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THE ESTABLISHMENT AND EVOLUTION OF PREVENTIVE MEDICINE DISCIPLINES AT THE BURDENKO VORONEZH STATE MEDICAL UNIVERSITY

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Currently, the level of training of preventive medicine specialists has great practical importance: it shapes the sanitary and epidemiological wellbeing of not only individual regions, but the country as a whole. The talent foundry that raises such specialists in Voronezh Oblast, with proper qualifications, is the Preventive Medicine (PM) Faculty of the Burdenko Voronezh State Medical University (VSMU). This article reviews the key stages of establishment and evolution of preventive medicine there, analyzes the historiographical data and the accumulated experience as it is presented in the archives. The PM faculty of VSMU is one of the youngest in the university; it possesses high potential for development, and specialists with education in this field are sought-after in the modern society. Qualified researchers and professors, and a solid educational, methodological, and applied research base enable training of highly skilled hygienists and epidemiologists. Longitudinal and transverse collaborations within scientific communities allow sharing experiences and expansion of the boundaries of research-related interaction. The presented data emphasize the importance of training medical and preventive care professionals, given the variety of specialties and the need for specialists in this field whose qualifications meet the current requirements and the specifics of demand on the part of practical healthcare.

Keywords: hygiene and sanitary school, preventive medicine, hygiene, epidemiology, prevention, contribution of scientists, organization departments

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СТАНОВЛЕНИЕ ПОДГОТОВКИ СТУДЕНТОВ ПО НАПРАВЛЕНИЮ «МЕДИКО-ПРОФИЛАКТИЧЕСКОЕ ДЕЛО» В ВОРОНЕЖСКОМ МЕДИЦИНСКОМ УНИВЕРСИТЕТЕ ИМЕНИ Н. Н. БУРДЕНКО

И. Э. Есауленко, Н. Ю. Самодурова ✉

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Сейчас большое практическое значение имеет уровень подготовки специалистов медико-профилактического профиля — от него зависит санитарно-эпидемиологическое благополучие не только отдельного региона, но и страны в целом. Кузницей квалифицированных специалистов этого профиля на Воронежской земле является медико-профилактический факультет Воронежского государственного медицинского университета имени Н. Н. Бурденко. В статье рассмотрены основные этапы становления медико-профилактического направления в ВГМУ имени Н. Н. Бурденко. Представлен анализ историографических данных, накопленного исторической наукой опыта по архивным материалам. Медико-профилактический факультет ВГМУ имени Н. Н. Бурденко является одним из наиболее молодых факультетов университета с высоким потенциалом развития и востребованности специалистов данного профиля в современном обществе. Квалифицированные кадры научно-педагогического состава, сильная учебно-методическая и научно-практическая база позволяют осуществлять подготовку квалифицированных специалистов в области гигиены и эпидемиологии. Продольные и поперечные коллаборации в научных сообществах позволяют обмениваться опытом и расширять границы научного взаимодействия. Представленные данные подчеркивают значимость медико-профилактического направления подготовки специалистов при существующем разнообразии научных специальностей и потребность в специалистах этого профиля, отвечающих задачам нового времени и требованиям практического здравоохранения.

Ключевые слова: санитарно-гигиеническая школа, медико-профилактический, гигиена, эпидемиология, профилактика, вклад ученых, структурные подразделения

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Вклад авторов: И. Э. Есауленко — концепция и дизайн исследования; Н. Ю. Самодурова — анализ и интерпретация результатов, подготовка рукописи; все авторы ознакомились с результатами работы и одобрили окончательный вариант рукописи.

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In September 2024, Burdenko Voronezh State Medical University (VSMU) will celebrate the 20th anniversary of one of its divisions, the Preventive Medicine (PM) Faculty. Back in 2004, the faculty was established as a response to the demand and need for specialists in the field of general medical care and prevention specialists who could prevent the occurrence

and spread of both infectious and non-communicable diseases, and control compliance with the legislation related to consumer protection.

Twenty years ago, VSMU admitted students to the PM Faculty for the first time, and six years later, in 2010, issued diplomas to the 49 educated epidemiologists and hygienists.

History of establishment of sanitary and hygienic curricula at VSMU

The PM Faculty's roots go back far into history of the Voronezh's medical university and are closely entwined with its evolution. In June of 1930, under the Resolution of the Council of People's Commissars of the RSFSR, the medical faculty of Voronezh University was transformed into the Voronezh Medical Institute. It consisted of only two faculties, general medical care and sanitary-hygienic [1, 2].

In 1931, Tikhon Yakovlevich Tkachev, professor and doctor of medical sciences, initiated establishment of a sanitary faculty in VSMU; professor Tkachev became the dean of this faculty and remained in this capacity for over 10 years. Tikhon Yakovlevich has an outstanding record: being one of the founders of the national healthcare system, he was the head of the Department of Central Institute for Advanced Medical Training and the Department of Healthcare Organization and History of Medicine (1941–1963) at VSMU, worked as the sanitary inspector of the People's Commissariat for Healthcare of the USSR, and a member of the editorial board of the Hygiene and Sanitation journal (1939–1940), lead an active public life and participated in the Pirogov Congresses, was appointed deputy at the Supreme Soviet of the USSR, and wrote one of the country's first textbooks on social hygiene. Tikhon Tkachev published over 120 articles, monographs, and textbooks [3, 4], and supervised preparation and defense of more than 20 theses seeking the ranks of candidates and doctors of sciences. For his scientific and pedagogical achievements, professor Tkachev received two Orders of Lenin (highest awards in the USSR) and several medals.

The curriculum of the sanitary and hygienic faculty was different from that of the general medicine faculty from the very first course. The former included higher mathematics, fundamentals of technological chemistry, communal and food hygiene, occupational hygiene, and occupational diseases. The students were given knowledge enabling them to assess the impact of environmental and industrial factors on the development of occupational pathology.

The Sanitary and Hygienic faculty existed for eleven years, but with the beginning of the Great Patriotic War of 1941–1945, priorities changed. It was merged with the Medical and Pediatric faculty with the aim to provide accelerated training to surgeons, anesthesiologists, traumatologists, infectiologists — medical professionals highly sought-after during wartime. Talented scientists and teachers continued to work at the departments; their efforts not only laid the foundation of preventive medicine in the Voronezh region but also contributed to the sciences of hygiene and epidemiology.

At VSMU, the founders of the medical and preventive care discipline were distinguished scholars M.I. Shtutzer, P.P. Mufel, E.A. Shepilevsky, and V.A. Pokrovsky.

In 1921, microbiologist and epidemiologist M.I. Shtutzer established and chaired the Department of Hygiene and Microbiology at the Medical faculty of VSMU, and founded the Voronezh Bacteriological Institute. His research advanced microbiology. M.I. Shtutzer authored about 80 scientific papers; the most popular of them were "A new variety of para dysentery bacilli" and "About bacterial flora of the intestinal canal of cholera patients."

P.P. Mufel, who graduated from the Medical faculty of the Yuriev (Derpt) University in 1909, became an epidemiologist, a sanitarian (1918), a doctor of medicine (1924), a professor (1936), and an honored Scientist of the RSFSR (1947). In Voronezh, he simultaneously chaired two departments, the

Department of Epidemiology (1936–1943) and the Department of Infectious Diseases (1941–1942, since 1943), and was also the vice principal of the VSMU. The research efforts of P.P. Mufel were summarized in "The experience of studying the epidemiology of malaria according to the survey of the Voronezh province" (1927), "Guide to the epidemiology of malaria" (Voronezh, 1936), "Prevention of infectious diseases in rural areas" (1945).

E.A. Shepilevsky became the first head of the department of General and Experimental Hygiene of the Medical faculty of VSMU, and held the position from November 1918 through February 1920. He published over 30 studies covering various aspects of hygiene and epizootology.

V.A. Pokrovsky graduated from the Sanitary faculty of the VSMU in 1931; he was an honored worker of the occupational hygiene sector of the Institute of Social Health of the Central Black Earth Region (1931–1933), worked as an assistant at the Department of Hygiene of VSMU, fought in the Great Patriotic War as a military doctor. After the War, he chaired the Department of Hygiene of VSMU from 1948 to 1980, and after this tenure was a professor therewith. His research efforts investigated the problems of hygiene and toxicology of organic synthesis. In 1948, he founded a scientific school studying the hygienic issues of public healthcare, and was the director of this school. V.A. Pokrovsky authored over 300 scientific works, including the "Textbook of Hygiene" (1961, 1979) for medical students [5, 6].

These were the outstanding scientists who gave rise to the faculty, enduring all the difficulties of war and post-war years, all the hardships, understaffing, lack of educational materials, unavailability of lecture halls and practical classrooms, and remaining firmly convinced that they were doing something very important. Teaching doctors, these professors shared invaluable experience and knowledge in the fields of epidemiology, hygiene, and sanitation.

The Great Patriotic War set new essential tasks before the country's healthcare system: it had to provide qualified medical assistance to the wounded, sick soldiers and commanders of the Soviet Army, ensure sanitary and epidemiological well-being of the military and civilians, and protect their health [7–9].

In wartime, VSMU trained doctors at an accelerated pace both for the Soviet Army and for civilian hospitals, and worked extensively to guarantee a good sanitary and epidemiological status overall. By the beginning of the Great Patriotic War, there was a well-organized sanitary and anti-epidemic service staffed with qualified personnel in the Voronezh Oblast.

The War became a hard test for the entire Soviet healthcare system, and especially for its sanitary and epidemiological component. The sanitary units of the Voronezh Oblast, as well as those anywhere else in the country, passed this test with honor.

When the War broke out, the epidemiological situation in Voronezh Oblast became dire: many sanitary professionals were drafted into the army, and the path of mass migration of the country's population ran through this area. The roads, railway stations, and hythes of the region were crowded with people, which raised the risk of outbreaks [10].

Despite certain adverse conditions that favored the spread of various epidemic diseases, there were no severe epidemics during the War. To a large extent, this success stemmed from the preventive nature of Soviet healthcare. Sanitary and hygienic evacuation points were opened along the migration routes, and sanitary control posts worked at large railway junctions [11].

Thanks to the active participation of all medical workers, the constant assistance rendered by the local Party and Soviet authorities as well as the general public, the sanitary

and epidemiological service of Voronezh Oblast successfully discharged its responsibilities during the difficult war years, even considering lack of laboratories, disinfection equipment and transport, understaffing, inadequate supply of antibacterial drugs, disinfectants, and laboratory equipment. Throughout the entire Great Patriotic War, the sanitary and epidemiological status of the region's population remained good [12].

Medical and preventive care education, research efforts, and sanitary awareness of the population: current state

The Sanitary and Hygienic faculty was closed in 1941, and, over time, the need for medical and preventive care specialists became acute. In 2004, the city of Voronezh lacked 246 such specialists, while the mean age of those who worked in this field was 50–54 years; in other regions, the situation was similar. That need made it clear the respective faculty had to resume operation.

In 2004, the Preventive Medicine Faculty opened its doors at the VSMA named after N.N. Burdenko. From then on, the university has been teaching specialty 32.05.01, "Medical and preventive care." L.E. Mekhantieva, professor, Doctor of Medical Sciences, an Excellent Healthcare Worker, awardee of the Golden Fund of National Science exhibition, became the dean of the faculty. A.I. Potapov, General Director of the Erisman Federal Research Center, and A.S. Faustov, professor, head of the Department of General Hygiene, contributed immensely to its relaunch. Today, the MPC faculty of VSMU has trained several generations of epidemiologists and hygienists, specialists sought-after in different parts of our country. All professors teaching at the university participate in the education of highly qualified sanitary doctors, but those giving them most of their professional skills and abilities work at the Departments of the Preventive Medicine Faculty.

Currently, the head of the PM Faculty is N.Yu. Samodurova, Candidate of Medical Sciences, Associate Professor, accredited expert of the Federal Service for Supervision in Education and Science. She was in the first batch of graduates after revival of the faculty; today, under her leadership, it continues to expand and develop, and successfully carry out its primary tasks in the field of medical and preventive care education. There are 10 departments to the Faculty: the Department of Hygienic Disciplines, the Department of Dermatovenerology and Cosmetology, the Department of Infectious Diseases, the Department of Disaster Medicine and Life Safety, the Department of Medical Prevention, the Department of Microbiology, the Department of General Hygiene, the Department of Pedagogy and Humanities, the Department of Phthisiology, and the Department of Epidemiology.

One of the most important tasks set before the PM Faculty today is to popularize healthy lifestyle based on the meaningful attitude of students to their health, and to the health of the population in their further professional life. Every year, staff and students of the PM Faculty organize and take part in the conferences and events dedicated to the topics of health preservation.

In cooperation with public organizations and healthcare institutions, the faculty educates university students and schoolchildren about prevention of infectious and mass non-communicable diseases in the city of Voronezh and Voronezh Oblast [13–16].

