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Стаття надійшла до редакції  
27.06.2021



UDC 612.821:159.9:378.6-057.875

<https://doi.org/10.26641/2307-0404.2021.4.248240>

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## PECULIARITIES OF CHANGES OF PSYCHOPHYSIOLOGICAL FUNCTIONS, STATE OF HUMAN ADAPTIVE CAPACITY AND STRESS RESISTANCE OF STUDENTS OF HIGHER MEDICAL INSTITUTIONS

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**Цитування:** *Медичні перспективи. 2021. Т. 26, № 4. С. 98-103*

**Cited:** *Medicni perspektivi. 2021;26(4):98-103*

**Key words:** *short-term memory, stress resistance, psychophysiology, functional mobility of nervous processes*

**Ключові слова:** *короткочасна пам'ять, стресостійкість, психофізіологія, функціональна рухливість нервових процесів*

**Ключевые слова:** *кратковременная память, стрессоустойчивость, психофизиология, функциональная подвижность нервных процессов*

**Abstract. Peculiarities of changes of psychophysiological functions, state of human adaptive capacity and stress resistance of students of higher medical institutions. Kalashchenko S.I.** *The study is devoted to assessing the psychophysiological adaptive capabilities of students of higher medical institutions. There was conducted a screening study on the basis of which a correlation analysis of a group of 42 students was performed. The main inclusion criterion was good physical activity. Exclusion criteria - the presence of chronic diseases, acute respiratory viral infections at the time of examination, taking antidepressants or psychoactive substances. The study was aimed to identify the peculiarities of changes in psychophysiological functions and the state of adaptive capacity of students of higher medical institutions being in stressful conditions. The following methods from the software and hardware complex "Psycholot-1" were used for the study: "Functional mobility of nervous processes according to Khilchenko" and "Memory." The survey was conducted under micro-stress, it means all tasks had to be completed in a limited period. Statistical analysis of the data was performed to establish correlations between psychophysiological indicators of short-term memory and functional mobility of nervous processes (Spearman's rank correlation index). It was found that the faster the stimulus appears in conditions of time deficit, the lower the mobility of nervous processes in the student, which is directly reflected in the indicators in increasing the minimum exposure time of the figure on the screen ( $0.27 \pm 0.007$  s). In addition, a relationship was found between the rate of reaction of*

*the left hand to a stimulus and the amount of information that a person can store in short-term memory. The information obtained will help to determine the initial data of the adaptive capacity of a potentially healthy contingent of people and predict their success in further professional activities in the sphere of medicine.*

**Реферат. Особливості змін психофізіологічних функцій і стану адаптаційних можливостей організму та стресостійкість студентів медичних закладів вищої освіти. Калашченко С.І.** Дослідження присвячене оцінці психофізіологічних адаптаційних можливостей студентів медичних закладів вищої освіти. Проведено скринінгове дослідження, на основі якого був здійснений кореляційний аналіз групи обстежуваних, яку склали 42 студенти. Основним критерієм включення була задовільна фізична активність, критеріями виключення – наявність хронічних захворювань, гострих респіраторних вірусних інфекцій на момент обстеження, прийом антидепресантів чи психоактивних речовин. Метою дослідження було визначити особливості змін психофізіологічних функцій і стану адаптаційних можливостей організму студентів медичних закладів вищої освіти, що перебувають у стресових умовах. Для дослідження були взяті такі методи з програмно-апаратного комплексу «Психолог-1»: «Функціональна рухливість нервових процесів за Хільченком» та «Пам'ять». Обстеження проводилося в умовах мікростресу, тобто всі завдання мали бути виконані за обмеженої проміжок часу. Проведений статистичний аналіз даних для встановлення кореляційних зв'язків між психофізіологічними показниками обсягу короткочасної пам'яті та функціональної рухливості нервових процесів (використовувався показник рангової кореляції Спірмена). Установлено, що чим швидше з'являється подразник в умовах дефіциту часу, тим нижчі показники рухливості нервових процесів показує студент, що знайшло пряме відображення в показниках у збільшенні мінімального часу експозиції фігури на екрані ( $0,27 \pm 0,007$  с). Також була виявлена залежність між швидкістю реакції лівої руки на подразник і обсягом інформації, яку людина може зберігати в короткочасній пам'яті. Отримана інформація допоможе визначити вихідні дані адаптаційних можливостей потенційно здорового контингенту людей та спрогнозувати їх успішність у подальшій професійній діяльності в медичній сфері.

