the results of heart rate different between in the in the standing position and supine position. An analysis of variance (ANOVA) using the Duncan method was then conducted to determine the influence of the faculty of education on the testing indicators.. A correlation analysis of testing indicators and ranks of faculties was carried out using the Tau-b Kendall method.

Results. Students of all experimental faculties were divided into 4 groups according to the number of errors in the choice reaction test based on the results of variance analysis (Duncan method). Faculties were divided into ranks from the first to the fourth. A significant negative correlation of the rank of the faculty according to the indicator of the strength and speed of nervous processes with the heart rate in the standing position ($p < 0.05$) and the difference between the heart rate in the standing and lying positions ($p < 0.01$) was revealed.

Conclusions. The results obtained are new in identifying differences in psychophysiological functions and orthostatic reactions among students of pedagogical universities of different faculties; also on the fact of the presence of a correlation between the rank of the faculty in terms of stability and strength of the nervous system of students and the features of their psychophysiological functions and orthostatic reactions. The new facts obtained in this study are the distribution of students into 4 groups according to the stability and strength of the nervous system (from the lowest values to the highest): group 1 - students of the faculties of primary and preschool education, group 2 - students of humanitarian faculties, group 3 - students of the faculty Arts, group 4 - students of the Faculty of Physical Culture and Sports. Also new is the fact of revealing a significant negative correlation between indicators of mobility (reaction rate) and the stability of the nervous system (the number of errors when performing a reaction rate test) in students of pedagogical universities. It is expedient to use physical exercises in accordance with the professional characteristics and personal inclinations of students, who were divided into 4 groups according to the indicators of reaction speed and orthostatic test.

Key words: orthostatic test, speed of reaction, students, pedagogical specialties, nervous system



Анотація

Козін О.В., Козіна Ж.Л., Крету М., Бойчук Ю.Д., Павлович Р., Гармаш І., Бережна Я.Л. Вегетативна регуляція судинного тонуусу та особливості нервової системи студентів педагогічних університетів. Чи є взаємозв'язок з професійною спеціалізацією?

Мета. Для підбору рекомендацій щодо застосування засобів фізичної культури для студентів - майбутніх вчителів необхідно виявити їх функціональні особливості та генетично обумовлені властивості нервової системи. Мета: виявити взаємозв'язок між показниками роботи нервової системи, показниками ортостатичної проби та професійною спеціалізацією студентів педагогічних університетів.

Матеріал і методи. Студенти 9 різних факультетів провідного педагогічного університету України взяли участь у дослідженні. Загальна кількість випробуваних становила 841 людина. Швидкість реакції визначалася за програмою «Психодіагностика». Ортостатичні реакції визначалися за результатами ЧСС у положенні лежачи та в положенні стоячи. Проведено дисперсійний аналіз (ANOVA) з використанням методу Дункан для визначення впливу факультету навчання на показники тестування. Проведено кореляційний аналіз показників тестування та рангів факультетів за методом Тау-б Кендалла.

Результати. Студенти всіх піддослідних факультетів за показником кількості помилок в тесті на реакцію вибору розподілилися на 4 групи за результатами дисперсійного аналізу (метод Дункан). Факультети були розподілені на ранги від першого до четвертого. Виявлено достовірний негативний взаємозв'язок рангу факультету за показником сили і швидкості нервових процесів зі значенням ЧСС в положенні стоячи ($p < 0,05$) та різницею між ЧСС в положеннях стоячи і лежачи ($p < 0,01$).

Висновки. Отримані результати є новими щодо виявлення відмінностей психофізіологічних функцій та ортостатичних реакцій у студентів педагогічних вузів різних факультетів; також за фактом наявності кореляційного зв'язку між рангом факультету зі стійкості та сили нервової системи студентів та особливості їх психофізіологічних функцій та ортостатичних реакцій. Новими фактами, отриманими у цьому дослідженні, є розподіл студентів на 4 групи за стійкістю та силою нервової системи (від нижчих значень до вищих): 1 група – студенти факультетів початкової та дошкільної освіти, 2 група – студенти гуманітарних факультетів, 3 група – студенти факультету мистецтв, 4 група – студенти факультету фізичної культури та спорту. Новим також є факт виявлення значущого негативного кореляційного зв'язку між показниками рухливості (швидкість реакції) та стійкістю нервової системи (кількість помилок при виконанні тесту швидкості реакції) у студентів педагогічних вузів. Фізичні вправи доцільно застосовувати відповідно до професійних особливостей та особистісних задатків студентів, які були поділені на 4 групи за показниками швидкості реакції та ортостатичної проби.

Ключові слова: ортопроба, швидкість реакції, студенти, педагогічні спеціальності, нервова система

Аннотация

Козин А.В., Козина Ж.Л., Крету М., Бойчук Ю.Д., Павлович Р., Гармаш И., Бережная Я.Л. Вегетативная регуляция сосудистого тонуса и особенности нервной системы студентов педагогических университетов. Есть ли связь с профессиональной специализацией?