The Department of Hygienic Disciplines of VSMU was opened in February of 2007. From the day of its foundation to the present, the department has been chaired by Yu.I. Stepkin, Honored Physician of the Russian Federation, professor, Doctor

of Medical Sciences, and chief medical officer at the Center for Hygiene and Epidemiology in Voronezh Oblast. The opening of this Department was a step towards creating the base to train highly qualified specialists in various fields of hygiene (food hygiene, hygiene among children and adolescents, labor, communal, and radiation hygiene), study the factors of the environment and habitat, working conditions, personal hygiene, and investigate the methods of control and prevention of non-communicable and infectious diseases. The Department works only for the students of the Preventive Medicine Faculty.

Currently, the Department of Hygienic Disciplines is one of the specialization departments of the Faculty; it provides fundamental knowledge and professional skill training to the Rospotrebnadzor personnel in the region.

Working with medical professionals in the context of the general hygiene curriculum, future specialists participate in control and supervisory activities, learn the specifics of operation of enclosed spaces, buildings, and equipment in the real-life conditions of businesses selling goods and/or rendering services. In the testing laboratory center, they prepare samples and do the subsequent laboratory testing under the guidance of mentors, and perform instrumental measurements directly at the facilities.

The Department of Dermatovenerology and Cosmetology first opened in 1918. It was part of the Medical Faculty of Voronezh State University, founded on the basis of the Yuriev University, which is the predecessor of the modern VSMU named after N.N. Burdenko.

G.I. Koppel, professor, otolaryngologist, was the first head of the department. From 1919 onwards, it was chaired by professor E.F. Friedman (1919–1920), professor N.N. Burdenko (1920), assistant A.V. Rossov (1920–1925), professor V.M. Boikov (1925–1927), surgeon professor S.S. Solovyov (1927).

From 1996 to the present, the Department of Dermatovenerology and Cosmetology is managed by L.A. Novikova, Doctor of Medical Sciences, professor.

Today, the staff of the department actively participates in educational work. They continuously improve educational and methodological materials, and master the new teaching methods.

In terms of research, the department seeks to refine the protocols of pathogenetic therapy of chronic dermatoses.

Through the years, the team of the department has prepared and defended seven doctoral and more than 40 candidate theses, published five monographs, over 40 methodological manuals (five of them approved by the Curriculum Division), and five collections of scientific papers. Every year, the results of the fundamental and practical research efforts are published and reported at conferences, congresses, forums of various levels, including international events. The department maintains close scientific and practical ties with the leading research institutions of the country.

The Department of Infectious Diseases has grown from the infectious diseases course lectured at the infectious diseases division of Voronezh State University in 1921. In 1923, the division was reorganized into the Department of Infectious Diseases; the first head thereof was M.I. Shtutzer, professor, who identified a new type of dysentery bacteria, subsequently named after him.

From 2003 to 2021, the department was chaired by Yu.G. Pritulina, professor, Doctor of Medical Sciences, Honored Physician of the Russian Federation, Honorary Professor of the VSMU named after N.N. Burdenko (2022). Under her leadership, the team was actively studying the immunological aspects of infectious diseases, the results of this work reflected in three candidate theses and over 350 scientific papers.

In 2021, by the decision of the Academic Council of VSMU, the Department of Infectious Diseases was merged with the Department of Pediatric Infectious Diseases, the latter launched in 1953 as an independent unit operating in the 7th Children's Clinical Hospital of Voronezh. V.N. Goldina, professor, was the first head of the new structure. The staff of the department studied the impact of infectious diseases on the development of somatic pathology in children and reported the results of this work in five collections of scientific papers and over 127 other publications.

S.P. Kokoreva, associate professor, Doctor of Medical Sciences, became the head of the joint Department of Infectious Diseases. Over the years, the unit prepared three candidate theses, published collections of scientific papers, organized an ongoing research workshop for students, and has been fostering academic competitions, including international ones. The department continues to develop its cooperation with the leading universities of the country, and its staff ceaselessly integrates advanced scientific achievements into the treatment process, and formulates clinical innovations within its specialization.

The Department of Disaster Medicine and Life Safety (DM and LS) is the oldest among the departments of this profile in the country. The unit, which studies the medical and sanitary aspects of disaster relief efforts (both peacetime and wartime), is an integral part of military medical science and practice. The highly qualified staff of the department has been continuously working to further refine the educational process and improve the quality of training of specialist doctors; here, they are taught in the traditions founded by outstanding Russian scientists, prominent figures in the fields of military and civilian healthcare: N.I. Pirogov, N.N. Burdenko, N.I. Leporsky, N.A. Kurshakov, A.I. Pokrovsky, E.A. Shepilevsky, D.M. Lavrov, A.A. Afanasyev, A.G. Rusanov, etc.

In 2008, medical universities of the country launched the mobilization training departments covering general healthcare and disaster medicine in lieu of the closed military training departments. At VSMU, this mobilization training department was named the Department of Disaster Medicine and Life Safety in 2014 [17].

The staff of the department organizes scientific and practical conferences at the university on a regular basis. These conferences are attended by the students from all medical faculties and courses, as well as residents of the Department of Anesthesiology, Intensive Care, and Emergency Medicine of the VSMU's Continued Professional Education Institute. Such professional exchange enables development and adoption of various approaches to emergency medical care in the context of simulated terrorist attacks, hostage situations, etc. [18].

The Department of Medical Prevention opened its doors in June 2021. From the beginning and to the present day, it has been chaired by T.N. Petrova, Doctor of Medical Sciences. The establishment of a department of this profile is the first step towards creating a unique platform for training preventive medicine specialists.

Currently, the department is an actively developing system of fundamental and practical medical and preventive education, paying special attention to instilling moral values and personal qualities, since character building is one of the most important elements of the pedagogical activity at a university. The staff of the department constantly takes students on tours to the patriotic and most significant places of Voronezh.

Today, educating and shaping a competent, highly educated doctor is not easy, but doable. The staff of the Department of Medical Prevention is ready to work tirelessly to help students

make the right choice, find the right guidelines, and live a life benefiting themselves and others.

The Department of Microbiology consists of 16 professors led by A.M. Zemskov, Honored Scientist of the Russian Federation, Academician of the Russian Academy of Sciences, professor, Doctor of Medical Sciences. A.M. Zemskov chaired the department in 1985, continuing the VSMU's glorious traditions microbiology research. Over the years, the department's team prepared more than 100 candidate and doctoral theses, made three scientific discoveries, registered over 20 patents for inventions, published over 60 monographs, 32 textbooks and confidential guides, 11 encyclopedias, manuals, reference books, submitted more than 700 articles to journals, with over 70 of them published in international press. A school of clinical immunology has been established on the basis of the department.

The list of achievements of the department includes the development and testing of mathematical methods of interpretation of immunograms; clinical assessment of the immune status involving lesser immunotherapy; optimization of targeted correction protocols based on the inversion analysis of immunograms; approbation of stepwise mono-, combined, alternative, complex, immuno-metabolic therapy; approbation of a simplified multilevel method of assessment and treatment of immunopathology (electronic physician assistant) using proprietary computer programs.

The Department of General Hygiene, like the university, has a 105-year history.

The academic and educational traditions that have developed in the course of the university's evolution enabled creation of a well-established hygiene school of thought. At different times, the department, its heads and staff alike, did everything in their power to carry out relevant scientific research, and the results of their efforts are inscribed in the pages of the history of national hygiene and preventive medicine. A special note should be made about the thrice-republished Hygiene textbook and the Geohygiene fundamental work by V.A. Pokrovsky, Honored Scientist of the RSFSR, professor. A significant contribution to occupational hygiene was made by Professor A.S. Faustov [19], who continued investigation of the influence of harmful production factors at the Sintezkauchuk plant. There has been written a number of specialized textbooks for students. In 2007, the department opened a new page: then, the position of its head was taken by Faustov's student V.I. Popov, professor, corresponding member of the Russian Academy of Sciences, Honored Worker of Higher Education of the Russian Federation (2022), Deputy Chairman of the Expert Council of the Higher Attestation Commission under the Ministry of Education and Science of the Russian Federation (medical prevention problems), member of two theses examination councils for specialization 3.2.1 "Hygiene," Deputy Editor-in-Chief of the peer-reviewed scientific and practical journal "Russian Bulletin of Hygiene", member of the editorial boards and councils of eight scientific journals.

The department began to address new scientific problems, including aging, students' health, and modern health-saving and health-shaping technologies. The staff developed Standards for Assessment of Physical Development of Children and Adolescents in the Russian Federation; since 2019, 10 monographs have been published on this topic. Professional burnout among medical workers was another subject investigated, with formulation of the basis thereof. In the field of bibliography, the department has published indexes of abstracts of hygiene-related theses defended from

1985 to 2010. Together with other educational organizations and scientific institutions, the team works on the development of products with therapeutic and preventive properties, and those possessing pre-designed functional characteristics. The Voronezh Nutrition Monitoring Center has been established at the department.

Today, the Department of General Hygiene is a well-coordinated group of like-minded people who fully devote themselves to the education and training of students. Their pedagogical work is characterized by continuity, which allows claiming establishment of the Voronezh hygiene school of thought. The department has strong ties with the leading Russian research institutes and centers, and participates in the work of the Federal and local problem commissions, and theses review councils. Specialists of the department hold positions at the editorial boards of peer-reviewed journals; they actively participate in the work of the Voronezh regional branch of the Society of Hygienists, Toxicologists, and Sanitary Doctors, a Russian national non-governmental organization.

The Department of Phthysiology, like many other VSMU's oldest departments, originates in the Yuriev University, which was evacuated to Voronezh. Professor P.I. Filosofov was the founder of this department.

In 1969, Therapy Department of VSMU launched a tuberculosis course, and in 1970, it became an independent structural unit, the Department of Tuberculosis, chaired by N.S. Tyukhtin, who remained in this capacity 2002. Through these years, the team investigated pleural diseases, with the results of the respective efforts presented in two doctoral and five candidate theses, and 265 scientific papers of different levels.

In 1977, N.S. Tyukhtin founded the first specialized department of pleural pathology in the USSR on the basis of the Voronezh City Clinical Tuberculosis Dispensary, where patients with pleural effusions were diagnosed and studied, and students and doctors received extensive training.

Subsequently, from 2002 to 2008, the Department of Tuberculosis was headed by N.A. Stogova, Doctor of Medical Sciences, professor; after her tenure, by the decision of the Academic Council of VSMU, the Department of Tuberculosis was merged with the Department of Epidemiology. The new department was named the Department of Epidemiology and Tuberculosis, with a phthysiology course for the university's Continued Professional Education Institute. N.P. Mamchik, Doctor of Medical Sciences, was the head of this department.

On September 1, 2011, the Department of Phthysiology was made a separate structural unit, chaired by O.V. Velikaya, Doctor of Medical Sciences, associate professor, author of over 100 scientific papers, and holder of seven patents for inventions. Two candidate theses were defended under her guidance.

For excellence in the field of national education, President of the Russian Academy of Natural Sciences awarded VSMU's Department of Phthysiology with a diploma and the Golden Department of Russia medal. Apart from educational and research activities, the Department of Phthysiology introduces advanced methods of anti-tuberculosis care into practice.

The Department of Epidemiology was established on December 29, 2005. The main task of the department was to train specialists (epidemiologists) for Rospotrebnadzor

institutions, the Center for Hygiene and Epidemiology in the Voronezh Region, and medical organizations. The department began teaching on September 1, 2006. The head of the department is N.P. Mamchik, a doctor of the highest qualification category, Honored Doctor of the Russian Federation, Excellent Healthcare Worker, Excellent Worker of the State Sanitary and Epidemiological Service of Russia, Honorary Professor of the Burdenko Voronezh State Medical University, Honorary Professor of the F.F. Erisman Federal Scientific Center for Hygiene.

Currently, the Department of Epidemiology is a structural unit of the Preventive Medicine Faculty, a specialization department that trains epidemiologists. It caters to students of the said faculty and other faculties of VSMU.

The department is actively involved in research activities, the results of which are reflected in many publications; it also organizes conferences, intra- and interuniversity competitions. The main areas of scientific research are ensuring the sanitary and epidemiological well-being and safety of the population, health risks assessment, epidemiology and prevention of infectious and non-communicable diseases. The results of these efforts are reported in nine candidate and one doctoral theses, eight textbooks, more than 50 educational and methodological manuals, and 31 collective monograph.

CONCLUSION

The joint activity of the departments forming the Preventive Medicine Faculty adequately fulfills the main task thereof, which is to train highly qualified personnel to federal educational standards and professional standards, capable of responding to the current challenges demands of the society. From 2011 to 2022, more than 108 graduates of the faculty were employed at the Center for Hygiene and Epidemiology in the Voronezh Oblast and its branches, and 99 were invited to work in the regional Rospotrebnadzor body; 81% of them continue working, with some having joined the faculty and, ensuring continuity through generations. The feedback from the employer received through a dedicated survey allows assessing satisfaction with the hires, and factor in the specifics thereof into the curricula. Graduates of the faculty have increased the staffing rate of Rospotrebnadzor institutions in the Voronezh Oblast to 90.4%, reduced the share of employees of retirement age from 34% to 16%, and raised the proportion of employees under the age of 35 from 6% to 48%.

