DOI 10.31392/NPU-nc.series15.2021.7(138).02
УДК 378.015.31

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STUDY OF PHYSIOLOGICAL AND PSYCHOLOGICAL INDICES OF UNIVERSITY STUDENTS

Purpose: assessment of functional indices of external respiration, the level of physical health and the general state of the autonomic nervous system of university students. Material: There were examined 192 students aged 18-21 years. All examined were divided into groups depending on gender, age and future profession. Anthropometric indices and parameters of the circulatory system were studied. Spirometer was used to measure the respiratory system functional indices. An express assessment of physical health level was made. Index of functional changes, the Kerdo vegetation index, the orthostatic index, and the Skibinskaya index were calculated. Stange test, Hench test and Martin-Kushelevsky's test were conducted. Results: The results are showed that the minute blood volume was higher in all examined young girls, whereas in young boys designers and pharmacists aged 17-18 years and 19-21 years, respectively it was lower than due values. Similar data were obtained after the Ruffier test (dynamic load tolerance). The index of vital lung capacity (VC) was significantly lower than due values in all students. The parameters of maximal pulmonary ventilation indicated good functional ability of the external respiration apparatus in young boys. This index was higher than that of young girls and exceeded due values. The adaptation capacities of the student body (index of functional changes (IFI)) were at a satisfactory level. The indices of physical health level of all students had average values. ***Conclusions****: Studies have revealed the most characteristic shifts of cardiorespiratory system indices, which are most expressed in students. Cardiorespiratory system shifts are caused by the influence of a complex of factors: increased academic load; requirements for the professionalization process continuity; performance of various structured activity types, manipulations, a high degree of responsibility. Increased pulse rate and minute blood volume; prevalence of the hyperkinetic type of blood circulation self-regulation at rest; irrational cardiovascular system response to dosed physical load; positive value of the Kerdo vegetation index; decreased ventilatory lung capacity and reserve capacity of cardiorespiratory system; tension of adaptation mechanisms; average level of physical health were recorded in students.*

Keywords: *students, physiological indices, physical health level, profession.*

Муса Джаміль, Коробейнікова Л.Г., Максимович Н.Ю. Дослідження фізіологічних і психологічних показників студентів університету*. Мета дослідження − оцінювання функціональних показників зовнішнього дихання, рівня фізичного здоров'я і загального стану вегетативної нервової системи студентів університету. Учасники: Обстежено 192 студенти у віці 18-21 рік. Усі обстежені були розділені на групи залежно від статі, віку і майбутньої професії. Організація дослідження. Вивчалися антропометричні показники і параметри системи кровообігу. Вимір функціональних показників дихальної системи здійснювали за допомогою спірометра. Проводилося експрес-оцінювання рівня фізичного здоров'я. Розраховували індекс функціональних змін, вегетативний індекс Кердо, ортостатичний індекс, індекс Скибинської. Проводили проби Штанге, Генчі, Мартине-Кушелевського. Висновки: Дослідження виявили найбільш характерні зрушення показників кардіореспіраторної системи, які найбільш виражені у студентів. Зрушення кардіореспіраторної системи викликані впливом комплексу чинників: підвищеним академічним навантаженням; вимогами безперервності процесу професіоналізації; виконання різних структурованих видів діяльності, маніпуляцій, високою мірою відповідальності. У студентів зареєстровано: збільшення пульсу і хвилинного об'єму крові; переважання гіперкінетичного типу саморегуляції кровообігу у спокої; нераціональну реакцію серцево-судинної системи на дозоване фізичне навантаження; позитивну величину вегетативного індексу Кердо; зниження вентиляційних здібностей легких і резервних можливостей кардіореспіраторної системи; напруга механізмів адаптації; середній рівень фізичного здоров'я.*

Ключові слова: *студенти, фізіологічні показники, рівень фізичного здоров'я, професія.*

Introduction. In recent years, a critical level of Ukrainian population health status has been noted. This is especially true for students. It is during this period that the future professional and carrier of the nation intellectual potential is formed. The health of a young specialist is assuming high public importance.

The current state of the higher education organization is characterized by a constant increase of educational loads in the face of pronounced psychoemotional tension and low motor activity level [1]. This creates the prerequisites for chronic fatigue development. Chronic fatigue influences the reduction in performance, physical fitness and the deterioration of the health of students [2]. The main reason for the deterioration of students' health is chronic psychoemotional stress associated with high mental loads, perception and processing of various information in a compressed time frame and intensive use of computer technology in the educational process [3, 4].