Цель. Для подбора рекомендаций по применению средств физической культуры для студентов будущих учителей необходимо выявить их функциональные особенности и генетически обусловленные свойства нервной системы. Цель: выявить взаимосвязь между показателями работы нервной системы, ортостатической пробы и профессиональной специализацией студентов педагогических университетов.

Материал и методы. Студенты 9 разных факультетов ведущего педагогического университета Украины приняли участие в исследовании. Общая численность испытуемых составила 841 человек. Скорость реакции определялась по программе «Психодиагностика». Ортостатические реакции определялись по результатам ЧСС в положении лежа и стоя. Проведен дисперсионный анализ (ANOVA) с использованием метода Дункан для определения влияния факультета обучения на показатели тестирования. Проведен корреляционный анализ показателей тестирования и рангов факультетов по методу Тау-б Кендалл.

Результаты. Студенты всех испытуемых факультетов по показателю количества ошибок в тесте на реакцию выбора распределились на 4 группы по результатам дисперсионного анализа (метод Дункан). Факультеты были распределены на ранги от первого до четвертого. Выявлена достоверная негативная взаимосвязь ранга факультета по показателю силы и скорости нервных процессов со значением ЧСС в положении стоя ($p < 0,05$) и разницей между ЧСС в положениях стоя и лежа ($p < 0,01$).

Выводы. Полученные результаты являются новыми по выявлению различий психофизиологических функций и ортостатических реакций у студентов педагогических вузов разных факультетов; также по факту наличия корреляционной связи между рангом факультета по устойчивости и силе нервной системы студентов и особенностями их психофизиологических функций и ортостатических реакций. Новыми фактами, полученными в данном исследовании, является распределение студентов на 4 группы по устойчивости и силе нервной системы (от низших значений к высшим): 1 группа - студенты факультетов начального и дошкольного образования, 2 группа - студенты гуманитарных факультетов, 3 группа – студенты факультета искусств, 4 группа – студенты факультета физической культуры и спорта. Новым также является факт выявления значимой отрицательной корреляционной связи между показателями подвижности (скорость реакции) и устойчивостью нервной системы (количество ошибок при выполнении теста скорости реакции) у студентов педагогических вузов. Физические упражнения целесообразно применять в соответствии с профессиональными особенностями и личностными задатками студентов, которые были разделены на 4 группы по показателям скорости реакции и ортостатической пробы.

Ключевые слова: ортопроба, быстрота реакции, студенты, педагогические специальности, нервная система



Introduction

In modern realities, physical inactivity is one of the main factors in the deterioration of people's health, including the health of students [1, 2]. This is especially true during online learning. Therefore, the motivation of students for independent physical culture and sports is of particular relevance [3, 4]. For this, it is necessary to develop such means and methods of physical education that would correspond to their individual psychophysiological characteristics [5]. The types of physical activity that are suitable for the student in terms of the characteristics of his nervous system will more quickly cause positive emotions when they are performed compared to those exercises that do not correspond to the individual characteristics of higher nervous activity [6–9]. And, if the type of physical activity suits a person, he will do it on his own. It is one of the main health factors [10].

Therefore, at the present stage, differentiated physical education of students is of great importance. Differentiated physical education involves an individual approach, taking into account the level of physical fitness, the interests of students, their natural inclinations and capabilities [11–14]. Also, differentiated physical education involves taking into account the professional specialization of students. Thus, it has been established [5, 15] that students from different faculties differ in the features of cognitive activity. This is reflected in the preferences in the choice of sports and physical activity for the use of various physical exercises [16–18]. In order for physical education classes to be interesting for students and bring maximum benefits to their health, it is necessary to select the types of motor activity taking into account their interests, as well as functional capabilities [19–22] and properties of the nervous system [23].

These provisions are typical for students of all specialties, including specialties of pedagogical universities. Each pedagogical specialty has its own characteristics [5]. Thus, a primary school teacher, just like teachers of preschool education, is a special category of teachers [6, 7]. Their profession is distinguished by the need to possess a wide arsenal of knowledge from various fields. These specialists must have extensive knowledge of the psychology of children of preschool and primary school age, as well as communication skills with children of this age group [5, 7, 8]. This category of children is characterized by the predominance of imaginative thinking over logical

thinking, a reduced level of inhibition processes, and a lower level of self-control ability [8, 9]. Specialists in this field perform the role of psychologists, educators and teachers at the same time. It is also necessary to know well and be able to teach children knowledge from various basic disciplines: mathematics, literature, natural history, and often drawing, music and physical education. This activity requires full commitment, the ability to work with children, the ability to manage a group of children and be friendly [8, 10].