The data and information on the establishment and development of the Preventive Medicine Faculty of VSMU given in this article confirm the significance of this discipline in the structure of medical education, adequate level of training and high qualifications of the graduates, and the demand for them not only in the institutions of Voronezh Oblast but in the Russian Federation on the whole.

The development of the departments constituting the Preventive Medicine Faculty through improvement of the equipment and material supply, educational and methodological base, advanced training of researchers and professors, and continued cooperation between clusters contribute to the faculty's growth and development evolution. And whatever difficulties may stand in the way, the close-knit team thereof will overcome.

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ASSESSMENT OF ADOLESCENT MORBIDITY IN VORONEZH OBLAST IN 2013–2022

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Morbidity among adolescents is a significant component of the overall morbidity in Russia, since this part of the population forms the potential of the country. Unfortunately, lately, the efforts to popularize healthy lifestyle and preventive measures, both of which entail decrease of the incidence of diseases in general, were insufficient. This study aimed to analyze the 10-year morbidity patterns among adolescents in Voronezh Oblast, rank pathologies, and compare the findings to the specifics of morbidity in Russia overall. We used statistical data describing diseases (types, incidence) affecting adolescents aged 15–17 in Voronezh Oblast and in Russia; the study covered the period from 2013 through 2022. The analysis of data for Voronezh Oblast revealed a number of classes of illnesses that exhibit significant growth and thus require special attention in the context of development of preventive measures and their implementation in educational establishments. We have also pinpointed the regions of the Central Federal District where, in the recent years, the incidence has been growing more rapidly than in others. The most significant rise of morbidity was registered in Voronezh Oblast. The region- and class-specific differences in the incidence of diseases should be factored in when implementing prevention campaigns and designing more detailed medical examination routines for the adolescents. Individual approach to each case plays an important part in slowing down the rate of morbidity, and it is crucial for the full realization of the potential of the respective efforts.

Keywords: morbidity, children and adolescents, students, pupils, morbidity analysis

Author contribution: Kopylov AS — study planning, literature analysis, data collection; Popov VI — data analysis and interpretation, manuscript drafting.

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АНАЛИЗ ЗАБОЛЕВАЕМОСТИ ПОДРОСТКОВ ВОРОНЕЖСКОЙ ОБЛАСТИ В 2013–2022 ГГ.

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Заболеваемость среди подростков занимает важное место в структуре заболеваемости по России, ведь именно подростки в недалеком будущем станут отражением потенциала нашей страны. К сожалению, в последнее время недостаточно внимания уделяют приобщению к здоровому образу жизни, профилактическим мероприятиям, способствующим снижению темпов прироста заболеваемости. Целью работы было изучить заболеваемость в Воронежской области за десятилетний период, выявить приоритетные патологии подросткового населения и выполнить сравнение с уровнем заболеваемости по России. Для анализа использовали официальные статистические данные по заболеваемости среди подростков 15–17 лет в Воронежской области и в России за период с 2013 по 2022 г. При проведении статистического анализа в Воронежской области выявлены демонстрирующие существенный прирост приоритетные классы заболеваний, на которые необходимо обратить особое внимание при разработке профилактических мероприятий и их внедрении в образовательную среду. Среди областей Центрального федерального округа отмечены регионы с наиболее быстро растущей в последние годы заболеваемостью. В последние несколько лет отмечен рост заболеваемости, при этом особенно значительным он был в Воронежской области. Различия уровней заболеваемости по регионам и классам болезней необходимо учитывать при проведении диспансеризаций и более тщательных и детальных обследований подросткового населения. Чтобы замедлить темпы прироста заболеваемости подростков, для достижения максимального эффекта важен индивидуальный подход.

Ключевые слова: заболеваемость, дети и подростки, учащиеся, школьники, анализ заболеваемости

Вклад авторов: А. С. Копылов — планирование исследования, анализ литературы, сбор данных, В. И. Попов — анализ, интерпретация данных, подготовка черновика рукописи.

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As shown by many researchers, the morbidity rate in the Russian Federation (RF) is fairly high. This fact suggests implementation of selective preventive measures that factor in the specifics of each region of the RF. Reduction of the overall incidence rate has always been one of the most important and significant domestic policy tasks in our country, and development and realization of preventive efforts enable solutions thereto [1–5].

Various sources indicate that, in general, only 25% of school-age children are fully healthy. This figure drops considerably among senior pupils: they develop disorders of the musculoskeletal system, their visual acuity drops, and digestive systems suffer disruptions [6–8]. Thus, it is necessary to introduce adolescents to healthy lifestyle from their early days in school, tell them about the optimal amounts of motor

activity, and teach to adhere to such recommendations throughout their lives [9]. Unfortunately, lately, the role of family and parents in shaping personality of an adolescent received insufficient attention. Often, parents lack proper knowledge in the field of medicine and preservation of children's health, and they do not consider it important to lead a healthy lifestyle and thus lead the younger generation by example. It is necessary to develop programs aimed at raising parents' awareness of health-related matters so they could help their children to live a healthy life [10].

Adolescence is extremely important for the development and formation of the body in general. This is when a person has his/her organs and systems taking their ultimate shape, and body grows close to its limits in length [11]. This is also a period

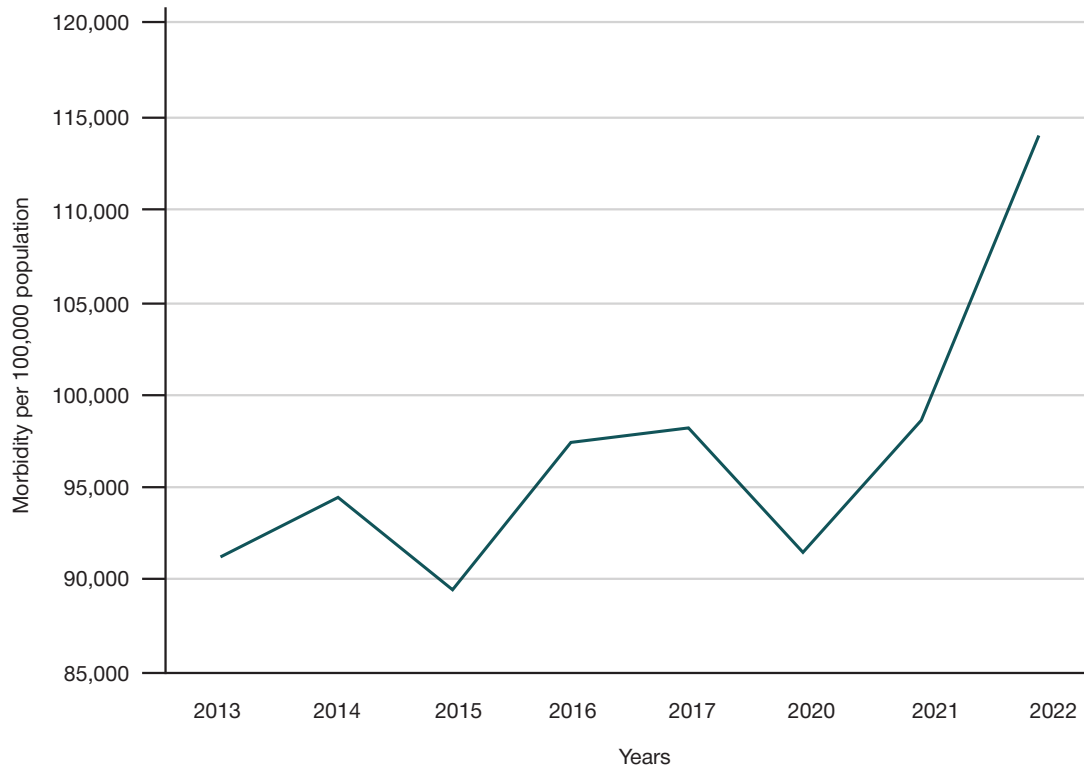


Fig. Dynamics of morbidity among adolescents aged 15–17 years in 2013–2022

of significant education-related loads, when the pupil has to learn much new information, and prepare for the next step, studying at a higher education establishment. These factors affect the quality of life, and can lead to various pathologies in the future [12]. In our country, the morbidity patterns among the youth can differ significantly between federal districts. Investigation of the specifics peculiar to a given region is one of the fundamental measures enabling the maximum possible realization of the potential of the designed prevention campaigns [13].

In the Central Federal District (CFD), 2010 to 2017, the overall morbidity rate went down, but in Voronezh Oblast, which is part thereof, the incidence rate grew by 18% (per 1000 people) from 2011 to 2022. It should also be noted that in 2010–2017, Voronezh Oblast climbed four positions in the general morbidity territorial rating, with the increase in percents equaling 8% [14].

As for the incidence among adolescents, Voronezh Oblast rose up to the third place, although in 2014, it showed the lowest level of morbidity per 100,000 population; this fact is certainly a reason for concern [15, 16]. Recently, insufficient attention has been paid to the study of morbidity in individual districts of our country and a targeted analysis of the most problematic regions with subsequent development of a set of measures aimed at reducing the morbidity growth rate.

This study aimed to analyze the 10-year morbidity patterns among adolescents in Voronezh Oblast, rank pathologies in this cohort, and compare the findings to the specifics of morbidity in Russia overall.

METHODS

By design, this was a retrospective study; we used the statistical data on morbidity among adolescents (first-time diagnoses) accumulated by the Territorial Body of the Federal State Statistics Service for Voronezh Oblast from 2013 through 2022, and the general Russian incidence statistics for the population

aged 15–17 years. Incidence growth and proportions of the diseases were calculated based on the ICD 10 definitions. We used standard methods of statistical analysis and MyOffice 2022 software package (New Cloud Technologies; Russia).

RESULTS

The analysis of the 10-year dynamics of morbidity among adolescents aged 15–17 years revealed a fairly high level of this indicator. It is also important to note that over the past few years, the incidence among adolescents has increased significantly: from 2020 to 2022, the respective figure has grown by about 25% (Fig.).

Studying morbidity as a whole, it is important to factor in its structure in order to develop prevention programs as effectively as possible. Table 1 presents such a structure over a 10-year period, broken down by disease classes. Therein, respiratory diseases occupy the top spots with a noticeable margin, and within the considered period, their incidence has grown by over 40%, which is significant. Two other classes worth mentioning are comprised of the diseases of the ear and mastoid process, and digestive system. The increase for them amounted to 26.9 and 44.6%, respectively. A significant (43.8%) growth of the incidence of diseases falling into the Neoplasms class is the reason for significant concern, especially considering its rate of increase and the affected population, adolescents. At the same time, we registered a significant drop of congenital anomalies (76.7%), with the respective figure approaching the zero point. The percentage of mental and behavioral disorders has more than halved, and the number of infectious and parasitic diseases has decreased by 40.7%. Despite the impressive increase in the overall morbidity over the past few years, eye diseases demonstrate a positive trend: their incidence has dropped 1.5 times, regardless of the ever increasing availability of various electronic devices, including to adolescents 15–17 years old. We have also seen a significant decrease in the incidence of skin

Table 1. Morbidity of adolescents aged 15–17 in Voronezh Oblast in 2013–2022 (per 1000 population)

Classes of diseases	Years										Growth rate, %
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022/2013
Total, including:	912.8	926.1	893.8	977.2	968.8	980	963.7	914.4	983.9	1130.8	+23.9
Some infectious and parasitic diseases	21.4	19.6	18	20.2	18	19.5	20.7	14.5	11.9	12.7	-40.7
Neoplasms	1.6	1.9	2.1	2.1	2	2.9	2.2	1.8	2	2.3	+43.8
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	3.2	3.3	3.1	3.6	3.7	3.7	4.3	3.6	3.6	3.5	+9.4
Endocrine, nutritional and metabolic diseases	21.3	29.6	37.4	30.9	32.7	29.7	33.5	18.5	22.4	18.3	-14.1
Mental and behavioral disorders	25	25.2	20.7	16.7	14.2	17.3	15.9	8.2	10.6	12	-52
Nervous system diseases	27.3	23.5	23.9	23.8	20.7	23.4	18.8	17.7	20.1	20.6	-24.5
Diseases of the eye and adnexa	52.3	53.4	47.6	45.5	47.8	50.7	51.1	35.5	30.1	34.1	-34.8
Diseases of the ear and mastoid process	36.5	38.7	51.1	53.5	46.6	46.2	45.8	43.1	44.9	46.3	+26.9
Diseases of the circulatory system	12.5	12.6	12.3	10	11	10.8	14.2	8.3	10.6	9.9	-20.8
Respiratory diseases	414.2	405.9	376.3	469.1	475.5	466.4	457.7	464.5	491.5	591	+42.7
Diseases of the digestive system	31.6	40.5	45	51.8	51.2	55.6	46.6	42.1	46.7	45.7	+44.6
Diseases of the skin and subcutaneous tissue	44.2	51.2	31.8	28.4	22.3	27.5	37.1	29.1	26.8	23.8	-46.2
Diseases of the musculoskeletal system and connective tissue	44.2	57.3	63.3	53.2	47.8	44.4	39.9	30.5	32.6	25.6	-42.1
Diseases of the genitourinary system	43.4	38.8	40.6	51.1	38.3	37.5	45.6	41.1	46.7	37.4	-13.8
Congenital malformations, deformations and chromosomal abnormalities	3	2.8	2.8	2.6	2.4	2.2	0.8	0.5	0.8	0.7	-76.7
Injury, poisoning and certain other consequences of external causes	98.4	109.2	108.5	110.2	132.7	139.2	122.8	119.1	101	100	+1.6

diseases and musculoskeletal system disorders, which may indicate that the respective preventive measures were effective. Finally, the share of nervous system disorders has dropped by a quarter, demonstrating a positive trend.

