

THE RESULTS OF APPLYING THE HEALTH DIAGNOSIS PROGRAM IN MEDICAL UNIVERSITY STUDENTS

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The introduction of a system for monitoring the body's functional state and nutritional characteristics into the medical university educational process seems to be a relevant solution to the problem of maintaining the health of student youth. The study aimed to test the use of the Valeoscan program for monitoring the health and diet features in the 1st-year, 4th-year, and 6th-year students of the Medical Institute of the Tula State University ($n = 3676$). A significant ($p < 0.05$) increase in the time it took to complete psychophysiological tests was reported in the first-years, who studied in 2016–2023: the time to complete the correction test increased from 200.59 ± 4.21 s to 231.83 ± 5.71 s in females; from 202.40 ± 6.02 s to 229.00 ± 7.34 s in males. In the dynamics of the years of study (from the 1st to 6th year), a significant ($p < 0.05$) increase in body mass index (BMI) was revealed: from 20.81 ± 0.30 kg/m² to 22.45 ± 0.41 kg/m² in females; from 22.71 ± 0.65 kg/m² to 24.24 ± 0.54 kg/m² in males, respectively. Furthermore, an increase in the proportion of students with overweight in the BMI range ≥ 29 kg/m² was revealed. In the 6th year, the proportion decreased of the students with excess fat in their diet (from 13.72 ± 0.09 to $8.32 \pm 0.04\%$ in females, $p < 0.05$; from 46.94 ± 0.28 to $6.72 \pm 0.05\%$ in males, $p = 0.00039$) and water deficit (from 72.41 ± 0.12 to $66.73 \pm 0.21\%$ in females, $p < 0.05$; from 71.85 ± 0.13 to $66.72 \pm 0.21\%$ in males, $p < 0.05$); the proportion of students, who followed healthy eating principles, increased (from 73.26 ± 0.64 to $81.39 \pm 0.73\%$ in females, $p < 0.05$; from 62.86 ± 0.52 to $65.71 \pm 0.54\%$ in males, $p < 0.05$). The Valeoscan program introduction into the educational process has made it possible to monitor the functional health indicators and nutritional characteristics of medical university students, which can be used to evaluate the effectiveness of the health-preserving technology being introduced.

Keywords: students, health preservation, software package, psychological health, diet

Author contribution: Markelova SV — academic advising, developing the research concept, manuscript writing; Prokhorov PYu — material collection, literature review, manuscript writing.

Compliance with ethical standards: the study complied with the principles of biomedical ethics and did not pose a risk to the participants.

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РЕЗУЛЬТАТЫ ПРИМЕНЕНИЯ ПРОГРАММЫ ДИАГНОСТИКИ ЗДОРОВЬЯ ОБУЧАЮЩИХСЯ МЕДИЦИНСКОГО ВУЗА

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Внедрение в образовательный процесс медицинского вуза системы мониторинга показателей функционального состояния организма и особенностей питания представляется актуальным решением проблемы сохранения здоровья обучающейся молодежи. Целью работы было апробировать применение программы «Валеоскан» для мониторинга здоровья и особенностей питания студентов 1-го, 4-го и 6-го курсов Медицинского института ТулГУ ($n = 3676$). У первокурсников, обучающихся в 2016–2023 гг., отмечено значимое ($p < 0,05$) увеличение времени выполнения психофизиологических тестов: время корректурной пробы выросло с $200,59 \pm 4,21$ с до $231,83 \pm 5,71$ с у девушек; с $202,40 \pm 6,02$ с до $229,00 \pm 7,34$ с у юношей. В динамике лет обучения (с 1-го по 6-й курс) выявлено значимое ($p < 0,05$) увеличение индекса массы тела (ИМТ): у девушек с $20,81 \pm 0,30$ кг/м² до $22,45 \pm 0,41$ кг/м²; у юношей с $22,71 \pm 0,65$ кг/м² до $24,24 \pm 0,54$ кг/м² соответственно. Помимо этого выявлено увеличение доли студентов с избыточной массой тела в диапазоне ИМТ ≥ 29 кг/м². На 6-м курсе сократилась доля студентов с избытком жиров в рационе питания (у девушек с $13,72 \pm 0,09$ до $8,32 \pm 0,04\%$, $p < 0,05$; у юношей с $46,94 \pm 0,28$ до $6,72 \pm 0,05\%$, $p = 0,00039$) и дефицитом жидкости (у девушек с $72,41 \pm 0,12$ до $66,73 \pm 0,21\%$, $p < 0,05$; у юношей с $71,85 \pm 0,13$ до $66,72 \pm 0,21\%$, $p < 0,05$); увеличилась доля студентов, соблюдавших принципы здорового питания (у девушек с $73,26 \pm 0,64$ до $81,39 \pm 0,73\%$, $p < 0,05$; у юношей с $62,86 \pm 0,52$ до $65,71 \pm 0,54\%$, $p < 0,05$). Внедрение программы «Валеоскан» в учебный процесс позволило обеспечить мониторинг показателей функционального состояния здоровья и особенностей питания обучающихся медицинского вуза, что может быть использовано для оценки эффективности внедряемых здоровьесберегающих технологий.