A differentiated selection of physical exercises for students of different faculties should be carried out on the basis of the features of the work of the main systems that provide features of movements, that is, the nervous and cardiovascular systems [24–26]. Selection of means and methods of physical education according to the characteristics of higher nervous activity of students. Tests that indirectly determine psychophysiological characteristics are based on determining the reaction rate in different testing modes [27–29]. Among the tests that are easy to use and reflect the work of regulatory systems of vascular tone, one can single out an orthostatic test [19–22]. Based on tests for reaction speed in different testing modes, it is possible to determine the mobility and stability (strength) of the nervous system. In these tests, the higher the reaction rate, the higher the mobility of the nervous processes [23, 27, 28]. The fewer errors in the performance of tests, especially tests for the reaction of choice, the higher the stability (strength) of the nervous system [23]. In the orthostatic test, the value of the heart rate at rest reflects the functional state of the cardiovascular system. In a healthy trained person, the value of the heart rate at rest can be from 40 to 60 beats per minute. At the same time, when the body position changes from horizontal to vertical, the heart rate increases by no more than 30 beats per minute [19, 20, 23]. Thus, according to this test, one can indirectly judge the general endurance of a person, which is determined by the state of the cardiovascular system.

In order for students to like physical exercises, they must correspond to the functional features of their nervous system [28–30]. To do this, it is necessary to identify the main patterns of the relationship between the performance of the nervous system, the regulation of vascular tone and the professional specialization of students. However, the relationship between the properties of the nervous system, the functionality of the regulation of vascular tone and the specialization of future teachers was not determined. Based on the foregoing, we formulated the main question of the



study: is there really a connection between the pedagogical specialization of students and the characteristics of their nervous system, as well as functional characteristics determined by the orthostatic test? In this regard, we formulated the following hypothesis: there is a connection between the properties of the nervous system, indicators of orthostatic reactions and the specialization of students - future teachers.

Purpose: to reveal the relationship between the performance of the nervous system, the indicators of the orthostatic test and the professional specialization of students of pedagogical universities.

Material and methods

Participants

Students of the leading pedagogical university of Ukraine took part in the study. The total number of subjects was 841 people. Of the participants, students of the faculty of future specialists in sport training amounted to 79 people, students of the Art faculty were tested in the amount of 74 people. The Faculty of Biology was represented by 124 students, the Faculty of Foreign Languages was represented by 127 students, the Faculty of the Ukrainian Language by 146 students. Also, 45 students represented the Faculty of Psychology, 74 students - the Faculty of History, 90 students studied at the Faculty of Preschool Education and 82 students studied at the Faculty of Primary Education.

Procedure

The study was conducted in September 2021 on the biophysics, biomechanics and kinesiology laboratory basis of the H.S. Skovoroda Kharkiv National Pedagogical University from 9-00 to 11-00. Students first performed an orthostatic test, then they were tested for reaction speed in different testing modes.

The method of determining the features of the nervous system and vegetative regulation of vascular tone

Peculiarities of the work of the students' nervous system were determined according to the program "Psychodiagnostics" [5, 23, 29, 30]. In this program, various images appear alternately on the monitor screen, to which the student must respond by pressing the mouse button. Indicators

of reaction speed without object selection (simple visual-motor reaction) and reaction speed with object selection (reaction to select 2 elements out of 3) were determined. In the reaction test without object selection, students had to press the left mouse button when any image appeared on the monitor screen. In the test of choice reaction speed, students had to press the left mouse button on the image of geometric figures, the right button - on the image of animals; students did not need to respond to all other images. The number of errors in each test was also determined.

According to these indicators, the mobility and strength (stability) of the nervous system were determined. Shorter reaction times were thought to correspond to higher rates of nervous system motility. Also, a smaller number of errors in the choice reaction test was considered an indicator of higher strength and stability of nervous processes [18, 23, 29].

The method of determining the functional state of nervous regulation of vascular tone of students using an orthostatic test

The orthostatic test was carried out as follows. Students measured heart rate in two positions - lying and standing. Testing was carried out using Polar devices (fitness watches) [5, 19, 20]. The test results were evaluated as follows. The lower the HR values in the supine position (50-64 beats/min), the higher the level of economy of the work of the cardiovascular system, and, accordingly, functional capabilities. Also, the smaller the difference in heart rate between the lying position and the standing position, the higher the level of orthostatic regulation and, accordingly, the body's functional capabilities.

Statistical analysis

First, samples were checked for normality of distribution using the Kolmogorov-Smirnov method. All samples corresponded to a normal distribution ($p > 0.05$). At the next stage, descriptive statistics were determined for each measured indicator. An analysis of variance (ANOVA) using the Duncan method was then conducted to determine the influence of the faculty of education on the testing indicators. A reliable influence of the faculty of student training was revealed only on the indicator of the stability of the nervous system according to the number of errors in the test on the reaction to the choice of two elements from three with the formation of four groups. Ranking of students of all studied faculties was carried out according to four groups formed by using the Duncan test. At the next stage, a correlation



analysis of testing indicators and ranks of faculties, formed as a result of dispersion analysis using the Duncan test, was carried out. At the same time, the correlation between the test indicators was calculated according to the Pearson method, since all these indicators belong to the interval scale. The correlation between the testing indicators and the rank of the faculty was calculated by the Tau-b Kendall rank correlation coefficient, since the rank of the faculty refers to an ordinal (rank) scale.