Some patterns emerged in the comparative analysis of the morbidity data on adolescents aged 15–17 years in various regions of the Central Federal District and comparison thereof with the data on incidence in Russia overall (Table 2). In general, the incidence rate in the Central Federal District is slightly lower than in the country on the whole, but, over the past few years, the figure has increased significantly (by 22% from 2020 to 2022). It should be underscored that within the past ten years, Central Federal District had the level of morbidity higher than the Russian average: this situation was registered in 10 out of 18 regions constituting the CFD, with Orlov Oblast, where the morbidity level was 1.5 times higher, performing the worst, followed by Vladimir Oblast and Tver Oblast, with Kaluga Oblast almost on par with the latter. In 2022, the lowest morbidity was registered in Lipetsk Oblast: compared to 2013, it dropped by the impressive 16.1%, which is significant against the data collected in other regions. Only the city of Ivanovo has shown an even more drastic decrease by 18%. Over the past several years, Kursk Oblast was the leading region in terms of morbidity per 100,000 population (adolescents); Lipetsk Oblast took the first place only in 2022. In 2013, Voronezh Oblast had the lowest incidence in the CFD, and by 2022 it moved to the third place in this rating. Within the period considered, the capital of the Black Earth Belt had morbidity growing up significantly, by 25%. The situation was more dire only in Orel and Yaroslavl Oblasts, where the rise was by 34% and 26.4%, respectively. Moscow, the capital of our country, has also been no exception: over the past three years, morbidity there has

grown, and the increase thereof 2013 through 2022 equaled 10%. In Moscow Oblast, however, the situation is different, and exemplary: there, the incidence decreased by 3.3%.

DISCUSSION

The analysis showed that over the past few years, the level of morbidity among adolescents has been increasing steadily. This fact should stimulate development of the new prevention programs for schoolchildren aged 15–17 years that would be aimed at arresting the growth of incidence of chronic diseases in this population. In addition, it is necessary to factor in the predominant classes of diseases by regions, since they may differ area to area, and target the efforts on the groups of pathologies that spread the fastest in order to slow down this process.

The researchers note that the number of inaugural diagnoses has been growing over the past few years, but in 2020 it decreased significantly, probably due to the introduction of measures against the coronavirus infection, which was spreading rapidly then. Yet, the contribution of COVID-19 to the growth of morbidity was insignificant [11]. In Voronezh Oblast, on the contrary, the incidence of infectious diseases was dropping since 2019; from 2019 through 2020, the overall morbidity trend was downward, but in the next few years, it increased significantly.

Respiratory disorders are, by a wide margin compared to other classes of diseases, the most common in Voronezh Oblast. Over the ten-year period, their incidence has grown significantly, which should trigger the design of preventive measures against this pathology. Other two classes deserving more attention are the diseases of the digestive system,

Table 2. Morbidity of adolescents aged 15-17 (first-time diagnosis) by the subjects of the CFD in 2013–2022

Territory	Year								Growth rate, % 2022/2013
	2013	2014	2015	2016	2017	2020	2021	2022	
Russian Federation	143754.8	143109.3	137383.8	137181.8	138346.1	121889	137118.7	149143.8	+3.8
Central Federal District	138032.5	137436.6	130667.6	133799.3	134543.4	119508.7	133758.4	143828.5	+4.2
Belgorod Oblast	163764.7	178353.6	160843.1	170251.4	161591.9	124869.5	151980.3	151457.7	-7.5
Bryansk Oblast	180715.6	183270.6	161278.9	150459.3	151855.9	132764.7	145338.3	161312.4	-10.7
Vladimir Oblast	168156.4	174301.6	168285.9	173935	166884.5	142880.7	160147.2	185582.9	+10.4
Voronezh Oblast	91276.7	94335	89383.6	97389.1	98142.4	91439.7	98521.4	114010.1	+24.9
Ivanovo Oblast	175735.4	186707.9	164589.1	173030.8	175945.9	132823.2	136546.2	144173.9	-18
Kaluga Oblast	152402.1	137842.8	136401.1	140576.4	144101.9	156872.9	175459.7	178242	+17
Kostroma Oblast	141276.5	132133	125290.4	130505.2	145439.2	120105	131400.2	146301.7	+3.6
Kursk Oblast	97396.4	95738.1	81169.2	92641.9	97262.6	80215.9	95071.2	106752.2	+9.6
Lipetsk Oblast	114896.3	116916	105494.1	103989.5	108117.2	100676.6	100362.1	96450.8	-16.1
Moscow Oblast	139830.1	142025.1	140379.4	142486.3	147807.5	132224.9	143314.1	135272.8	-3.3
Orel Oblast	165657.4	168735.8	171081.9	168766.4	167646.9	145575.2	169146.8	221990.6	+34
Ryazan Oblast	152288.8	154476.5	140546.6	143187.8	137803.3	146656.1	155075.4	167176	+10
Smolensk Oblast	165732.4	167744.6	139908	153609.5	158116.4	117803.9	124545.7	139083.1	-16.1
Tambov Oblast	131915.4	132282.2	136168.3	132420.7	129372.1	119597.2	130179.7	152985.3	+16
Tver Oblast	171589.3	172369.5	167687.8	154723.4	159685.2	132726.7	149951.5	178524.7	+4
Tula Oblast	151805.4	143560.3	132664.3	128883.4	132184.4	123398.7	135152.5	162789.7	+7.2
Yaroslavl Oblast	128432	129092.1	131939.3	145029.7	144951.5	126692.6	146381.5	162376.6	+26.4
City of Moscow	125292.6	120236.2	115923.5	120358.4	118284.3	105829.4	129825.9	137754.8	+9.9

and neoplasms, which have also shown significant growth within the studied period.

Compared to the situation in the Far Eastern Federal District, the level of gastrointestinal morbidity in Voronezh Oblast has grown significantly, but the number of cases of disorders of the musculoskeletal system and connective tissue decreased. Respiratory pathologies, which, as mentioned above, are the most common, and tend to spread further, should be viewed as the generalizing factor [17].

In the CFD, Orel Oblast and Yaroslavl Oblast are the regions raising special concerns about morbidity among adolescents: there, it has grown significantly in the past 10 years. While showing a relatively low level of incidence, the capital of the Black Earth Belt has seen the growth rate a quarter greater than that registered in 2013. Ivanovo, Lipetsk, and Smolensk Oblasts demonstrate the best dynamics, with the morbidity figures dropping by 16 to 18%.

It is important to account for the environmental conditions in each region, factor in the environmental indicators that contribute to the development of certain diseases. This is especially important for the pathologies of respiratory and cardiovascular systems, and infectious diseases, since said conditions can trigger exacerbations of the chronic processes [18, 19]. Therefore, it is essential to comprehensively address the increasing morbidity of various organs and systems in collaboration with hygienists, epidemiologists, and pediatricians. It is important to remember the specifics of a growing adolescent body, which is particularly vulnerable between the ages of 15 and 17, when most body systems are taking their ultimate shape [17, 20].

Many authors note that the health of adolescents generally deteriorates, with some schoolchildren classified as belonging

to the fifth health group. This classification may indicate an insufficiency of efforts aimed at reinforcing child health and preventing disease. The approach should be systematic, with involvement of medical doctors of various specialties, parents, and school staff, from teachers to principals [21–23].

CONCLUSIONS

Both in Voronezh Oblast and Russia in general, the morbidity among adolescents has been growing in the recent years, becoming an especially important problem. The shares of nosologies in the overall incidence, priority risk factors etc. can vary significantly in different regions of the country. Therefore, it is necessary to carefully and purposefully study the pathologies affecting specific organs and systems, develop prevention programs tailored to the region, and apply an individual approach.

The results of the comparative analysis suggest that in the Voronezh Oblast, special attention should be paid to diseases of the respiratory and digestive systems, as well as neoplasms, which are the most common first-time diagnoses and are increasing in incidence. Compared to other regions of the Central Federal District, the capital of the Black Earth Belt has the second-lowest incidence, following only the Kursk and Lipetsk Oblasts, but the respective figure has increased by 24.9% over the past decade. It is also important to note that in 2013, the level of morbidity in Voronezh Oblast was the lowest among the constituents of the Central Federal District. A comparison with the overall national incidence figures has shown that in the said Oblast, the number of first-time diagnoses was 1.5 times lower than the national average in Russia.

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THE IMPACT OF SOCIO-HYGIENIC AND PSYCHOPHYSIOLOGICAL FACTORS ON THE HEALTH STATUS OF MEDICAL UNIVERSITY STUDENTS

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The analysis of socio-hygienic and psychophysiological factors affecting the students' health is a highly relevant issue. The paper reports hygienic and psychophysiological health risk factors in the second-year medical students. The study was aimed to assess the influence of psychophysiological and hygienic factors on the health status of 263 medical students. According to the polling data, complaints of asthenic and neurotic nature prevailed among the respondents. The Spielberger State-Trait Anxiety Inventory results showed that during the semester high state anxiety was found in 43% of the respondents. State anxiety increased more, than trait anxiety during the end of semester exams. Furthermore, the correlation between anxiety and the students' academic load was revealed. Hygienic analysis of the students' lifestyle revealed the following health risk factors: hypodynamia, spending large amounts of time on social media, inadequate sleep duration, harmful habits (smoking). Such hygienic factors of learning environment, as microclimate and luminosity, were assessed. It was found, that there was a strong positive correlation between air temperature in the classrooms and low students' working capacity. We have proposed possible ways to improve socio-hygienic and psychological environment for maintenance and promotion of students' health, which will result in the development of effective health preservation programs in educational institutions. Appropriately, such solutions will help ensure the students' wellness and good working capacity, and will have a positive effect on the learning outcomes and further professional career.

Keywords: health, students, functional status, working capacity, socio-hygienic factors, psychophysiological factors

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Compliance with ethical standards: the study was compliant with the principles of biomedical ethics. The written informed consent was obtained from all study participants.

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ВЛИЯНИЕ СОЦИАЛЬНО-ГИГИЕНИЧЕСКИХ И ПСИХОФИЗИОЛОГИЧЕСКИХ ФАКТОРОВ НА СОСТОЯНИЕ ЗДОРОВЬЯ ОБУЧАЮЩИХСЯ МЕДИЦИНСКОГО УНИВЕРСИТЕТА

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Анализ социально-гигиенических и психофизиологических факторов, влияющих на здоровье студентов, является весьма актуальной темой. В статье рассмотрены гигиенические и психофизиологические факторы риска здоровью обучающихся на 2-м курсе медицинского университета. Целью исследования было оценить влияние психофизиологических и гигиенических факторов на состояние здоровья 263 студентов-медиков. По данным анкетирования, среди респондентов преобладали жалобы астенического и невротического характера. Результаты опросника Спилбергера показали, что в течение семестра высокий уровень ситуативной тревожности имел место у 43% опрошенных. Во время сессии ситуативная тревожность выросла в большей степени, чем личностная. Кроме того, установлена корреляционная связь между тревожностью и учебной нагрузкой студентов. Гигиенический анализ образа жизни обучающихся выявил ряд факторов риска здоровью: гиподинамию, длительное пребывание в социальных сетях, несоблюдение продолжительности сна, наличие вредных привычек (курение). Были исследованы гигиенические факторы учебной среды, такие как микроклимат и освещенность. Установлена сильная прямая связь между температурой воздуха в учебных аудиториях и низкой работоспособностью обучающихся. Предложены возможные пути улучшения социально-гигиенической и психологической среды для поддержания и укрепления здоровья студентов, которые приведут к разработке эффективных программ здоровьесбережения в образовательных организациях. Соответственно, такие решения помогут обеспечить студентам хорошее самочувствие и работоспособность, положительно повлияют на результаты обучения и будущую профессиональную карьеру.

Ключевые слова: здоровье, обучающиеся, функциональное состояние, работоспособность, социально-гигиенические факторы, психофизиологические факторы

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Соблюдение этических стандартов: проведенное исследование соответствовало требованиям биомедицинской этики. Добровольное информированное согласие получено от каждого участника исследования.

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The students' health status is a frequently discussed and always relevant issue, as well as an important component of educational process. Many disorders are swiftly rising lately, chronic forms of the diseases are reported, which reduces the learning efficiency [1–3].