Ключевые слова: студенты, здоровьесбережение, программный комплекс, психологическое здоровье, рацион питания

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Соблюдение этических стандартов: исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников.

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The steady deterioration of health indicators among student youth is a pressing issue of modern higher education. Numerous studies point to the complex nature of the causes of this phenomenon. The leading negative factors include high academic workload, the spread of digital educational technologies, including distance learning, a sedentary lifestyle, and an unbalanced diet among students [1, 2].

The population health preservation is one of the main tasks faced by the Government of the Russian Federation (RF). In the context of the state's national policy, the student youth health preservation becomes one of the primary tasks of preventive medicine [3].

The hardware and software systems for studying health and lifestyle indicators, environmental factors are widely used in various fields. The list of indicators monitored and the frequency of their testing are determined in accordance with the objectives of the study. Software packages may contain specific diagnostic algorithms that can be applied to specific population groups or professional groups.

Such software packages, as Helzy, SberHealth, SberMed AI, Symptom Checker, Medical Diagnostics, LetsGetChecked, etc., are examples of the use of free online services for the diagnosis of disorders [4].

Automated systems are used to diagnose the mental state of workers in a number of professions associated with the risk of emergency situations, high psycho-emotional stress, and irregular working hours [5].

The Health Test program is used for preclinical diagnosis of psychophysiological adaptation and health status under industrial conditions [6].

By using the Sveto-Test device when studying the functional state of the body, the critical frequency of light flickering fusion is assessed in various modes of using electronic devices [7].

The NS-PsychoTest hardware and software system is used to evaluate the psychophysiological properties and body's functions when using an interactive whiteboard in preschool education institutions [8].

The use of KPFK-99 "Psychomat" for scientific research purposes allowed scientists to evaluate a simple sensorimotor response and the critical frequency of light flickering when studying the influence of the quality of visual materials presented by electronic learning tools on the development of functional disorders by the body [9].

The use of the domestically produced Varicard 2.51 software package was tested in a higher education institution in 2022. Researchers studied the functional health status based on heart rate indicators. Data on the cardiac rhythm nervous regulation features were obtained; an assessment of the body's adaptive capability was carried out; the body's functional state was studied depending on the educational process organization form [10].

Monitoring the health and lifestyle indicators of students in higher education institutions allows one to obtain the data necessary for identifying the causes of the emergence and spread of non-communicable diseases among student youth, and developing a system of preventive measures for both group and individual purposes.

The study aimed to test the use of the Valeoscan hardware and software system for monitoring the functional health status and diet features in students within the framework of the medical university curriculum.

METHODS

A total of 3676 1st-year, 4th-year, and 6th-year students of the Tula State University aged 17–24 years (2459 females and 1217 males) were enrolled. Follow-up period: years 2016–2023.