Results

It was found that according to the indicators of the properties of the nervous system, students - future specialists in primary and preschool education differ from students of other pedagogical specialties. The time of a simple visual-motor reaction is the lowest among students of the faculty of primary education in comparison with the values of students of the following faculties: history, natural sciences, foreign philology, Ukrainian language, the faculty of future specialists in sport training, the art faculty, and the faculty of psychology and sociology (Table 1).

The number of errors in the test for the time of a simple visual-motor reaction is the largest among students of the faculties of elementary education and preschool education, and the largest number of discrepancies according to this indicator for students of elementary education ($p < 0.001$; $p < 0.01$; $p < 0.05$) (table 2).

The reaction time for choosing 2 items out of 3 is the lowest among students of the faculty of elementary education in comparison with the values of students of the following faculties: history, natural sciences, foreign philology, Ukrainian language, the faculty of future specialists in sport training, the art faculty, and the psychology faculty (Table 3).

The number of errors in the test for the reaction to the choice of 2 elements out of 3 is the lowest among students of the faculties: physical education and sports, arts and natural sciences; the largest among students of the faculties of elementary education, history and the faculty of preschool education (Table 4).

From the side of the cardiovascular system, students of the faculty of future specialists in sport training have the best indicators (Table 5): they have the lowest heart rate values in the lying position and in the standing position. And the difference between the indicators of the heart rate lying down and in the standing position is the largest among students of the faculty of elementary education. The biggest differences were found between the indicator of heart rate difference in the lying position and in the standing position was found in students of the faculty of elementary education and the faculty of future specialists in sport training ($p < 0.01$). The same applies to HR indicators in the lying position and in the standing position (Table 5).

Table 1

The simple reaction time of pedagogical university students

Faculties	N	$\bar{x}$	S	m
Primary education	82	338.60	34.53	3.81
Stories	74	393.15	57.23	6.65
Biology	124	387.04	54.14	4.86
Foreign languages	127	414.52	67.17	5.96
Preschool education	90	375.56	72.66	7.66
Ukrainian language	146	421.94	70.51	5.84
Physical education and sports	79	403.75	62.45	7.03
Arts	74	509.50	101.26	11.77
Psychology	45	393.0	87.60	13.06



Table 2

The errors number in the test for a simple reaction time test of pedagogical university students

Faculties	N	$\bar{x}$	S	m
Primary education	82	4.20	0.41	0.05
Stories	74	1.31	0.28	0.03
Biology	124	1.73	0.07	0.01
Foreign languages	127	3.63	0.15	0.01
Preschool education	90	4.19	0.3	0.03
Ukrainian language	146	2.69	0.34	0.03
Physical education and sports	79	0.75	0.22	0.02
Arts	74	2.25	0.89	0.10
Psychology	45	2.13	0.67	0.10

Table 3

The choice reaction time of pedagogical university students

Faculties	N	$\bar{x}$	S	m
Primary education	82	449.13	55.38	6.12
Stories	74	573.75	67.44	7.84
Biology	124	484.12	207.14	18.60
Foreign languages	127	542.86	77.69	6.89
Preschool education	90	522.27	78.70	8.30
Ukrainian language	146	531.24	91.40	7.56
Physical education and sports	79	519.75	72.01	8.10
Arts	74	507.50	66.08	7.68
Psychology	45	546.50	47.10	7.02

Table 4

The errors number in the test for a choice reaction time test of pedagogical university students

Faculties	N	$\bar{x}$	S	m
Primary education	82	19.40	4.05	0.45
Stories	74	8.13	3.18	0.37
Biology	124	2.28	0.78	0.07
Foreign languages	127	6.49	0.92	0.08
Preschool education	90	12.67	2.61	0.28
Ukrainian language	146	6.73	1.25	0.10
Physical education and sports	79	1.25	0.26	0.03
Arts	74	2.00	0.82	0.10
Psychology	45	7.50	2.14	0.32



Table 5

The functional state determining of pedagogical university students of a based on indicators of orthostatic reactions