More than a half of applicants already have health problems by the moment of entering higher education institutions. Upon graduation, student morbidity in the Russian Federation increases on average 3.8-fold.

Poor work/rest balance, inadequate nutrition, uncomfortable living conditions, high academic load, and other factors observed during the period of study at the university can contribute to the increase in the student youth morbidity [4–6].

The medical students' health status remains a concern due to the emergence of a number of negative factors during training (such as the need to communicate with patients and their relatives). The student health risks can be diverse, these can include the interrelated hygienic, psychological,

and social causes. It is necessary to understand, which factors are crucial and how to affect these factors.

An important role in ensuring the students' health is played by the socio-hygienic and psychophysiological factors. Their effects can be both direct and indirect. Hygienic factors, such as good indoor microclimate, high-quality air, sufficient lighting, contribute to the students' health preservation. Failure to comply with hygiene requirements may on the contrary lead to impaired immunity, various diseases, and reduced working capacity [7–9].

Psychophysiological factors, such as emotional tension, stress, fatigue, lack of sleep, negative emotions, affect the students' well-being. Continuous tension and chronic stress can result in the reduced working capacity, worse training outcomes, and various psychosomatic disorders.

The reported negative trends in the students' health are confirmed by numerous studies conducted by other authors [4, 10, 11]. It seems necessary to ensure healthy learning environment considering both hygienic and psychophysiological aspects of the educational process organization.

The study was aimed to assess psychophysiological and hygienic health risk factors in medical university students.

METHODS

The cross-sectional study involved students of the general medicine and pediatric faculties of the Burdenko Voronezh State Medical University (VSMU). A total of 263 individuals (179 females and 84 males) took part in the study. We performed anonymous polling of the second-year medical university students, whose average age was 19.2 ± 0.3 years. The students' somatic and mental health was assessed by performing the questionnaire survey. We used a universal questionnaire developed in accordance with the nosological and functional-systemic principles by the Research Institute of Hygiene and Health Protection of Children and Adolescents RAMS. The questionnaire represented clusters of questions including the sets of symptoms reflecting the condition of various body organ systems. Furthermore, the study involved the use of the Spielberger State-Trait Anxiety Inventory (adaptation by Yu.L. Khanin) and the Anfimov tables. Microclimate parameters in the classrooms were assessed using the Meteoscope-M meter (NTM-Zashhita; Russia); luminosity was assessed using the TKA light meter (TKA NGO; Russia).

The data acquired were processed and analyzed by the mathematical statistics methods. Statistical analysis of the results was performed using the MyOffice 2022 software package (New Cloud Technologies; Russia). Comparison of sample means was performed using the Student's *t*-test for independent samples with subsequent determination of statistical significance (*p*-value). Correlations were considered significant at $p \leq 0.05$. Quantitative assessment of the correlation between the level of health and the hygienic and psychophysiological risk factors was performed using the parametric Pearson correlation coefficient (*r*).

RESULTS

The anonymous polling results showed that the level of health of the majority of university students was average (45%) and above average (48%). Only 7% of the respondents characterized their level of health as high.

During the study we revealed health problems that were most common among students, which made it possible to form groups at risk and perform monitoring of the level of health.

According to the results of the questionnaire survey conducted in accordance with the nosological and functional-systemic principles, asthenic and neurotic syndromes, as well as the set of symptoms characterizing vegetovascular dysfunction prevailed among the surveyed students.

Asthenic syndrome, i.e. behavior characterized by the increased fatigue, weakening of the ability for prolonged physical or mental stress, irritability, frequent changes of mood, manifested itself, in particular, by the increased rate of headache (40% of students). Furthermore, 50% of students complained of rare mild headache, 10% of students had no headache.

Sleep disorder is an important symptom of asthenic syndrome. Almost all the respondents (99%) reported sleep disorders of varying severity. Thus, 99% of the respondents suffered from drowsiness during the day. More than 80% of the surveyed students noted unsociability and inattention, 89.5% of the respondents reported lethargy and rapid fatigue during the day, as well as reduced working capacity.

Neurotic syndrome, the core of which is represented by the impaired balance and flexibility of the major neural processes, and which is characterized by subjective experiences and somato-vegetative disorders (anxiety, irritability, disturbance of speech due to excitement, loss of appetite, palpitation), manifested itself in many young adults. Thus, 88% of the respondents experienced irritability, 82% experienced anxiety, 52% reported restless sleep, about 70% reported disturbance of speech due to excitement.

Within the framework of hysteria-like syndrome 85% of the respondents were prone to fantasy, 70% reported resentment, 76% reported emotional incontinence. At the same time, 80% of the respondents experienced indecisiveness, self-doubt, and shyness.

Vegetovascular dysfunction syndrome manifested itself in mood instability (70%), emotional overexcitability, and fatigue (70%).

According to the questionnaire survey results, the condition of other body's functional systems, such as respiratory, cardiovascular, and hematopoietic systems, was not a serious concern. However, the following gastrointestinal symptoms were reported: abdominal pain associated with food consumption, loss of appetite, heartburn.

When considering the impact of psychophysiological factors on the health status, it should be noted that positive emotions experienced by students during training can improve many aspects of academic activity. Positive emotions contribute to higher motivation for learning, better memorization of information, better concentration of attention, and create an atmosphere of more productive communication in the group of students.

However, unsustainable academic load can result in overstrain of the students' nervous system, which, in turn causes the decrease in working capacity, increases anxiety and absent-mindedness, results in loss of focus and sleep disorder. Based on the questionnaire survey results, sleep inversion manifested by drowsiness during the day, disturbed night sleep, and restless sleep attracts attention.

There are numerous tests for assessment of anxiety, however, the experts recommend the use of the Spielberger State-Trait Anxiety Inventory (adaptation by Yu.L. Khanin), since the Inventory enables differentiated measurement of anxiety as a personal trait and as a condition associated with the current situation. The Inventory results show the level of trait anxiety (determines susceptibility to anxiety) and the state component (demonstrates subjective emotions in the stressful situation).

Table. Mean values of microclimate indicators of the classrooms throughout the academic year ($M \pm m$)

Microclimate indicators ($M \pm m$)	Microclimate indicators before classes		Microclimate indicators after classes	
	Cold season	Warm season	Cold season	Warm season
Temperature (°C)	21.3 ± 0.7	24.8 ± 1.2	22.0 ± 0.9	26.2 ± 1.3
Relative humidity (%)	77.9 ± 4.95	55.2 ± 1.2	80.2 ± 3.4	57.5 ± 5.0
Air velocity (m/s)	0.04 ± 0.02	0.06 ± 0.04	0.07 ± 0.03	0.09 ± 0.05

The Spielberger State-Trait Anxiety Inventory (adaptation by Yu.L. Khanin) results have shown, that the majority of respondents have elevated state anxiety levels, which makes it possible to assess the level of real anxiety. Thus, in the fall semester 6% of the respondents had low state anxiety, 51% had moderate state anxiety, and 43% had high state anxiety. Trait anxiety was determined using the second scale showing the response to the threatening situations. Moderate trait anxiety was found in 76%, while high trait anxiety was reported in 24% only.

During the end of semester exams state anxiety increased by 33%, while trait anxiety increased by 26%. Assessment of the results revealed gender differences: state anxiety was higher in girls, while trait anxiety, on the contrary, was higher in boys.

We revealed a correlation between anxiety and the students' academic load (pair correlation coefficient $r = 0.67$, $p < 0.05$). Thus, elevated academic load significantly increases the students' anxiety.

Estimation of mental performance conducted in this age group using the Anfimov tables yielded the average population result (131.8 ± 7.2 symbols/min).

Working capacity was assessed in terms of its effect on academic performance. The students, who studied "satisfactorily", showed low working capacity as early as by midweek, while students with good academic performance kept working throughout the week. Perhaps, this is due to high anxiety in students with low academic performance.

Working capacity and anxiety affect not only the learning process efficacy and outcomes (marks for tests and exams), but also the students' body functioning, reflected in the mood decline, lethargy, inattention.

The correlation between academic load and working capacity was significant ($r = 0.67$, $p < 0.05$).

Along with psychophysiological factors, hygienic factors also play an important role in maintaining the medical students' health. Their effects can be significant and have both beneficial and adverse consequences.

Hygienic assessment of the students' lifestyle revealed a number of adverse features, such as hypodynamia (42%), spending large amounts of time on social media (on average 4.5 ± 0.2 h during the week), inadequate sleep duration (6.3 ± 0.3 h), high rate of tobacco smoking (71% of males and 59% of females).

The students spend most of their time in the classrooms that are often noncompliant with the hygienic standards for microclimate. The relationship between microclimate and health status have been rather thoroughly investigated in many studies and is beyond doubt. The optimal parameters of microclimate, luminosity, air quality contribute to maintenance of high working capacity and ensure effective mastering of educational material. In this regard, it is important to provide a comfortable environment in the classrooms and lecture halls, laboratories and recreational areas.

In the classrooms of the Burdenko VSMU laboratory building, regular assessment of such parameters, as temperature, humidity, air velocity, luminosity was performed before and after

the classes in different periods of the year. The results of the microclimate parameter measurement are provided below (Table).

The results provided indicate noncompliance of hygienic microclimate parameters (air velocity, temperature, and humidity) with comfortable values in both warm and cold seasons. In winter relative humidity in classrooms exceeded the upper permissible limit by more than 15%. In summer humidity was acceptable, while the air temperature exceeded the upper limit of normal, especially in the end of classes. We revealed a strong positive correlation between the air temperature in the classrooms and low students' working capacity (correlation coefficient $r = 0.74$, $p < 0.05$). Thus, deterioration of the microclimate parameters during classes was observed, which caused deterioration of students' health and loss of concentration.

Artificial and natural lighting in the classrooms, in contrast, was sufficient based on all major lighting indicators. When all the light sources were on, the average artificial lighting intensity was 800 lux. Students did not complain of visual discomfort and visual fatigue during classes.

DISCUSSION

The analysis of data of a number of research studies [7, 9, 11–13] focused on health preservation in students revealed negative trends. In particular, the incidence of visits to medical institutions due to seasonal diseases increases from course to course, overall morbidity increases, diseases become chronic, behavioral deviations occur.

The trend towards predominance of asthenic and neurotic complaints in students observed in our study is associated with the increased anxiety levels and manifestations of psycho-emotional stress.

Specific factors typical for medical university students, such as large time costs for transfer from one medical institution to another, increased emotional strain due to empathy toward patients and their relatives, contribute to the increased anxiety and fatigue, which affect health and academic performance.

The students' health is also largely determined by their lifestyle, rejection of harmful habits, such as smoking, consumption of alcohol and other psychoactive substances, which is confirmed by many researchers [1, 10, 14, 15].

One positive trend is the young adults' desire to preserve their health, lead a healthy lifestyle. Among young adults, 48% believe that one needs to take care of maintaining his/her health already in youth, 71% believe that it is necessary to adhere to the principles of healthy lifestyle and to do it consciously [16–18]. Despite the fact, that students understand the importance of health preservation, not all the respondents adhere to the principles of healthy lifestyle. The reasons for such behavior can include lack of time, unwillingness to visit doctors and share problems with other people. In particular, this is demonstrated by our study, during which the students were reluctant to answer the questions related to the body's disorders.

The correlation between hygienic factors and students' health is the subject of many studies. Hygienic factors

include diverse aspects, such as environmental conditions, healthy diet, physical activity, personal hygiene, etc. The studies show that these factors can have a significant impact on the students' health. Therefore, these form important directions for organization of health preservation [19–22].

CONCLUSIONS

In general, the results of the questionnaire survey conducted in accordance with the nosological principle made it possible to distinguish asthenic and neurotic syndromes as the most challenging for the second-year students. The surveyed students significantly less often reported the symptoms characterizing somatic disorders.

Our study showed that the students' working capacity remained at the average level during the learning process, but it was to the greater extent violated in students with low academic performance. The Spielberger State-Trait Anxiety Inventory results revealed rather high anxiety in the respondents during the learning process. The majority of students experience emotional stress due to inner and personal experiences. Furthermore, it should be noted that girls show higher state

anxiety, while trait anxiety is higher in boys. The relationship between anxiety and academic load has been determined. According to our data, working capacity and anxiety levels affect not only learning outcomes, but the students' overall health.

To reduce anxiety, it has been proposed to introduce light physical activity aimed to relieve strain of the musculoskeletal and nervous systems into the daily routine, ensure that students develop a healthy lifestyle attitude.

The correlations between air temperature in the classrooms and the students' working capacity, academic load and working capacity are significant. To optimize the students' working capacity, it is recommended to normalize academic load, adhere to the work, rest, and sleep mode. It has been proposed to introduce the scale for labour intensity per discipline in order to ensure optimal schedules in the universities. To improve socio-hygienic environment and the general level of the culture of health among student youth, it has been recommended to develop effective programs involving inclusion of classes, creative competitions, sports competitions on health preservation in the educational process. This is especially relevant for medical students, who will take over the function of messengers of healthy lifestyle principles for the population in the future.