To implement a comprehensive personalized approach to monitoring the students' body functional state and nutritional characteristics, the Valeoscan software package was introduced into the educational process at the Tula State University Medical Institute (Certificate of state registration of a computer program No. 2024689385 RF. "Valeoscan", developers Venevtseva YuL, Melnikov AKh, Prokhorov PYu, Putilin LV; Russia). The survey of students was carried out over eight years of follow-up (2016–2023), including the study of the indicators of the 2017 recruitment course over six years of study (in the 1st, 4th and 6th years). The testing frequency was determined by the need to study the degree of health-preserving skill development during mastering a medical specialty. The survey, conducted in the first year, allowed us to evaluate the knowledge and skills in health preservation formed by the time of entering the medical university, as well as to study the body's functional state characteristics in the new educational environment. The survey, conducted in the 4th year, allowed us to assess the dynamics of the body's functional indicators, the knowledge and skills in health preservation after mastering the program of the discipline "Hygiene" and other educational programs in the departments focused on theoretical training. The survey, conducted in the 6th year, allowed us to assess the dynamics of the indicators monitored, considering changes in academic load, preparation for the state final certification, internship.

The Valeoscan software package included 45 survey items and nine psychophysiological tests that allowed us to study the body's psycho-emotional state, cognitive functions, and mental performance of students. The color test by M. Luscher was used to assess the psycho-emotional state and the level of aggressiveness; the correction test was used to assess the mental performance; cognitive characteristics were studied using the methods "Sequence of Images", "Exclusion of Concepts". Computer testing was used to assess the prevalence of health complaints and vision loss, dietary patterns and eating habits. The examination protocol included information on systolic and diastolic blood pressure, heart rate, height and body weight, and the body mass index (BMI) was calculated. The questionnaire part of the program was developed by the research author with the help of specialists accredited in the specialties "Hygiene of Children and Adolescents", "Hygiene Education".

The study of nutritional characteristics was carried out taking into account the analysis of the daily diet, which was assessed in accordance with the approved regulatory and methodological documents [11].

Based on the examination results, the Valeoscan hardware and software system generated a list of individual preventive measures taking into account the identified deviations from the physiological norm in the state of the cardiovascular, nervous, digestive, musculoskeletal systems, the facts of having excess body weight, hypo/hypertension.

When compiling the recommendations, the criteria presented in the documents issue by the World Health Organization (WHO) were taken into account, regarding the diet adjustment (reducing the consumption of table salt, increasing the consumption of vegetables and fruits), optimizing psychological well-being, the use of hardening measures (taking a shower, bathing with regulation of the water temperature and duration of the procedure); recommendations were proposed for the use of music and aromatherapy elements [12].

Statistical processing of the data obtained was performed by standard methods using the MS Office Excel (Microsoft; USA), Statistica 12.0 (StatSoft; USA) software. The differences were considered significant at $p < 0.05$.

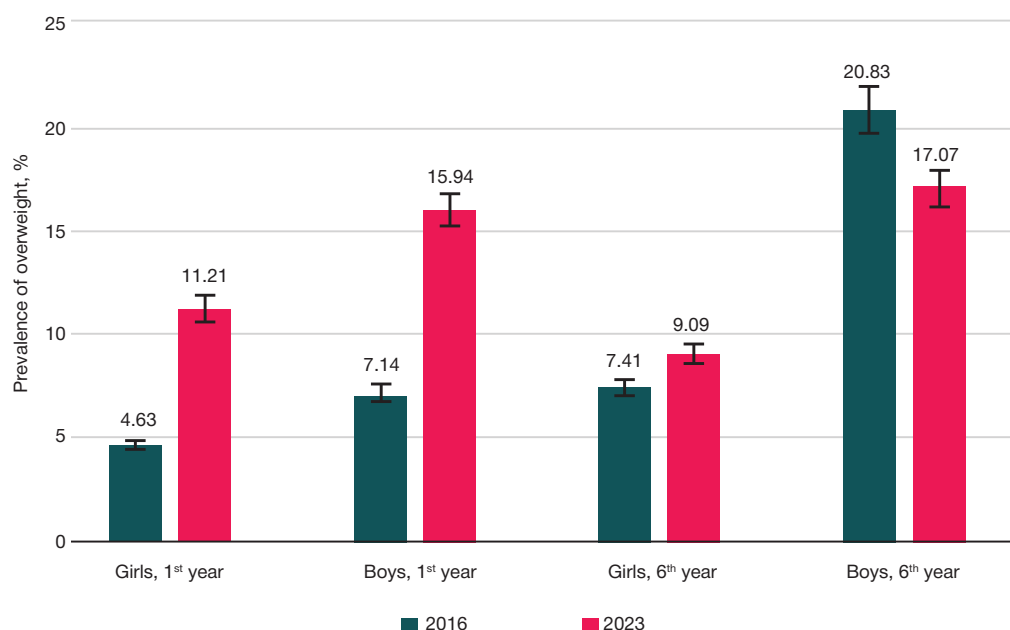


Fig. 1. Prevalence of overweight among 1st- and 6th-year medical university students (BMI range ≥ 29 kg/m²) in 2016 and 2023, %