Indicators	Faculties	N	$\bar{x}$	S	m
Lying heart rate, beats·min ⁻¹	Primary education	82	71.50	4.95	0.55
	Stories	74	67.25	9.29	1.08
	Biology	124	68.58	11.63	1.04
	Foreign languages	127	70.10	8.14	0.72
	Preschool education	90	71.89	8.94	0.94
	Ukrainian language	146	74.00	9.22	0.76
	Physical education and sports	79	65.00	4.58	0.52
	Arts	74	68.00	12.49	1.45
	Psychology	45	70.17	15.73	2.34
Standing heart rate - beats·min ⁻¹	Primary education	82	100.50	27.58	3.05
	Stories	74	82.25	12.71	1.48
	Biology	124	90.83	13.77	1.24
	Foreign languages	127	95.10	15.37	1.36
	Preschool education	90	91.22	11.64	1.23
	Ukrainian language	146	87.61	7.96	0.66
	Physical education and sports	79	79.67	6.66	0.75
	Arts	74	84.00	10.39	1.21
	Psychology	45	88.00	14.24	2.12
Difference between standing heart rate - lying heart rate, beats·min ⁻¹	Primary education	82	29.00	22.63	2.50
	Stories	74	15.00	2.76	0.32
	Biology	124	18.37	13.60	1.22
	Foreign languages	127	25.00	9.38	0.83
	Preschool education	90	17.40	5.39	0.57
	Ukrainian language	146	15.61	3.01	0.25
	Physical education and sports	79	12.00	3.02	0.34
	Arts	74	15.67	2.49	0.29
	Psychology	45	15.83	2.44	0.36

Analysis of variance using the Duncan test showed the greatest differences for different faculties in terms of choice response errors. As a result of using the Duncan test, all faculties were divided into 4 groups. The first group included elementary and preschool education faculties students. They reliably have the highest number of errors in the choice reaction test (Table 6, Fig. 1). The second group included following faculties students: biology, foreign language, Ukrainian language, psychology, history. According to the number of errors in the choice reaction test, they ranked second among all the tested. The third group consisted of students of the Art faculty, and the fourth - students of the Faculty of future specialists in sport training. The students of the third and fourth groups had the lowest number of errors in the choice reaction test. This testifies to

the highest stability and strength of the nervous system in students of these specialties.

According to the groups formed by the Duncan method, the faculties were divided into ranks from the first to the fourth. As the rank increases, the strength and stability of nervous processes increases, as determined by the number of errors in the choice reaction test. Since the groups of faculties belong to an ordinal (rank) scale, the relationship between the indicators of the work of the nervous system, orthostatic reactions and the rank of the faculty in terms of the strength and stability of the nervous system was determined by the Tau-b Kendall rank correlation coefficient (Table 7). Between all other indicators, the correlation coefficient was determined by the Pearson method, since they belong to the interval scale of measurements.



It was determined that there is a significant positive relationship ($p < 0.05$) between the rank of the faculty according to the stability and strength of nervous processes and reaction time (both simple and choice reaction) (Table 7). The higher the rank of the faculty in terms of strength and stability of nervous processes, the greater the reaction time. But between the rank of the faculty according to the strength and stability of nervous processes and the number of errors in the choice reaction test, a negative and reliable relationship was found ($p < 0.01$) (Table 7). This is quite understandable, since the rank of the faculty was determined

precisely by the number of errors in the choice reaction test. That is, the higher the rank of the faculty according to the indicator of strength and stability of nervous processes, the smaller the number of errors in the reaction speed test. Also, a reliable negative correlation of the rank of the faculty according to the indicator of the strength and speed of nervous processes with the heart rate in the standing position ($p < 0.05$) (Table 7) and the difference between the heart rate in the standing and lying positions) ($p < 0, 01$) (Table 7).

Table 6

Different faculties students testing results according to the errors number in the test for a choice reaction time of pedagogical university students. Variance analysis using the Duncan (a, b) method ($N = 841$, Subset for $\alpha = 0.05$)

Faculties	N	Faculty groups				Validity of differences between groups of faculties	
		1	2	3	4	F	p
Physical education and sports	79				1.24		
Arts	74			2.01		4.114	0.000
Biology	124		4.277				
foreign languages	127		5.486				
Ukrainian language	146		6.529				
Psychology	45		7.5				
Stories	74		9.125				
preschool education	90	14.45					
Primary education	82	20.7					
Significance of differences within groups		0.07	0.2	0.06	0.06		

Averages for groups in homogeneous subsets are displayed.

a Uses harmonic mean sample size = 9.155.

b Uneven group sizes. The harmonic mean of group sizes is used. Type I error levels are not guaranteed