Conducting screening studies of a potentially healthy contingent of people helps to understand the adaptive capabilities of the human body in both routine and extreme conditions of life. Features of the impact on the educational environment and the constant stress of adaptation mechanisms cause changes in the functional reserve of the individual. These changes are the best observed in a potentially healthy contingent of people without pre-existing malformations and chronic diseases [8]. It is worth noting that training in higher medical institutions (HMI) is associated with intense mental activity, which for a long time creates the preconditions for the emergence of such conditions as fatigue, overexertion, and stress. When studying the adaptive potential of students in MIHE, attention does focus on the integrity of the integration functions of the human brain and the body as a whole to create the preconditions for improving the adaptive mechanisms of the student to ensure practical current learning activities [12].

The stress-resistance includes such concepts as micro-stress and macro-stress. Examples of micro-stress in educational activities can be current testing, assessment of answers to the questions in classical methods of recitations, any task that should be completed in a limited period of time. Vivid examples of macro-stress are passing an exam, test, modular control. Domestic scientists described that constant micro-stress is no less harmful than macro-stress, usually occurring in student life once or twice a year during examination session, leading to decreased adaptive capacity of the student organism [2, 11].

It is possible to predict how quickly he will be able to adapt to further professional activities, the conditions of which are associated with a lack of information or lack of time, when studying the psychophysiological characteristics of a person and his initial data of the body's functional reserve [5]. In the works devoted to studying the process of adapting medical students to the conditions of the educational environment in the medical college and HMI, attention focuses on the deterioration of both the psychological state and the emergence of several diseases of somatic nature [7]. One of the most common reasons for a medical student to drop studying, including in senior courses, is depression, the causes, and consequences of which were described in detail in a study on adaptation and psychological state of students at a medical college in New Zealand [9]. Determining the adaptive capacity of the human body under micro-stress is an essential element for optimizing the psychophysiological adaptation of medical students to the educational process and the features of further professional activity [6].

The aim of the study: to identify the features of changes in psychophysiological functions and the state of adaptive capacity of students of higher medical institutions being in stressful conditions.

#### MATERIALS AND METHODS OF RESEARCH

The work materials were obtained during the research based on the Department of Emergency Medicine and Tactical Medicine of Bogomolets National Medical University from October to December 2020. The study used "Psycholot-1" (software

and hardware complex of professional psychological selection and psychophysiological examination PPE-1) NPP Metikol Nizhyn [4]. This examination included methods "Functional mobility of nervous processes according to Khilchenko" and "Memory" (studying the volume of short-term memory). The device has a license for use as a medical device. The survey involved 45 medical students aged 18 to 27, from the first to the third courses of the medical university. The study analyzed the impersonal data of respondents under the Law of Ukraine "On Personal Data Protection" (2010) and the WMA Declaration of Helsinki – "Ethical principles for medical research involving human subjects" (1964-2000). The calculation of the sample was performed using the program MedCalc. According to calculations, the expected sensitivity and specificity were 70%, error 20%, the level of significant difference  $p=0.05$  at a power of 80%. The inclusion criteria: constant physical activity (students were members of student groups in volleyball, weightlifting, attended the gym at least twice a week, or swimming pool); absence of acute respiratory viral infections at the time of examination. The exclusion criteria: chronic diseases, namely neurological (epilepsy) and cardiovascular pathologies, including congenital heart defects, taking antidepressants or psychoactive substances.

The study was conducted under micro-stress. Each task with PPE "Psycholot-1" does complete in a limited time. When passing the examination accor-

ding to the method "Functional mobility of nervous processes according to Khilchenko," this interval was not more than 240 s when passing the method "Memory" – not more than 60 s. The results' calculation were performed using the licensed statistical package (IBM SPSS Statistics Base v.22; sublicense agreement No. 138 of August 4, 2016, Licensee of TOV "Prohnostychni rishennya"). In addition, the calculation used the D'Agostino-Pearson test (testing for normality) and Spearman's rank correlation index [1].

## RESULTS AND DISCUSSION

The D'Agostino-Pearson criterion was used to test the distribution of the functional mobility of nervous processes (FMNP) to the customary distribution law. It establishes that for the indicators, the total number of errors, the number of erroneous reactions to the circle, the average reaction time of the right hand after the circle distribution do not differ from regular at the level of significance  $p>0.05$ . For indicators: the minimum exposure time of the figure, the average reaction time of the left hand, the average reaction time of the right hand, and the average reaction time of the left hand after the figure circle, the distribution differs from standard  $p<0.05$ . The D'Agostino-Pearson test also tests indicators for a volume of short-term memory (VSTM) for normality. Again, indicators of task time and the number of correct answers were statistically different from usual,  $p<0.05$  (table 1).