Physical development is one of the main indices characterizing the population health status. The respiratory system is considered an indicator of psychoemotional tension state. It is one of the body key systems. The respiratory system determines the

body adaptation abilities to a wide variety of environmental factors [5, 6].

The autonomic nervous system plays an important role in the body functioning [7]. It ensures the maintenance of homeostasis and affects various forms of mental and physical responses.

To program physical education classes with account for the profession peculiarities, it is necessary to obtain a number of important indices. They should disclose the health level, adaptation capacities, physical development, functional potential and several others. Similar studies have been conducted [8, 9]. However, studies of physiological parameters of students of creative professions (designers) and those of exact sciences (pharmacists), as well as their comparison, have not been carried out yet.

Objective of study − assessment of functional indices of external respiration, the level of physical health and the general state of the autonomic nervous system of university students.

Material and methods. Participants. 192 students aged 18-21 years were examined. All examined were divided into groups depending on gender, age and future profession**.**

Organization of study. Anthropometric indices and circulatory system parameters were studied (standard complex of methods was used). “Spiro C-100” spirometer was used for measuring respiratory system functional indices. An express assessment of physical health level (PHL) was made. Index of functional changes (IFC), the Kerdo vegetation index (KVI), the orthostatic index (OI) and the Skibinskaya index (SI) were calculated. Stange test, Hench test and Martin-Kushelevsky’s test (20 squats in 30 s) were conducted.

Statistical analysis. During experimental data processing, we determined the average values of indices and their errors (M ± m), the degree of difference of averages and the significance of differences (t, p).

The study was conducted in compliance with the ethical principles of the European Convention and the Helsinki Declaration (ethics principles regarding human experimentation). It was confirmed by the Bioethics Commission of the University. Examined provided written approvals for analysis and subsequent disclosure.

Results. The calculation of the Quetelet index indicated normal bodybuild in a greater number of subjects (20.55±0.78 - 24.15±1.55 kg m^{-1} and 20.94±1.55 - 25.62±1.59 kg m^{-1} in students designers and students pharmacists, respectively).

Table 1

Pulse, Kerdo vegetation index (KVI) and orthostatic index (OI) in examined students (M±m)

Indices	n	Pulse, beats·min^{-1}		KVI, %	OI, c.u.
		actual	due		
designers					
Young girls aged 18-19 years	28	72.60±1.76	67.20±1.60	8.50±0.58	1.26±0.24
Young girls aged 20-21 years	37	69.10±2.26	66.42±2.28	3.02±0.79	1.17±0.18
Young boys aged 18-19 years	14	70.20±1.94	65.80±1.52	5.73±0.53	1.22±0.20
Young boys aged 20-21 years	12	78.34±2.38	68.18±1.52	8.12±1.27	1.31±0.17
pharmacists					
Young girls aged 18-19 years	28	84.00±1.74	67.21±1.29	16.01±1.39	1.68±0.21
Young girls aged 20-21 years	37	73.59±1.96	67.68±1.23	12.48±0.87	1.53±0.22
Young boys aged 18-19 years	14	90.12±2.87	68.88±1.34	18.21±2.39	1.63±0.19
Young boys aged 20-21 years	12	78.34±2.32	66.24±1.47	10.29±0.32	1.52±0.13

The actual pulse was higher than expected in a larger number of subjects (Table 1). Sympathetic regulation (judging by the magnitude of the Kerdo vegetation index (KVI)) was noted in pharmacist students. Among the designers there were students with parasympathetic regulation.

Minute blood volume was higher in all examined young girls, whereas in young boys designers and pharmacists aged 17-18 years and 19-21 years, respectively it was lower than due values.

Table 2

Indices of external respiration function in examined students (M±m)

Indices	n	VC, l		% of VC of due VC	Forced VC, l	% of forced VC of VC
		actual	due			
designers						
Young girls aged 18-19 years	28	3.33±0.10	3.92±0.15	84.94±2.46	2.96±0.13	89.18±2.71
Young girls aged 20-21 years	37	3.34±0.11	3.93±0.11	85.04±2.98	2.91±0.11	87.23±2.96
Young boys aged 18-19 years	14	4.73±0.21	5.76±0.22	82.13±3.12	4.19±0.10	88.85±2.31
Young boys aged 20-21 years	12	4.24±0.22	5.40±0.16	78.52±2.88	4.05±0.15	95.52±3.56

pharmacists						
Young girls aged 18-19 years	28	2.87±0.19	4.01±0.20	71.57±2.36	2.54±0.15	87.90±2.42
Young girls aged 20-21 years	37	2.95±0.25	3.97±0.15	74.31±2.41	2.69±0.19	88.17±3.12
Young boys aged 18-19 years	14	4.26±0.33	5.63±0.29	75.49±2.52	3.16±0.28	74.18±2.98
Young boys aged 20-21 years	12	3.89±0.26	5.48±0.21	70.98±2.12	3.42±0.34	87.92±2.31