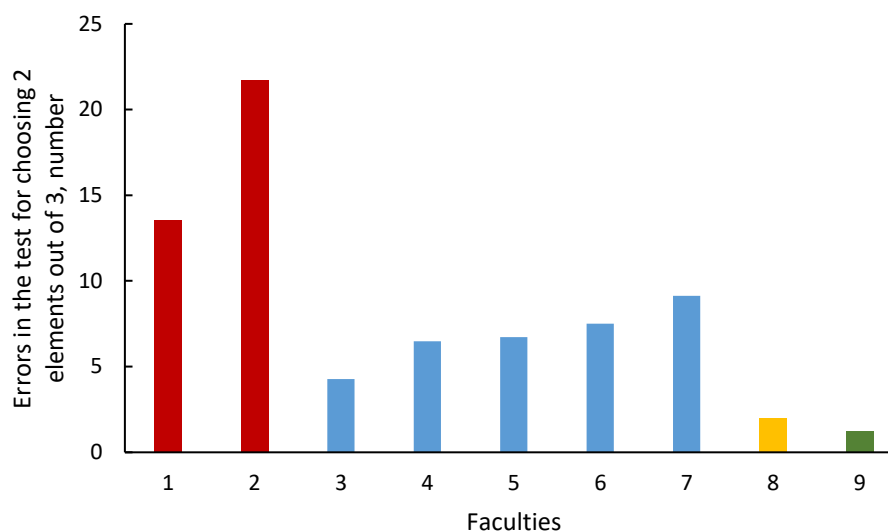


Fig. 1. Results of testing students of various faculties of pedagogical universities according to the error rate in the test for determining the reaction time of choosing 2 elements from 3: 1 - primary education; 2 - preschool education; 3 – biology; 4 - foreign languages; 5 - Ukrainian language; 6 – psychology; 7 – stories; 8 – arts; 9 - physical education and sports

■ p 1; ■ - group 2; ■ - group 3; ■ - group 4

Table 7

Correlation matrix of indicators of psychophysiological functions, orthostatic test and ranks of faculties according to the properties of the nervous system of students (N=841)

Indicators	Correlation	1	2	3	4	5	6	7	8
1. Latent time of a simple reaction ^a , ms	r	1	0.613**	0.609**	-0.515**	-0.021	-0.431*	-0.053	0.505*
	p	.	0	0	0.007	0.747	0.039	0.399	0.034
2. Mistakes in the test on a simple reaction ^a , numbers	r	-0.613**	1	0.460**	-0.003	-0.05	-0.078	0.004	-0.002
	p	0.002	.	0.001	0.959	0.489	0.273	0.954	0.97
3. Latent time of a reaction choosing ^a , ms	r	0.609**	0.460**	1	-0.407*	0.006	-0.034	-0.059	0.088
	p	0.004	0.001	.	0.042	0.924	0.591	0.35	0.081
4. Mistakes in the test on a reaction choosing ^a , numbers	r	-0.515**	-0.003	-0.407*	1	0.03	0.025	0.039	-0.622**
	p	0.007	0.959	0.042	.	0.723	0.765	0.636	0.000
5. Heart rate, living ^a , bpm	r	-0.021	-0.05	0.006	0.03	1	0.431**	-0.474**	0.037
	p	0.747	0.489	0.924	0.723	.	0.004	0.008	0.625
6. Heart rate, standing ^a , bpm	r	-0.431*	-0.078	-0.034	0.025	0.431**	1	0.455**	-0.421*
	p	0.039	0.273	0.591	0.765	0.006	.	0.008	0.038
7. Difference between the heart rate	r	-0.053	0.004	-0.059	0.039	-0.474**	0.455**	1	-0.514**
	p	0.399	0.954	0.35	0.636	0.008	0.005	.	0.007



(standing) and Heart rate (lying) ^a , bpm									
8. Rate of faculty (1–4) ^b	r	0.505*	-0.002	0.088	-0.622**	0.037	-0.421*	-0.514**	1
	p	0.034	0.97	0.081	0.000	0.625	0.038	0.007	.

Notes: ** - Correlation is significant at the level of 0.01; * - Correlation is significant at the level of 0.05: a - correlation was calculated using the Pearson method; b – correlation was calculated using Kendall's Tau-b method: 1 – first group (rank), faculties of elementary education and preschool education; 2 - the second group (rank), faculties of biology, history, foreign languages, Ukrainian language, psychology; 3 - the third group (rank), art faculties; 4 - fourth group (rank), faculty of future specialists in sport training

A significant negative relationship between the time of a simple reaction and the number of errors was also found ($p < 0.01$) (Table 7). The reaction speed is higher, the shorter the response time to the object. The speed of reaction is characteristic of people with high mobility of nervous processes. Based on the obtained data, the shorter the reaction time to a visual stimulus, the greater the number of errors that occur when performing this test. The number of errors in the reaction speed test reflects the strength and stability of the nervous system. The fewer errors in this test, the higher the strength and stability of the nervous system. A similar pattern is observed for the choice reaction test: the faster the reaction speed (the shorter the latent reaction time), the greater the number of errors when performing this test. That is, the higher the mobility of the nervous system, the lower its strength and stability. And, on the contrary, the greater the strength and stability of the nervous system, the less its mobility. But the relationship between these indicators is average ($r = (-0.613)$, ($r = (-0.515)$)), which indicates the possibility of cases where both high mobility of nervous processes and high strength and stability of nervous processes are observed.