Table 1

### Estimation of the average value of indicators of FMNP by Khilchenko and VSTM at medical students

Indicators of psychophysiological techniques	Sample size, (N)	Me±m	Significance level, p
<b>Functional mobility of nervous processes by Khilchenko</b>			
X1. the total number of errors	N=42	52±0.5	p=0.085
X2. the number of erroneous reactions to the circle		8± 0.6	p=0.326
X3. the minimum exposure time of the figure		0.27±0.007	p<0.05
X4. the average reaction time of the left hand		0.2±0.01	
X5. the average reaction time of the right hand		0.23±0.008	
X6. average reaction time of the left hand after the figure circle		0.21±0.013	
X7. average reaction time of the right hand after the figure circle		0.22±0.012	p=0.116
<b>The volume of short-term memory</b>			
X8. Task execution time	N=42	38±2.5	p<0.05
X9. Number of correct answers		9±0.3	

The distribution of the reaction time of the subjects to different stimuli (circle, triangle, square) and VSTM indicators differed from average ( $p < 0.05$ ), so non-

parametric indicators were used for comparisons, namely Spearman's rank correlation index. The results of the correlation analysis are shown in Table 2.

Table 2

## Spearman's rank correlation indicators FMNP by Khilchenko and VSTM

Variables	X1	X2	X3	X4	X5	X6	X7	X8	X9
X1	-	-	0.496	0.435	0.426	0.431	0.390	-	-
X2	-	-	-	-	-	-	-	-	-
X3	0.469	-	-	0.547	0.393	0.375	0.545	-	-
X4	0.435	-	0.547	-	-	0.753	0.316	-0.348	-
X5	0.426	-	0.393	-	-	-	0.793	-	-
X6	0.431	-	0.375	0.753	-	-	-	-0.428	-
X7	0.390	-	0.545	0.316	0.793	-	-	-	-
X8	-	-	-	-0.348	-	-0.428	-	-	-0.332
X9	-	-	-	-	-	-	-	-0.332	-

Note: table 1 presents a description of psychophysiological parameters (X1, X2, X3, X4, X5, X6, X7, X8, X9).

During the correlation analysis of the values of functional mobility of nervous processes and the amount of short-term memory, a strong positive correlation was found between the average reaction time of the right hand to stimuli (X5) and the average reaction time of the right hand after a circle (X7),  $r = 0.793$ ,  $p < 0.05$ . In addition, there was a strong positive correlation between the mean reaction time of the left hand to the stimulus (X4) and the average reaction time of the left hand after the circle (X6),  $r = 0.753$ ,  $p < 0.05$ .

When comparing the task execution time (X8) and the average reaction time of the left hand after the circle (X6), a negative correlation of medium strength was found ( $r = -0.428$ ,  $p < 0.05$ ). Furthermore, there was a weak negative correlation between the task execution time (X8) and the average reaction time of the left hand to the stimulus (X4),  $r = -0.348$ ,  $p < 0.05$ ; between the task execution time (X8) and the number of correct answers (X9),  $r = -0.332$ ,  $p < 0.05$ .

There was also found a correlation between the mean strength between the total number of errors (X1) and the minimum exposure time of the figure (X3),  $r = 0.496$ ,  $p < 0.05$ ; the total number of errors (X1), and the average reaction time of the left hand to the stimulus (X4),  $r = 0.435$ ,  $p < 0.05$ ; the total number of errors (X1) and the average reaction time of the right hand to stimuli (X5),  $r = 0.426$ ,  $p < 0.05$ ; the total number of errors (X1) and the average

reaction time of the left hand after the circle (X6),  $r = 0.431$ ,  $p < 0.05$ ; the minimum exposure time of the figure (X3) and the average reaction time of the left hand to the stimulus (X4),  $r = 0.547$ ,  $p < 0.05$ ; the minimum exposure time of the figure (X3) and the average reaction time of the right hand after the circle (X7),  $r = 0.545$ ,  $p < 0.05$ .

Analyzing the scientific literature, the authors concluded that disorder of the adaptive capacity of medical students begins at the beginning of training in HMI. It is due to intense mental activity, which eventually leads to depletion of the functional reserve of the body; low physical activity, constant micro-stresses, and macro-stresses, which cause severe disorders of both psychological and physical condition of human [3, 10]. Additional results of this study are the possibility of identifying a contingent of students who need periodic monitoring according to their functional status. There is a problem of the broader monitoring of health of medical students who have low results of quality and success in the educational process.

## CONCLUSIONS

1. In the course of the conducted research, the peculiarities of psychophysiological functions and the state of adaptive capabilities of the organism of medical students who are in conditions of micro-stress are determined. The obtained results testify to

the need to create individualized programs of preventive rehabilitation to reduce the body's reactions to micro-stresses and macro-stresses.

2. During the screening study, it was found that the faster the stimulus appears in conditions of time deficit, the lower the mobility of nervous processes shows the student, which is directly reflected in the

increase in the minimum exposure time (presentation) of the figure on the screen from 0.2 s (average) to  $0.27 \pm 0.007$  s. The mobility of nervous processes, in turn, is directly related to the adaptive capacity of the body.

Conflict of interests. The authors declare no conflict of interest.

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Стаття надійшла до редакції  
15.06.2021