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ASSESSMENT OF AWARENESS ABOUT PROPER NUTRITION AMONG STUDENTS OF THE BURDENKO VORONEZH STATE MEDICAL UNIVERSITY

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Proper eating habits, as a key factor in maintaining good health, should be trained in the university and college students. This study aimed to assess the awareness of students of different faculties of the Burdenko Voronezh State Medical University about healthy nutrition. It involved 197 young people studying at the general medicine, pediatric, and preventive medicine faculties. The survey included questions concerning the frequency of meals, eating habits, and the role of vitamins and trace elements. According to the results, most students know much about proteins and carbohydrates, but their knowledge about fats, vitamins, and trace elements is less extensive. A significant portion of students admit inadequate meal planning and frequent snacking between main meals. About half of the participants prefer healthy snacks, while the rest choose less benign options. The awareness of how much water to consume should also be improved. Most students realize the link between poor nutrition and the risk of developing chronic diseases such as obesity, diabetes, and disorders of the cardiovascular system. The interfaculty differences revealed emphasize the importance of raising students' awareness of proper nutrition, focusing on the practical aspects of rational selection of food and its importance for maintaining good health and preventing diseases.

Keywords: proper nutrition, students, medical university, survey, nutrition knowledge, eating habits, student health

Author contribution: Komissarova OV — selection and analysis of the literature, analysis and generalization of the results, article authoring and formatting; Khatuaev RO — online survey preparation, processing of the results of the study, participation in article authoring.

Compliance with ethical standards: the study was consistent with the principles of biomedical ethics. The survey was anonymous, which ensured confidentiality of the information provided. Each participant was informed about the objectives and methods of the study and gave a prior informed consent.

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ОЦЕНКА ЗНАНИЙ О ПРАВИЛЬНОМ ПИТАНИИ СТУДЕНТОВ РАЗНЫХ ФАКУЛЬТЕТОВ ВОРОНЕЖСКОГО МЕДИЦИНСКОГО УНИВЕРСИТЕТА ИМЕНИ Н. Н. БУРДЕНКО

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У студенческой молодежи необходимо формировать правильные пищевые привычки — это ключевой фактор поддержания здоровья. Целью настоящей работы было оценить осведомленность студентов разных факультетов Воронежского государственного медицинского университета имени Н. Н. Бурденко о здоровом питании. В исследовании приняли участие 197 студентов лечебного, педиатрического и медико-профилактического факультетов. Использованная для проведения опроса анкета включала в себя вопросы, касающиеся частоты приема пищи, пищевых привычек, а также осведомленности о роли витаминов и микроэлементов. Результаты показали, что большинство студентов демонстрируют высокий уровень знаний о белках и углеводах, однако их знания о жирах, витаминах и микроэлементах менее обширны. Значительная часть студентов признает недостаточное планирование питания и частые перекусы между основными приемами пищи. Около половины студентов предпочитают здоровые перекусы, тогда как остальные выбирают менее полезные варианты. Знания о достаточном потреблении воды также нуждаются в улучшении. Большинство студентов осознают связь между неправильным питанием и риском развития хронических заболеваний, таких как ожирение, диабет и сердечно-сосудистые заболевания. Выявленные различия между факультетами подчеркивают важность повышения осведомленности обучающихся о правильном питании, акцентируя внимание на практических аспектах рационального питания и его значении для поддержания здоровья и профилактики заболеваний.

Ключевые слова: правильное питание, студенты, медицинский университет, анкетирование, знания о питании, пищевые привычки, здоровье студентов

Вклад авторов: О. В. Комиссарова — работа с литературой, анализ и обобщение результатов, написание и оформление статьи; Р. О. Хатуаев — онлайн-анкетирование, обработка результатов исследования, работа с текстом статьи.

Соблюдение этических стандартов: исследование соответствовало принципам биомедицинской этики. Анкетирование было анонимным, что обеспечивало конфиденциальность предоставленной информации. Каждый участник был проинформирован о целях и методах исследования и дал информированное согласие на участие до начала опроса.

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Among students, unbalanced nutrition and deflection from the proper dietary patterns mainly stem from the insufficient knowledge about the functional, metabolic, and hygienic aspects of the action of nutrients in the body [1]. Educational institutions pay insufficient attention to catering. Consequently, the youth's food preferences and diets often fail to meet the requirements, so the actual nutritional status of students is suboptimal, which negatively affects their health and studies [2, 3]. The analysis of their eating habits revealed significant dietary deviations, including insufficient or excessive

consumption of proteins, carbohydrates, fats, vitamins, and minerals [4]. This leads to alimentary-dependent diseases, such as body weight deficiency or excess, dissonant physique and functional disorders, and disrupted operation of the gastrointestinal tract [5–8]. The effective ways of countering these trends involve optimization of the respective aspects of education: early disease prevention, health-saving activities, and popularization of the proper nutritional patterns and healthy lifestyle [9]. Awareness of how well students know the principles of healthy eating, rational dietary structure and patterns, allows identification of the gaps

in their knowledge and thus enables development of the effective health improvement programs for them [10].

Given the intense rhythm of students' lives, proper nutrition plays a key role in maintaining their health and well-being [11]. Food, in general, affects all aspects of a person's existence, including physical and mental prowess, and overall well-being. Realization of the importance of a balanced diet is especially important for students, since they experience significant academic and social loads [12].

Proper nutrition is a vital factor ensuring optimal functioning of the body [13]. Students, due to lack of time and frequently occurring stressful situations, often fail to properly organize their food intake [14]. Consequently, they can opt for ready-to-eat or fast-to-cook products that are not necessarily healthy, which has a negative effect on their health. Raising the students' awareness of the principles of proper nutrition can help improve their physical and mental condition, and up the level of their performance in general [15–20].

This study aimed to assess the eating habits, awareness of the various sides of nutrition in the context of life, and some aspects of eating behavior of students of the Burdenko Voronezh State Medical University (VSMU).

METHODS

The study revolved around a survey of 197 2nd year students of the general medicine, pediatric, and preventive medicine faculties of VSMU. The mean age of the participants was 19.6 ± 1.5 years. The survey took place at the beginning of the academic year, three weeks after the start of classes.

A special questionnaire was developed to assess the knowledge of students about nutrition; it consisted of 20 questions covering the main aspects thereof, including the frequency of meals, the role of macro- and micronutrients, snacking habits, and water consumption.

The questionnaire was divided into several sections. The first section requested the participants' demographic data, such as age, gender, and faculty. The second section sought to uncover the frequency of meals and the students' ability to take them on a regular basis (breakfast, lunch, and dinner). The third section contained questions revealing the participants' knowledge about proteins, fats, and carbohydrates, as well as their roles in the body, and the main sources thereof. The fourth section revolved around vitamins and trace elements, their importance for health, and where they can be found. The fifth section dealt with snacking habits, snack preferences, and the effect of snacking on overall health. The sixth section was about water consumption and understanding the importance of hydration for the body.

The questionnaire was designed to reveal not only the basic knowledge of students about nutrition, but also their food-related habits. The questions were of a yes/no and open-ended types. The participants had to complete the survey within two weeks. They filled out the questionnaires anonymously, which helped to get honest and frank answers. All questionnaires were collected and processed for subsequent statistical analysis.

We used the methods of descriptive statistics to analyze the data. The results of the survey were processed with the help of StatTech v.2.8.8 (Stattech; Russia); the results of the processing were grouped by faculty and analyzed with the aim to identify common trends and differences in the nutrition-related knowledge. We calculated means, standard deviations, and percentages. Analysis of variance (ANOVA) allowed establishing the significant differences

in the eating habits and the level of knowledge about nutrition between students of different faculties. The differences were considered significant at $p < 0.05$.

RESULTS

The analysis of the results of survey of VSMU's students revealed a number of interesting trends and differences in the knowledge about nutrition possessed and eating habits practiced peculiar to different faculties. The Figure below gives the faculty-wise distribution of students.

Most students of the Faculty of General Medicine take food 2–3 times a day. Seventy-five percent of the respondents regularly have breakfast, 80% have lunch, and only 60% have dinner. About half of the students mentioned frequent snacking between main meals, which indicates possible violations of the dietary patterns and poor nutrition planning. Over 70% of the students correctly named the main sources of protein, but only 50% understood their importance for tissue growth and repair, as well as the metabolic processes. Proper knowledge about fats was less common. Only 60% of the respondents knew about their role in metabolism and the importance of fats for the absorption of fat-soluble vitamins, and just 40% of the students could list good sources of fats. As for carbohydrates, 55% of the students knew about their importance for energy balance and could name the key sources of carbohydrates. Many students were unaware of the differences between simple and complex carbohydrates. Only 45% of the students correctly identified the sources and functions of essential vitamins. The knowledge about trace elements, such as iron and calcium, was also limited. About 50% of students prefer healthy snacks such as fruits and nuts, while the rest choose less healthy options (potato crisps, sweets, carbonated drinks). Only 40% of the respondents drink the recommended 1.5–2 L of water per day, and the remaining 60% consume less and prefer to quench their thirst with sweet fizzy drinks, which can negatively affect their hydration status and health in general. Most students understand that poor nutrition can lead to various diseases (obesity, diabetes, cardiovascular diseases), but only half of them knows of the relationship between nutrition and the risk of developing such.

The students of the Pediatric Faculty demonstrated a good level of knowledge. Most of them eat 2–3 meals a day: 80% regularly have breakfast, 85% — lunch, and 70% — dinner. About 45% of the students admitted that they often snack between main meals. Some 75% of this group of participants correctly pointed out the main sources of protein and showed clear understanding of its role in tissue growth and repair. The knowledge about fats turned out to be less extensive: 65% of the students knew about their role in metabolism and how important they are for the absorption of fat-soluble vitamins, but only 45% could name good sources of fats. About 60% of the students were aware of the importance of carbohydrates for energy metabolism and could name the main sources of carbohydrates. The awareness of the differences between simple and complex carbohydrates was limited. About 50% of the students could correctly identify the sources and functions of essential vitamins. The knowledge about the importance of trace elements could be improved, though. About 55% of the participants prefer healthy snacks, while the rest opt for less benign options. Only 45% of the respondents drink the recommended 1.5–2 L of water per day, the rest consume much less. Most students understand that poor nutrition can cause various diseases, but only 55% are aware of the role of nutrition in the development of these diseases.

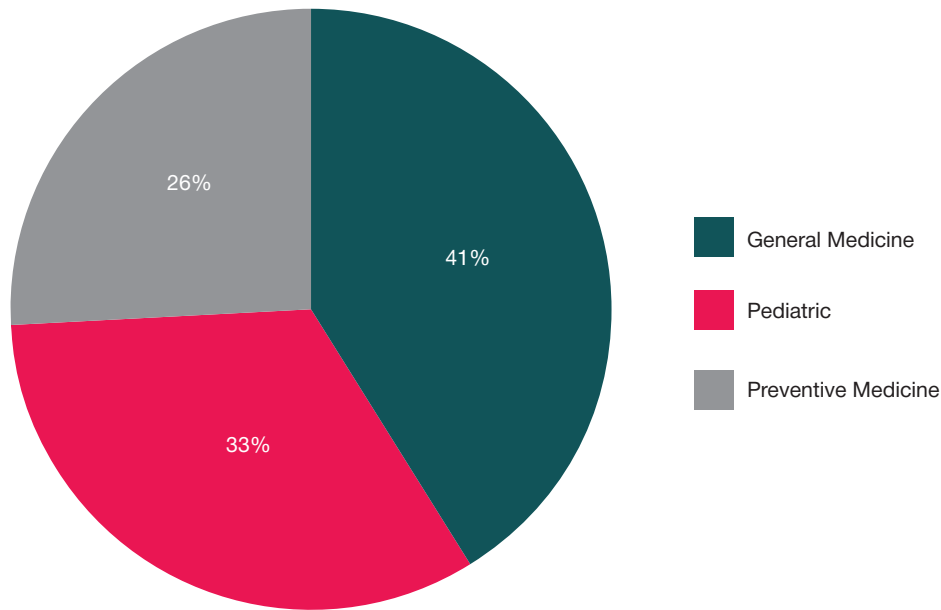


Fig. Faculty-wise distribution of students

Students of the Preventive Medicine Faculty demonstrated good knowledge about nutrition. Most of them eat three meals a day, with 85% regularly having breakfast, 90% — lunch, and 75% — dinner. About 40% of the students admitted frequent snacking between main meals. Some 80% of the participants from this group correctly identified the main sources of protein, and demonstrated understanding of the part they play in the body's vital activities. The knowledge about fats was also quite extensive: about 70% of the students were aware of the role of fats in metabolism and their importance for the absorption of fat-soluble vitamins, and some 60% named healthy sources of fats. This group possessed more information about carbohydrates than students from the other two faculties. About 65% of the respondents knew why carbohydrates are important for energy metabolism, and could name the main sources thereof; 63% of the students were aware of the differences between simple and complex carbohydrates. About 60% of the participants correctly indicated the sources and functions of essential vitamins. The level of knowledge about trace elements (iron, calcium, etc.) was quite high. About 60% of the students prefer healthy snacks, while the rest opt for less benign options. Some 50% consume the recommended 1.5–2 L of water per day, the rest drink less. Most students of the Preventive Medicine Faculty understand that improper nutrition can lead to various diseases, and 58% of them are aware of the relationship between food and the risk of developing these diseases.