RESULTS

Monitoring the indicators controlled yielded the following results. During the eight-year follow-up (2016–2023) a significant ($p < 0.05$) decrease in the proportion of the 1st- and 6th-year with normal body weight and an increase in the proportion of overweight students, including in the range of BMI ≥ 29 kg/m², was noted (Fig. 1).

During the eight-year follow-up (2016–2023) first-year students showed a significant ($p < 0.05$) increase in the time of psychophysiological test completion. The correction test completion time increased from 200.59 ± 4.21 s to 231.83 ± 5.71 in females, from 202.40 ± 6.02 s to 229.00 ± 7.34 in males. At the same time, the number of errors made in the correction test remained stable. In the “Sequence of Images” test, the number of images remembered increased significantly ($p < 0.05$) in students of both sexes; the test completion time also increased in females: from 46.08 ± 1.22 s (2016) to 49.72 ± 1.07 s (2023);

$p < 0.05$). In the “Exclusion of Concepts” test, girls also showed a significant ($p < 0.05$) increase in the number of correct answers against the background of an increase in the test completion time: from 122.60 ± 2.60 s to 130.93 ± 2.92 s ($p < 0.05$).

The eight-year follow-up (2016–2023) showed that among first-year students higher anxiety levels were observed in females compared to males, along with the increase in the levels of psycho-emotional stress in male first-year students to the levels reported for female first-year students (Fig. 2).

A study of students' diets over the years of study (from the 1st to 6th year) revealed a number of features.

Among first-year students, excess fat in the diet was significantly more often ($p < 0.05$) observed in males ($46.94 \pm 0.28\%$) compared to females ($13.72 \pm 0.09\%$). Water deficit was observed in more than 60% of students, excess salt was reported for $27.62 \pm 0.02\%$ of females and $18.83 \pm 0.73\%$ of males.

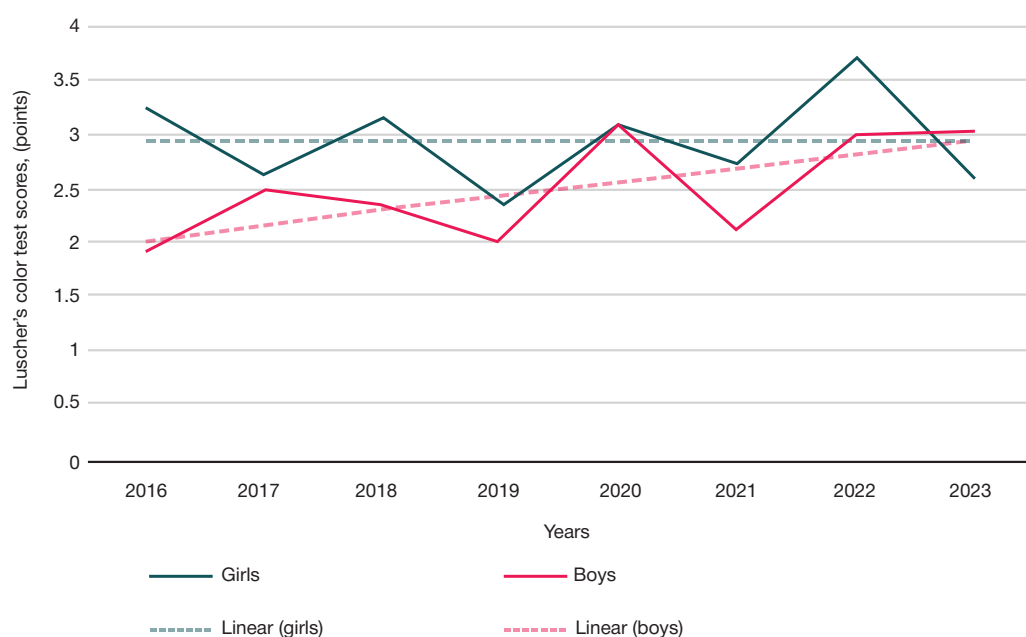


Fig. 2. Dynamic changes in anxiety levels of 1st-year students in 2016–2023, points