Response quality index (RQI) was calculated to evaluate the Martin-Kushelevsky's test. It demonstrated an irrational response in a larger number of young girls pharmacists (1.52±0.27 - 1.59±0.23). A satisfactory response was noted among young boys pharmacists (0.42±0.16 - 0.47±0.18) and young girls designers (0.42±0.08 - 0.46±0.14). In young boys designers, the values of this index corresponded to a good response (0.51±0.15 - 0.52±0.11). Similar data were obtained after the Ruffier test (dynamic load tolerance). The index of vital lung capacity (VC) was significantly lower than due values in all students (Table 2). One of the parameters of external respiration for removal of carbon dioxide and blood oxygen saturation is the potential of external respiration (PER). The potential of external respiration in all students was satisfactory (49.50±2.10 - 58.49±2.79). The parameters of maximal pulmonary ventilation indicated good functional ability of the external respiration apparatus in young boys. This index was higher than that of young girls and exceeded due values (Table 3).

Table 3

Values of maximal pulmonary ventilation in examined students (M±m)

Indices	n	Maximal pulmonary ventilation (MPV), l		% of MPVof due MPV
		actual	due	
designers				
Young girls aged 18-19 years	28	93.31±4.94	101.43±4.10	91.69±3.44
Young girls aged 20-21 years	37	96.46±3.23	109.88±4.10	87.48±2.67
Young boys aged 18-19 years	14	137.36±2.88	124.65±4.95	110.33±4.16
Young boys aged 20-21 years	12	146.40±3.70	135.01±3.12	108.65±4.78
pharmacists				
Young girls aged 18-19 years	28	92.47±3.87	104.29±3.40	88.67±3.41
Young girls aged 20-21 years	37	94.12±2.97	103.26±3.54	91.15±2.45
Young boys aged 18-19 years	14	133.41±5.85	132.54±6.13	104.19±3.37
Young boys aged 20-21 years	12	140.60±7.75	136.52±7.15	106.61±4.21

Numerous researchers suggest using *Stange test and Hench test* to determine cardiorespiratory system reserve capacities. In our studies minimum timed inspiratory and expiratory capacity was noted in pharmacists (Table 4).

Table 4

Results of Stange test, Hench test and Skibinskaya index in examined students (M±m)

Indices	n	Stange test, sec.	Hench test, sec.	Skibinskaya index, c.u.
designers				
Young girls aged 18-19	28	39.35±3.59	28.20±3.21	31.02±2.18
Young girls aged 20-21	37	37.75±2.35	29.75±2.74	29.17±1.11
Young boys aged 18-19	14	41.25±4.57	31.43±4.35	32.51±1.01
Young boys aged 20-21	12	43.75±2.41	34.50±5.45	33.68±1.16
pharmacists				
Young girls aged 18-19	28	28.53±2.47	25.61±2.84	18.11±2.13
Young girls aged 20-21	37	29.25±2.38	26.34±2.63	19.48±2.19
Young boys aged 18-19	14	30.76±2.59	27.75±2.19	21.90±1.17
Young boys aged 20-21	12	35.50±2.42	29.75±2.45	20.01±2,18

The adaptation capacities of the student body (*index of functional changes* (IFI)) were at a satisfactory level. The indices of physical health level of all students had average values (Table 5).

Table 5

Values of the index of functional changes (IFC) and physical health level (PHL) in examined students (M±m)

Indices	n	IFC, c.u.	PHL, c.u.
designers			
Young girls aged 18-19	28	2.70±0.14	0.56±0.03
Young girls aged 20-21	37	2.82±0.13	0.61±0.04
Young boys aged 18-19	14	2.69±0.10	0.69±0.05
Young boys aged 20-21	12	2.61±0.04	0.75±0.06
pharmacists			
Young girls aged 18-19	28	3.29±0.13	0.53±0.04
Young girls aged 20-21	37	3.22±0.19	0.57±0.05
Young boys aged 18-19	14	3.11±0.11	0.62±0.06
Young boys aged 20-21	12	3.13±0.08	0.66±0.07

Discussion. Studying at universities represents a complex and strenuous intellectual work. It is performed under conditions of time deficit in the face of a sharp decrease in motor activity. The actual academic load of the examined pharmacist students per week is greater than that of the designers [10].