To assess the significance of differences in eating habits and nutrition knowledge between the groups, we set up ANOVA. The number of meals per day was chosen as the key indicator, which enabled identification of the dietary trends peculiar to students of different faculties. The ANOVA revealed significant interfaculty differences in the number of meals taken per day, with $p < 0.05$.

The mean values of the number of meals per day were distributed among students of various faculties as follows: students of the Faculty of General Medicine had 2.92 meals a day, students of the Pediatric Faculty — 2.88 meals, and students of the Preventive Medicine Faculty — 2.83 meals. The F-statistic value was 4.12, and p -value was at 0.018, which indicates significant differences in the dietary patterns peculiar to the students of different faculties. These indicators show that

the differences in the number of meals per day between students of different faculties do exist and are statistically significant.

DISCUSSION

The data resulting from our research confirm the conclusions of studies that point to the insufficient awareness of nutrients among students. Similar works demonstrate that this cohort of population often has an unbalanced diet due to both lack of time and insufficient knowledge of the principles of healthy eating [2, 8, 13]. Scholars note that being poorly informed about the role of macro- and micronutrients such as proteins, fats, carbohydrates, vitamins, and minerals students make suboptimal food choices [1, 4, 15].

Despite having basic knowledge about nutrition, most students do not realize the importance of proper distribution of macronutrients and their impact on their health and academic activities. Similar results were reported in the studies that have also shown irregular meals and inclination to snack possibly leading to the development of alimentary-dependent diseases such as obesity, diabetes mellitus, and disorders of the gastrointestinal tract [5, 7].

A number of studies emphasize the importance of educational and preventive programs aimed at raising awareness of healthy eating among students [12, 18, 19]. Our results further confirm it and demonstrate the need to implement such programs in order to train stable healthy habits among students of medical universities.

Thus, the results of our study are consistent with the conclusions of other researchers, and point to the necessity of working out an integrated approach to the students' nutrition and health issues, including information campaigns and efforts to improve the nutrition culture and promote a healthy lifestyle.

CONCLUSIONS

The results of our study show that the VSMU's students possess the basic knowledge about proper nutrition but have gaps in understanding specific aspects thereof. It should be noted that interfaculty, students have different eating habits, which may be due to differences in academic workload, daily routine, and lifestyle. These differences emphasize the need to take into

account the specific needs and living conditions of students when developing nutrition recommendations and organizing the educational process. It is important to factor in the specifics of each faculty in the context of analysis of the resulting data,

and pay special attention to the most problematic aspects. Raising awareness about proper nutrition will help students lead healthier lifestyles, increase their productivity and improve their quality of life in the long run.

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ISSUES OF PROFESSIONAL HYGIENIC TRAINING OF CHILD SUPERVISORS AND EDUCATORS

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Professional hygienic training and certification of specialists employed in the fields associated with epidemiological hazards are of great practical importance. The level of sanitary literacy of those exposed to epidemiologically significant factors determines the sanitary and epidemiological conditions in the respective facilities. This study aimed to gauge the said level among those employed in the field of children's education and upbringing. By design, the study was applied, single-center, cross-sectional, and selective. The object of the study was the staff of a facility with inherent epidemiological risks (child educators and supervisors), and the subject of the study was their level of sanitary literacy. The work lasted for 6 calendar months, until the sample reached the required size needed to reliably calculate the level of sanitary literacy of the staff expressed as means based on the test results. The methods of medical statistics were used for the analysis of the study's results. We discovered that the level of sanitary literacy of persons whose professional activities are related to the upbringing and education of children is low (the average amount of correct answers to the test questions was 65%), and identified attributes influencing the educational process: mode of attendance, gender, age, frequency of training, job title groups.

Keywords: hygienic education, hygienic upbringing, professional hygiene training, hygiene of children and adolescents, level of sanitary literacy

Author contribution: Myznikova IA — determination of the level of sanitary literacy of the employees working at facilities exposed to epidemiological hazards, literature review, collection and analysis of literary sources, article authoring and editing; Mehantiev II, Stepkin Yul — organization of primary data collection, article editing; Nenakhov IG — article editing. All authors confirm conformity of their parts to the international ICMJE criteria (all authors have made a significant contribution to the development of study's concept, its conduct, and article authoring; all authors have read and approved the final version thereof before publication).

Compliance with ethical standards: the study was approved by the Ethics Committee of the Burdenko Voronezh State Medical University (protocol No. 1 dated February 29, 2024). The respondents were informed about the purpose of the study (the informed consent paper prepared and distributed).

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ВОПРОСЫ ПРОФЕССИОНАЛЬНОЙ ГИГИЕНИЧЕСКОЙ ПОДГОТОВКИ РАБОТНИКОВ, ЗАНЯТЫХ В СФЕРЕ ВОСПИТАНИЯ И ОБУЧЕНИЯ ДЕТЕЙ

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Большое практическое значение имеют профессиональная гигиеническая подготовка и аттестация сотрудников эпидемиологически значимых объектов. От уровня санитарной грамотности лиц, контактирующих с эпидемиологически значимым фактором, зависит санитарно-эпидемиологическая обстановка на объекте, что может быть выявлено при осуществлении контрольно-надзорной деятельности. Целью исследования было определить уровень санитарной грамотности сотрудников, занятых в сфере обучения и воспитания детей. Исследование было прикладным, одноцентровым, поперечным и выборочным. Объектом исследования стал персонал эпидемиологически значимого объекта, чья профессиональная деятельность связана с воспитанием и обучением детей, а предметом исследования — уровень санитарной грамотности персонала. Продолжительность исследования составила 6 календарных месяцев, до получения необходимого размера выборки, позволившего достоверно рассчитать уровень санитарной грамотности персонала, выраженный через средний балл по результатам тестирования. Оценку полученных результатов осуществляли, используя методы медицинской статистики. Согласно результатам исследования, уровень санитарной грамотности лиц, чья профессиональная деятельность связана с воспитанием и обучением детей, может быть охарактеризован как низкий (в среднем 65% верных ответов). Выявлены признаки, влияющие на образовательный процесс: форма обучения, половая принадлежность, возрастная группа, периодичность подготовки, группа должностей по отношению к трудовому процессу.

Ключевые слова: гигиеническое обучение, гигиеническое воспитание, профессиональная гигиеническая подготовка, гигиена детей и подростков, уровень санитарной грамотности

Вклад авторов: И. А. Мызникова — проведение исследования уровня санитарной грамотности сотрудников эпидемиологически значимых объектов, обзор литературы, сбор и анализ литературных источников, написание и редактирование текста статьи; И. И. Механтьев, Ю. И. Степкин — организация сбора первичных данных, редактирование текста статьи; И. Г. Ненахов — редактирование текста статьи. Все авторы подтверждают соответствие своего авторства международным критериям ICMJE (все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией).

Соблюдение этических стандартов: исследование одобрено этическим комитетом ФГБОУ ВО «Воронежский государственный медицинский университет имени Н. Н. Бурденко» (протокол № 1 от 29 февраля 2024 г.). Респонденты были ознакомлены с целью проведения исследования (разработан и оформлен опросник «информированное согласие»).

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Hygienic education of the population, an activity well-known in medicine, is of great practical importance [1–4].

Professional hygiene training and certification is an integral component of the system of hygiene education in the Russian Federation and some post-Soviet countries [5–10]. The key to professionals hygienic training is the transfer of systemic sanitary and epidemiological knowledge to the specialists working at epidemiologically significant facilities, i.e., those that deal with production, storage, transportation, and sale of food and drinking water, as well as education and training of children and adolescents, provisions of public utility and household services, as given in the Russian Federation Healthcare Ministry Order 229 of June 29, 2000 "On professional hygienic training and certification of officials and employees of organizations" [11].

For an employee, professional hygiene training is several hours of education followed by certification (in the form of testing or a survey) [5], the results of which are necessarily recorded by the organization providing the said training. Using the data collected by the Center of Hygiene and Epidemiology in the Voronezh Oblast, we analyzed the figures of post-training testing of three groups of students (different job profiles) who studied during the period from 2018 through 2023. The analysis revealed the lowest rate of successfully completed certification in the child educators and supervisors group, which justified further research.

This study aimed to assess the level of sanitary literacy among child educators and supervisors, as it is defined and classified in the Russian Federation Healthcare Ministry Order 229 of June 29, 2000, and to identify the dependence of the said level on factors of the learning process (hereinafter referred to as attributes): mode of attendance, gender, age group, frequency of sessions, job title groups.

METHODS

By design, the study was applied, single-centered, cross-sectional, and selective. Under the concept, it did not employ a control group.

The pattern of the research activities included several stages:

- preparatory stage (study design development, preparation of materials);
- pilot study (determination of the preliminary sample size; at this stage, we calculated the share of the specialists that passed the test (the indicator) in order to find out the sample size that would guarantee statistical significance);
- assessment of the level of sanitary literacy of the specialists working at epidemiologically significant facilities (questionnaire survey);
- processing of the results of the study.

The inclusion criteria were employment at facilities with extremely high, high, significant, medium, moderate, and low epidemiological risk (according to Methodological Recommendations 5.1.0116-17 "Risk-oriented model of control and supervisory activities in the field of sanitary and epidemiological welfare. Classification of economic entities, types of activities and objects of supervision by health hazard potential in the context of planned control and supervisory activities" [12]); employment as child educator and/or supervisor; consent to participate in an anonymous survey.

The core Center of Hygiene and Epidemiology in the Voronezh Oblast and its 8 branches in the districts of the region provided data for the study.

The sample can be considered homogeneous in terms of the level of residual knowledge, since private medical organizations rely on the training materials developed

and recommended by the Center of Hygiene and Epidemiology in the Voronezh Oblast when training their staff.

The planned and actual duration of the study, including the stage of results generalization and statistical processing, was from February to July 2023.

Using the methodological base of the Center of Hygiene and Epidemiology in the Voronezh Oblast, we designed questionnaires to gauge the level of sanitary literacy of the respondents (10 questions), and prove/disprove the hypothesis about the influence of the aforementioned attributes on the said indicator. The questionnaire tasks were approved by the Central Methodological Council of the Burdenko Voronezh State Medical University.

Depending on the choice of the respondents, the questionnaire was supplied on paper (with subsequent collection thereof after filling out) or in the digital form, made using the Yandex.Forms service. The maximum time for completing the tasks was 30 minutes, the limitation controlled by the person who collected the primary data.

In this study, the level of sanitary literacy of the specialists working at epidemiologically significant facilities was the key indicator, since it was organized to assess it.

The attributes suggested as influencing the said level (mode of attendance, gender, age group, frequency of sessions, job title group) were acknowledged as additional indicators.

In the course of the study, we formed the following groups of respondents:

- specialists who received professional hygiene training and underwent certification, and specialists trained in the context of the summer health improvement campaign;
- mode of attendance: full-time, mixed, distance;
- male and female specialists;
- age groups: ≤ 20 years old, 21–35 years old, 36–60 years old, 61–75 years old;
- employees attending training sessions once a year and every two years;
- job title groups: support staff, management personnel exposed to an epidemiologically significant factor, immediate doers of the work the facility is designed for.

In case the questionnaire was filled out on paper, we tallied the results using the codifier; questionnaires filled in the Yandex.Forms service returned the total score automatically.

The principles behind the sample size: since the general totality, i.e., the number of employees of epidemiologically significant facilities engaged in child education and supervision, is remains unknown, the sample size was set at 400 people, as yielded by the methods developed by K.A.Otdelnova and V.I. Paniotto, and as per the calculation (with statistical error at 5%, the calculation suggests the sample size of 236 respondents, which makes 400 a more reliable figure) [13].

The results were processed with the help of MyOffice software (New Cloud Technologies; Russia), using the Pearson's chi-squared test (χ^2), with $p < 0.01$.

RESULTS

The sample consisted of 477 people [13] working in organizations rendering services "education and training of children and adolescents." Inviting the participants, we took into account their direct contact with the epidemiologically significant factor.

Thus, the analysis of the sample following distribution of the respondents into groups, yields the following ratios:

- specialists who received professional hygiene training and underwent certification — 385 individuals (80.7%,

Table 1. Testing results by mode of attendance

Mode of attendance	Average score	Respondents in the group, people, total	Respondents who passed the initial test, people	Respondents who passed the initial test, %
Full-time	6.2	122	57	46.7
Mixed	7.2	196	130	66.3
Distance	6	159	52	32.7

and specialists trained in the context of the summer health improvement campaign — 92 individuals (19.3%);

– specialists that studied full-time — 122 persons (25.6%), practiced mixed mode of attendance — 196 people (41.1%), took part in distance courses 159 individuals (33.3%);

– number of male specialists — 47 persons (9.9%), female 430 persons (90.1%);

– number of people in the ≤ 20 years age group — 78 (16.4%), in the 21–35 years age group — 2116 (4.4%), in the 36–60 years age group — 271 (56.8%), in the 61–75 years age group — 12 (2.5%);

– employees attending training sessions once a year — 92 individuals (19.3%), every two years — 385 persons (80.7%);

– number of support staff representatives — 77 (16.1%), management personnel exposed to an epidemiologically significant factor — 17 persons (3.6%), immediate doers of the designated job — 383 people (80.3%).