Discussion

The conducted study is one of the first in the field of determining the characteristics of the nervous system and the characteristics of the regulation of vascular tone by students of different pedagogical specializations. The hypothesis put forward in this study was confirmed. Students of different pedagogical specializations have different properties of the nervous system. They have different speed of reaction, and, accordingly, the mobility of nervous processes, as well as different resistance of the nervous system to fatigue. Students of different faculties were divided into 4 groups (ranks) according to the strength and

stability of the nervous system. They also have different indicators of reaction speed.

Group (rank) 1 - primary and preschool education faculties students. For these students, it is more typical to have a high speed of reaction (mobility of nervous processes) and a high number of errors when performing these tests (low strength and stability of the nervous system). Such a structure of their nervous system is connected, in our opinion, with the fact that they intuitively chose a pedagogical specialty based on their own nervous system features. After all, future work with young children requires the ability to switch attention. And therefore, a high ability to switch attention is a strong point of professionals who work with young children. Accordingly, primary and preschool education faculties students, having intuitively chosen a pedagogical specialty, have precisely such properties of the nervous system as high mobility of nervous processes, high ability to switch attention [18, 23, 29]. But these properties are accompanied by insufficient stability of the nervous system [29]. This is not accidental, because a person cannot maintain a high level of attention switching speed and a high speed of response to external stimuli for a long time. That is why for these students the most suitable physical exercises will be those based on the mobility of nervous processes. I. like any physical exercises, they will also contribute to the strengthening of the nervous system, improving its stability and strength. Such exercises include mobile and sports games, martial arts, cyclical exercises with variable intensity of work and sufficient duration of rest. Movement and sports games for these students should be used in such a way that they do not lead to great fatigue, but at the same time provide a certain load on the body. This will contribute to the development of their strengths, that is, the mobility of nervous processes, and at the same time, it will strengthen their weaknesses, that is, insufficient strength and stability of the nervous system.

Group (rank) 2 - students of humanities and natural sciences faculties (biology, history,



foreign language, Ukrainian language, psychology). These students are characterized by average values of reaction speed and the number of errors when performing reaction tests, that is, average mobility and average strength of nervous processes. This is a group of students that occupies an intermediate place between two polar groups: a group of students with high mobility and low strength and stability of nervous processes and a group of students with high strength and stability of nervous processes and low mobility of the nervous system. Accordingly, any physical exercises that require an average manifestation of all these qualities are suitable for them: cyclic sports, dances, gymnastics, sports games, martial arts. Exercises from these types of sports should be applied in such a way as to provide an average load on the body from the point of view of both mobility and stability of the nervous system.

Group (rank) 3 - students of the Art faculty. These students are characterized by a low reaction speed and a small number of errors when performing reaction tests. That is, these students are characterized by high stability and strength of the nervous system and relatively low mobility of nervous processes. This, in our opinion, is due to the fact that doing art requires a high concentration of attention for a long time. That is why these students have a small number of errors in reaction tests, since they are able to concentrate for a long time on creative work idleness. And that is why they have a relatively low level of reaction speed, that is, the mobility of nervous processes, the ability to switch attention [18]. Due to their ability to concentrate attention on any task, these students are not prone to constant switching of attention and, accordingly, to quick reaction to external stimuli. In this regard, physical exercises that require a high concentration of attention for a long time are suitable for them, for example, cyclical exercises. Students of the Art faculty can perform them for quite a long time, unlike students of the faculties of elementary education and preschool education.

Group (rank) 4 - students of the faculty of future specialists in sport training. These students have the highest indicators of strength and stability of the nervous system, since they have the least number of errors in reaction tests. This is due to the fact that physical exercises help strengthen the nervous system and increase its resistance to long-term stimuli. The mobility of nervous processes (choice reaction speed and simple reaction speed) in students of the faculty of future specialists in sport training does not differ reliably from this indicator of students of other faculties. This can be

explained by the fact that the speed of reaction is a more hereditary indicator compared to the strength and stability of nervous processes, and therefore under the external influence of physical exertion, it develops not as noticeably as the ability of the nervous system to resist fatigue [23]. In addition, students of the faculty of future specialists in sport training have the best results of the orthostatic test: they have the lowest heart rate values when moving from a lying position to a standing position. This indicates a high level of adaptive capabilities of vascular tone regulation to changes in the position of the body in space.

Thus, any physical exercises have a positive effect on the stability and strength of the nervous system, as well as on the orthostatic regulation of vascular tone. This is evidenced by the best results of the students of the faculty of future specialists in sport training according to the results of tests on reaction speed and orthostatic stability.

Students of pedagogical specialties related to creativity (music, fine arts) are distinguished by a higher stability of the nervous system and less mobility [18]. This is due to the fact that students of creative specialties are more inclined to concentrated work, which does not require frequent switching of attention. An intermediate position is occupied by students of the humanities.