Physical development directly affects the functioning of all body organs and systems. Ideal body mass depends on the gender and height of the person. Mass is associated with various factors of life. In case of overweight, it is harder for organs and systems to provide normal functioning of the body. In recent decades, there has been an increase in the frequency of obesity among adolescents and young people [11]. The values of the Quetelet index indicated a normal bodybuild of a larger number of examined students. However, some researchers have obtained opposite results [12, 13].

Cardiovascular system is the most important criterion of human body functional state. Its activity often restricts the development of adaptation responses to various environmental conditions. One of the labile functional indices of this system is the pulse, which was higher in pharmacists. However, the actual pulse was higher than due in a larger number of subjects. This may be associated with psychoemotional tension and is accompanied by a weakening of supporting influences on the part of the heart vagus nerves, with an increase of the sympathetic system impact [13, 14]. Sympathetic regulation (according to KVI value) prevailed among medical students. Among the designers there were students with parasympathetic regulation. The pulse reflects the final result of numerous regulatory influences on the circulatory system [15, 16] and characterizes the peculiarities of the already established homeostatic mechanism. Any disturbing factor can cause an oscillatory shift in the internal milieu. This will induce a phase change in sympathetic and parasympathetic activity [17, 18].

For a more complete assessment of cardiovascular system functional state, one should take into account the indices of stroke and minute blood volumes. The minute blood volume in all the examined girls was higher than due values, whereas in young boys designers aged 17-18 years old and young boys pharmacists aged 19-21 years old it was lower than due values [19]. The most favorable type of blood circulation is eukinetic, which is characterized by high adaptation capacities. It was more common among designers (44%). This is confirmed by the values of the orthostatic index, which was calculated after the orthostatic test [20]. Hyperkinetic type of blood circulation prevailed among pharmacists (49%). Hypokinetic type of blood circulation self-regulation was more common for pharmacists. This indicates a restricted range of circulatory system compensatory capacities [21, 22].

The study of functions at rest is important for determining the initial state of executive and regulatory mechanisms of an organ, system or body as a whole. In order to reveal the ability of an organ or system to exist under physiological, homeostatic, stressful and extreme conditions, stress studies are needed [23, 24].

The response quality index of the Martin-Kushelevsky's test (RQI) revealed an irrational response in most girls. This is associated with fatigue, overstrain, low physical activity. A satisfactory response was observed among young boys pharmacists and young girls designers. In young boys designers, the values of this index corresponded to a good response.

Similar data were obtained after the Ruffier test (dynamic load tolerance).

The vital lung capacity (VC) depends on the body length, the degree of the chest development, respiratory muscles, physical preparation [25]. High levels of VC were found in boys as compared to girls. However, the respiratory system state of students is low. In all examined students, the studied index was lower than due values. This indicated a decrease in ventilatory lung capacity. Similar findings were obtained by Koviasina, Pogrebniak, Kudelko, Nagovitsina, Zhu et all.

One of the parameters of external respiration for removal of carbon dioxide and blood oxygen saturation is the potential of external respiration (PER). The potential of external respiration in all students was satisfactory. This is indicative of a prolonged absence of physical loads, as a result of which the muscles involved in respiratory movements lose their performance efficiency. This leads to a decrease in gas exchange efficiency and a lack of oxygen in the body [26, 27]. Lower values of this index were noted in pharmacists. To evaluate bronchial patency, which in healthy individuals normally constitutes at least 70% of VC per second, a forced VC test was used. This was just revealed in examined students. Higher values of the studied index were identified in designers. It appears that frequent walks in the fresh air, which are associated with the performance of professional tasks, have a beneficial effect on the VC [28].

One of the most important indices of external respiration function, which determines both the speed and volume characteristics of ventilation, is the maximal pulmonary ventilation (MPV). The diagnostic value of MPV is that it reflects the reserves of respiratory function. A decrease in these reserves is a sign of a pathological condition. The decrease in MPV occurs due to reduced volume of ventilated lung tissue and decreased bronchial patency, hypodynamia [29]. In all examined young boys, this parameter indicated good functional ability of the external respiration apparatus. MPV was higher in young boys as compared to young girls and exceeded due values.