In the 6th year, compared to the 1st year, the proportion of students with water deficit significantly decreased (from 72.41 ± 0.12 to $66.73 \pm 0.21\%$ in females, $p < 0.05$; from 71.85 ± 0.13 to $66.72 \pm 0.21\%$ in males, $p < 0.05$); the number of students with excess fat in their diet has decreased (from 13.72 ± 0.09 to $8.32 \pm 0.04\%$ in females, $p < 0.05$; from 46.94 ± 0.28 to $6.72 \pm 0.05\%$ in males, $p = 0.00039$); the proportion of students who adhered to healthy eating principles increased (from 73.26 ± 0.64 to $81.39 \pm 0.73\%$ in females, $p < 0.05$; from 62.86 ± 0.52 to $65.71 \pm 0.54\%$ in males, $p < 0.05$).

The average BMI value in students of both sexes has increased significantly over the years their studies (from the 1st to 6th year): in females, $20.81 \pm 0.30 \text{ kg/m}^2$ in the 1st year, $22.45 \pm 0.41 \text{ kg/m}^2$ in the 6th year ($p < 0.05$); in males, $22.71 \pm 0.65 \text{ kg/m}^2$ in the 1st year, $24.24 \pm 0.54 \text{ kg/m}^2$ in the 6th year ($p < 0.05$).

DISCUSSION

Medical university students in various years were reported to be overweight, which is consistent with the literature data [13, 14]. An increase in the proportion of students with the BMI $\geq 29 \text{ kg/m}^2$ in the 1st and 6th years was reported in eight years of follow-up, which suggests the increase in the proportion of medical students with undeveloped health-preserving skills and may be accompanied by the body's functional state violation, deterioration in the quality of life. In 2023, excess body weight with the BMI массы $\geq 29 \text{ kg/m}^2$ was determined in every 10th girl (11.21%) in the 1st year and every 11th one (9.09%) in the 6th years, as well as in every 6th boy in the 1st (15.94%) and 6th (17.07%) years. An increase in the average BMI value was reported in students of both sexes over the years of study (from the 1st to 6th year), which results from insufficient development of rational nutrition skills among medical students, violation of healthy lifestyle principles. This suggests the need to expand the training program for medical university students on these topics.

High levels of anxiety, especially among female students in their 1st year of study, and psycho-emotional stress

can be the cause of poor academic performance and early termination of training. According to the literature, the reasons for increased psycho-emotional stress and anxiety may be high activity on social networks and non-compliance with the principles of digital hygiene [15], what can be considered as an area of prevention to be implemented at a medical university.

The reduction in the proportion of students of both sexes with a fluid deficiency and excess fat in their diet, registered in the 6th year, and the increase in the proportion of students who tried to follow healthy eating rules in the 6th year may be the result of mastering the training program, but the list and completeness of mastery of the issues covered are insufficient, as demonstrated by the above research results.

The introduction of monitoring the body's functional state indicators and nutritional characteristics into the curriculum will facilitate the development of individual prevention programs aimed, among other things, at reducing psycho-emotional discomfort and optimizing the diet [6, 16].

CONCLUSIONS

The monitoring system organized at the Tula State University provided dynamic control over the indicators of the body's functional state and the nutritional characteristics of students over eight years of follow-up (2016 to 2023), as well as over the years of study (from the 1st to 6th year), made it possible to develop individual prevention programs for students and evaluate their effectiveness throughout the period of study at the medical university. The introduction of automated software systems into the medical university educational process in various years of study contributes to the development of health-preserving skills in future doctors, maintaining their health, acquiring skills in self-diagnosis of health problems, developing preventive programs and evaluating their effectiveness, which ultimately forms a specialist competent in health-preserving issues. The knowledge acquired allow one to identify gaps in students' knowledge and skills related to health preservation issues and can serve as a basis for optimizing educational programs.

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