The functional capabilities of students of different specializations according to the results of an orthostatic test do not differ from each other. The only exception is a student of the faculty of future specialists in sport training. They have a significantly higher level of functional readiness in comparison with students of other specialties.

Students of all faculties should use physical exercises to improve the functional state of the nervous and cardiovascular systems. Physical exercises should be used according to professional characteristics and personal inclinations. In general, any exercises will be useful for students of all faculties, but the greatest benefit will be brought by exercises that correspond to the peculiarities of the nervous system of students of different faculties. For students of the faculties of elementary education and preschool education, we recommend using mobile and sports games, martial arts, cyclical exercises with variable intensity of work and sufficient duration of rest. Movement and sports games for these students should be used in such a way that they do not lead to great fatigue, but at the same time provide a certain load on the body. This will contribute to the development of their strengths, that is, the mobility of nervous



processes, and at the same time, it will strengthen their weaknesses, that is, insufficient strength and stability of the nervous system.

For students of humanities and natural sciences faculties (biology, history, foreign language, Ukrainian language, psychology), any physical exercises that require an average manifestation of all these qualities are suitable: cycle sports, dances, gymnastics, sports games, martial arts. Exercises from these types of sports should be applied in such a way as to provide an average load on the body from the point of view of both mobility and stability of the nervous system.

Physical exercises that require high concentration of attention for a long time, for example, cyclic exercises, are suitable for students of the Art faculty. Students of the Art faculty can perform them for quite a long time, unlike students of the faculties of elementary education and preschool education.

We recommend that students of the faculty of future specialists in sport training continue to improve in their chosen sport, while also studying other sports.

The results obtained are new in relation to our earlier data [18] on the differences in psychophysiological functions and orthostatic reactions of students of pedagogical universities of different faculties, the fact of the presence of a correlation between the rank of the faculty in terms of stability and strength of the nervous system of students and the features of their psychophysiological functions and orthostatic reactions. The results obtained by us in our previous studies [18] on the impact on the indicators of orthostatic stability only of physical culture and sports and the absence of influence on these indicators of professional specialization of students were confirmed. The new facts obtained in this study is the distribution of students into 4 groups according to the stability and strength of the nervous system (from lower to higher values): group 1 - students of the faculties of primary and preschool education, group 2 - students of humanitarian faculties, group 3 - students of the art faculty

in sport training. Also new is the fact of revealing a significant negative relationship between indicators of mobility (reaction rate) and stability of the nervous system (the number of errors when performing a reaction rate test) among students of pedagogical universities.

Conclusions

1. It was determined that the greatest stability and strength of the nervous system is observed in students of the Art faculty and the faculty of future specialists in sport training. This is evidenced by the following results. Based on the results of variance analysis using Duncan's test, students of all experimental faculties were divided into 4 groups based on the number of errors in the choice reaction test. The first group included primary and preschool education faculties students (reliably the highest number of errors in the choice reaction test). Foreign language and history, Ukrainian language, psychology, biology faculties students were included in the second group. The third group included students of the Art faculty (reliably the least number of errors in the choice reaction test). The fourth group consisted of students of the faculty of future specialists in sport training (the smallest number of errors in the choice reaction test and the smallest values of heart rate increase in the orthostatic test). indicates the highest stability and strength of the nervous system in students of these specialties.

2. According to the groups formed by the Duncan method, the faculties were divided into ranks from the first to the fourth. It was determined that there is a significant positive correlation ($p < 0.05$) between the rank of the faculty according to the stability and strength of the nervous processes and the reaction time (both simple and choice reaction). The higher the rank of the faculty in terms of strength and stability of nervous processes, the greater the reaction time. But between the rank of the faculty according to the strength and stability of nervous processes and the number of errors in the choice reaction test, a negative and reliable relationship was found ($p < 0.01$). A reliable negative relationship between the rank of the faculty according to the indicator of the strength and speed of nervous processes with the heart rate in the standing position ($p < 0.05$) and the difference between the heart rate in the standing and lying positions) ($p < 0.01$) was revealed.

3. Physical exercises should be used according to professional characteristics and personal inclinations. For primary and preschool education faculties students, we recommend using mobile and sports games, martial arts, cyclical exercises with variable intensity of work and sufficient duration of rest. For students of humanities and natural sciences faculties (biology, history, foreign language, Ukrainian language, psychology), any physical exercises that require an



average manifestation of all these qualities are suitable: cycle sports, dances, gymnastics, sports games, martial arts. Exercises from these types of sports should be applied in such a way as to provide an average load on the body from the point of view of both mobility and stability of the nervous system. Physical exercises that require high concentration of attention for a long time, for example, cyclic exercises, are suitable for students of the Art faculty. Students of the Art faculty can perform them for quite a long time, unlike students of the faculties of elementary education and preschool education. We recommend that students of the faculty of future specialists in sport training continue to improve in their chosen sport, while also studying other sports.

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Conflict of interest

The authors declare that there is no conflict of interest.

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