Many researchers suggest to use the Stange test and Hench test [30, 31] in order to determine the cardiorespiratory system reserve capacities. In our studies, the minimum timed inspiratory and expiratory capacity was observed in pharmacists. This may indicate a decrease in the reserve capacity of cardiorespiratory system, insufficient oxygen supply and a minimum level of training level [32]. This statement is confirmed by the values of the Skibinskaya index.

We used the index of functional changes (IFC) as a criterion of adaptation capacities. IFC values indicated the predominance of satisfactory adaptation in designers and the tension of adaptation mechanisms in pharmacists.

Physical health indices (PHL) were average for all students. Above the average PHL indices were noted in designers. This fact is confirmed by VC indices.

Conclusions. 1. Studies have revealed the most characteristic shifts in the indices of the cardiorespiratory system, which are most expressed in students. Shifts in the cardiorespiratory system are caused by a complex of factors:

- increased academic load;
- requirements for professionalization process continuity;
- performance of various structured types of activity, manipulations,
- high degree of responsibility.

2. The following was observed in students:
• increase of pulse and minute blood volume;
• prevalence of hyperkinetic type of circulation self-regulation at rest;
• irrational cardiovascular system response to dosed physical load;
• positive value of the Kerdo vegetation index;
• decrease of ventilatory lung capacity and reserve capacities of the cardiorespiratory system;
• tension of adaptation mechanisms;
• average level of physical health.

Conflict of interest. The authors declare that there is no conflict of interests.

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DOI 10.31392/NPU-nc.series15.2021.7(138).03
УДК 378.015.31

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THE STUDY OF THE DYNAMIC CHARACTERISTICS OF HAND MOVEMENTS OF FEMALE BOXERS WITH DIFFERENT TYPES OF FUNCTIONAL ASYMMETRY

Purpose: determining peculiarities of speed characteristics of hand movements of female boxers with different functional asymmetry types during dynamic work performance. Material: 50 highly skilled female boxers (masters of sports of international class, masters of sports). The study of female boxer psychomotor functions was designed according to a certain scheme. The motor component of motor response was examined by means of tapping test. The time of a simple and two complex visual-motor responses was determined. The study was completed by determining the identification time for visual stimuli of various degrees of complexity without a motor response. It was assumed that this will allow to consider the visual-gnostic component in a "pure" form. Such a design of the study permitted to evaluate the contribution of each component of psychomotor response to the response speed of female boxers with different types of functional hemispheric asymmetry (FHA) profile. Results: For the first time, the psychophysiological indices of female boxers were obtained. Female boxers were conditionally divided into right-handers, left-handers and ambidexters. The differences of these groups of female athletes in psychophysiological indices were established. Conclusions: In convenient mode, ambidexters perform work at a high rate than right-handers. At that, their right hand is faster than the left. The total number of movements performed by left-handers is greater than that of right-handers and ambidexters (it concerns both hands). The speed characteristics of female boxers with different types of functional asymmetry in accelerated mode are the same. The pace stability of right-handers and left-handers is high, but less than that of ambidexters. Ambidexters who use the right-handed stance are at advantage than right-handers with right-handed stance. Left-handed female athletes perform movements with greater speed than right-handed ones. For right-handed and left-handed female athletes it is more difficult to maintain the optimal pace of the right than the left hand, whereas ambidexters have problems with maintaining the optimal pace of the left hand. Left-handed female athletes are faster than right-handed ones.

Keywords*: boxing, psychophysiology, female boxers, functional asymmetry.*

Штанагей Д.В., Коробейніков Г.В., Колумбет О.М., Дудорова Л.Ю. Дослідження динамічних характеристик рухів рук жінок-боксерів з різними типами функціональної асиметрії. *Мета: визначення особливостей швидкісних характеристик рухів рук жінок-боксерів з різними типами функціональної асиметрії при виконанні динамічної роботи. Учасники: Висококваліфіковані жінки-боксери (майстри спорту міжнародного класу, майстри спорту) у кількості 50 осіб. Дослідження психомоторних функцій жінок-боксерів було побудоване за певною схемою. За допомогою теппінг-тесту досліджувався моторний компонент рухової реакції. Визначався час простої та двох складних зорово-моторних реакцій. Дослідження завершувалося визначенням часу упізнання зорових стимулів різної міри*