The study has shown that the average level of sanitary literacy among specialists involved professionally in education and supervision of children was 6.5 points out of 10.0 possible (65% of correct answers). A parallel study investigated the level of sanitary literacy among those whose job is associated with the production, storage, transportation and sale of food, drinking water, as well as public utilities and household services; they have shown the average scores of 7.9 out of 10.0 (79% correct answers) and 6.6 out of 10.0 (66% correct answers). Thus, those charged with educating and supervising children scored the lowest.

Table 1 presents the calculated values of indicators "percentage of respondents who passed the initial test, %" and "average score" for each group, depending on the mode of attendance. A participant that scored 7.0 out of 10.0 was considered to have passed the test.

To identify significant differences between the groups for the "respondents who passed the initial test, people" indicator, we applied the χ^2 test ($\chi^2_{\text{calc}} = 40.446$, $\chi^2_{\text{table}} = 9.21$, the relationship between factorial and effective attributes considered significant at $p < 0.01$, with 2 degrees of freedom).

Table 2 presents the calculated values of indicators "percentage of respondents who passed the initial test, %" and "average score" for each group, depending on the age.

To identify significant differences between the groups for the "respondents who passed the initial test, people" indicator, we applied the χ^2 test ($\chi^2_{\text{calc}} = 48.032$, $\chi^2_{\text{table}} = 11.345$, the relationship between factorial and effective attributes considered significant at $p < 0.01$, with 3 degrees of freedom).

Table 3 presents the calculated values of indicators "percentage of respondents who passed the initial test, %" and "average score" for each group, depending on the frequency

of sessions. It should be noted that for child educators and supervisors, the frequency of training is determined by the character of their job: those engaged in the summer health improvement campaign are actually trained once a year, while professional hygiene training for them is organized every two years.

To identify significant differences between the groups for the "respondents who passed the initial test, people" indicator, we applied the χ^2 test ($\chi^2_{\text{calc}} = 13.957$, $\chi^2_{\text{table}} = 6.635$, the relationship between factorial and effective attributes considered significant at $p < 0.01$, with 1 degree of freedom).

Table 4 presents the calculated values of indicators "percentage of respondents who passed the initial test, %" and "average score" for each group, depending on the job title (as per OK 016-94. Russian national classifier of professions and tariff categories).

To identify significant differences between the groups for the "percentage of respondents who passed the initial test, %" indicator, we applied the χ^2 test ($\chi^2_{\text{calc}} = 39.913$, $\chi^2_{\text{table}} = 9.21$, the relationship between factorial and effective attributes considered significant at $p < 0.01$, with 1 degree of freedom).

Application of the χ^2 test to the gender data of the respondents revealed that it had no effect in their level of sanitary literacy.

Among the undesirable events, we considered erroneous filling out of questionnaires intended for the mentioned parallel study that involved other professional groups (production, storage, transportation and sale of food products, drinking water; public utilities and household services). There were 43 such forms in total, they were discarded from the processed batch.

DISCUSSION

The overall level of sanitary literacy of the specialists engaged in child education and supervision was 65%, i.e., on average, the respondents answered correctly to 6.5 questions out of 10.0.

Findings based on the attributes:

– the number of specialists that have passed the test was the highest in the mixed mode of attendance group, same as the average score;

– the fewest number of respondents who have passed the test was in the 61–75 years old age group;

– the largest number of respondents who have passed the test was in the group that was trained hygiene every two years;

– the largest number of respondents who have passed the test was in the "support staff" group, the smallest — in the "immediate doers of the job" group.

The most practically significant indicator was the level of sanitary literacy, expressed in terms of the average test score.

Table 2. Testing results by age group

Age group	Average score	Respondents in the group, people, total	Respondents who passed the initial test, people	Respondents who passed the initial test, %
≥ 20 years old	7.3	30	30	100
21–35 years old	6.8	116	58	50
36–60 years old	7.9	271	149	54.9
61–75 years old	4.5	54	2	3.7

Table 3. Testing results by frequency of training sessions

Frequency of sessions	Average score	Respondents in the group, people, total	Respondents who passed the initial test, people	Respondents who passed the initial test, %
Once a year	5.9	92	30	32.6
Every two years	6.7	385	209	54.3

Table 4. Testing results by job title group

Job title group	Average score	Respondents in the group, people, total	Respondents who passed the initial test, people	Respondents who passed the initial test, %
Support staff	7.7	77	58	75.3
Management personnel exposed to an epidemiologically significant factor	6.5	17	6	35.3
Immediate doers of the work the facility is designed for	6.3	383	175	45.7

The registered value of 6.5 out of 10.0 is below the successful passing threshold of 7.0.

The data yielded by the statistical processing of the study results cannot be considered as random, since they are backed by a sufficient sample size calculated using three methods, and by the following judgments:

- the mixed mode of attendance has proven to be the most effective, since, in the context of a professional hygiene training, the student can not only to consult with the teacher in person, but also study independently using the materials provided; distance learning has proven to be the least effective [14–16];

- specialists belonging to the 61–75 years old age group form the most vulnerable cohort in terms of professional hygiene training;

- the highest average score was registered for the specialists that are trained hygiene every two years, probably because those tested once a year participate in distance learning courses primarily, which was also discovered by the study;

- the "immediate doers of the job" group scored the lowest in the test, which may be due to the higher complexity of the educational program compared to other groups, since each job title receives an individual program.

One of the limitations of this study is the lack of data (both in official sources and medical literature) on the number

of people working at epidemiologically significant facilities in the country in general and Voronezh Oblast in particular [7, 8].

In addition, the developed methodology for determining the level of sanitary literacy of employees of epidemiologically significant facilities stems from the data provided by the Center of Hygiene and Epidemiology in the Voronezh Oblast (including test tasks), however, there have been set up no studies to confirm the validity of test tasks used to certify the results of professional hygiene training.

CONCLUSIONS

This study allowed assessing the level of sanitary literacy of child educators and supervisors as low, and helped identify and analyze the main factors (attributes) affecting the educational process and the ultimate residual level of knowledge. Thus, in the context of professional hygiene training, people belonging to the 61–75 years old age group form the most vulnerable cohort, same as the "immediate doers of the job" group, and the most effective mode of attendance is mixed.

The developed and tested study model and the data obtained can be used for optimization of the process of professional hygienic training and certification of employees of epidemiologically significant facilities.

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METHODOLOGICAL ASPECTS OF RISK MONITORING FOR THE HUMAN HEALTH SHAPING, MAINTENANCE, AND PRESERVATION DIGITAL PLATFORM

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Solving the problems of ensuring long and active life of all Russians, regardless of their place of residence, requires the development and implementation of digital preventive medicine technologies. It is noted that it is necessary to develop and implement health risk monitoring consistent with the digital technology development level, principle of data-driven management, and conceptual provisions of the disease prediction and prevention, personalized and participatory nature of medical care to create the human health shaping, maintenance, and preservation digital platform. The paper provides the rationale for the fact that the block (cascade) diagram of occupational health changes in aviation, the use of which as part of the digital platform to be created requires enlargement of the set of blocks of the health risk minimization cascade and the cascade of the risk factor effect minimization aimed to consider all the health risk minimization potentialities, as well as to develop methodological support of the risk factor dose and health risk calculation aimed to cover the maximum number of social and occupational population groups, meets these requirements.

Keywords: cascade diagram of health changes, digital preventive medicine, health risk, health risk monitoring, digitalization of healthcare, data-driven management, 4P-medicine, health risk management

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МЕТОДИЧЕСКИЕ АСПЕКТЫ МОНИТОРИНГА РИСКОВ ДЛЯ ЦИФРОВОЙ ПЛАТФОРМЫ ФОРМИРОВАНИЯ, ПОДДЕРЖАНИЯ И СОХРАНЕНИЯ ЗДОРОВЬЯ ЧЕЛОВЕКА

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Решение задач обеспечения продолжительной и активной жизни всех россиян, вне зависимости от их места проживания, требует разработки и реализации технологий цифровой профилактической медицины. Отмечено, что для создания цифровой платформы формирования, поддержания и сохранения здоровья человека необходимо разработать и реализовать мониторинг рисков здоровью, соответствующий уровню развития цифровых технологий, принципу управления на основе данных и концептуальным положениям предупреждения и предотвращения заболеваний, персонализации и партисипативности медицинской помощи. В статье приведено обоснование того, что этим требованиям соответствует структурная (каскадная) схема изменений профессионального здоровья в авиации, применение которой в составе создаваемой цифровой платформы требует расширения набора блоков каскада минимизации рисков здоровью и каскада минимизации эффектов факторов риска в интересах учета всех потенциальных возможностей минимизации рисков здоровью, а также развития методического обеспечения расчета доз факторов риска и рисков здоровью в интересах охвата максимального количества социо-профессиональных групп населения.

Ключевые слова: каскадная схема изменения здоровья, цифровая профилактическая медицина, риск здоровью, мониторинг рисков здоровью, цифровизация здравоохранения, управление на основе данных, 4П-медицина, управление рисками здоровью

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One of the national development goals of the Russian Federation for the period until 2030 and for the future until 2036 is determined as “maintenance of the population, health improvement, human well-being promotion, support of the family”, and achieving these goals envisages “creation and launch by the year 2030 of the digital platform contributing to shaping, maintenance, and preservation of human health throughout human life based on the data-driven management principle” [1].

The key objective of the digital platform created is to ensure reliable intuitive digital service for the citizens’ communication with medical professionals and medical institutions, access

to the digital health profile, features regarding self-monitoring and decision-making to maintain and improve health.

The experience in the development and operation of the digital services that are comparable in scale (public services portal, banking applications, etc.) suggests public confidence in reliability and confidentiality of the information acquisition and processing. That is why the issues of implementation of the consolidation of personal data (including health information) of the patients from medical institutions of various ownership and independently acquired information at the federal level within the framework of the digital platform developed are potentially

solvable. However, it is still necessary to earn the citizens' trust in terms of usefulness of the digital platform created for health maintenance and improvement.

Consolidation of information about the citizens' health provides a framework to address the issues of preventive medicine: prevention of diseases and injuries, prevention and elimination of the risk of diseases and injuries. Objective information about health risks is needed to solve such problems [2–5]. The analysis of past experiences shows that the issues of health risk monitoring are effectively resolved using the block (cascade) diagram of occupational health changes in aviation [6].

The study was aimed to provide the rationale for proposals regarding adoption of the block (cascade) diagram of occupational health changes in aviation for solving problems of risk monitoring during implementation of the digital platform for human health shaping, maintenance, and preservation.

Methods

We performed systematic analysis of the block (cascade) diagram of occupational health changes in aviation in order to determine the possibility to ensure it keeps pace with the digital technology development and is consistent with the data-driven management principle and the concept of 4P-medicine based on the principles of predictive, preventive, personalized, and participatory healthcare.

Block (cascade) diagram of health changes

During their life humans are continuously exposed to the effects of manageable (behavioral, metabolic, environmental) and non-manageable (biological, genetic, demographic) health risk factors. The impact of risk factors on human health is largely determined by the person's individual characteristics combining the following: body's compensatory response specifics; prior condition; individual resistance to the effects of certain risk factors; mobilization of body reserves; psycho-emotional, motivational, and volitional commitment to activity, etc. [7–9].

The changes in human condition resulting from the current and cumulative effects of adverse factors lead to depletion of body's reserve capacity and, as a consequence, to deterioration of health [10–12]. Reduction of the effective dose of the exposure to factors requires an integrated solution to multidirectional super-tasks:

- human health preservation and professional longevity extension require reduction of the dose and intensity of the influencing risk factors;
- the need for life support in the context of increasing industrial and domestic equipment capacity, increasing intensity of professionally significant information flows, reduced time costs for the decision-making support in the course of activity requires life support in the context of increasing health risk factor intensity and exposure time [13, 14].

A complete picture of immediate (acute) and delayed effects of such changes is described by the cascade diagram of health changes (Fig.) based on the dose approach to standardization of factors [6]. The operation logic of such diagram combining blocks that belong to one of three cascades is as follows [6]:

- the risk of potentially dangerous conditions and health deterioration is determined by the risk factor dose in accordance with the first cascade;
- reduction of the dose of the risk factors of adverse conditions and health deterioration is achieved through blocks of the second and third cascades.

Lines on the diagram show the relationships between the cascade blocks (Fig.); different line patterns are chosen only for reasons of better readability of the drawing.

There is a factor dosimeter in front of each block (designated by double lines in the Figure) — a module (block, device) calculating the actual dose of the risk factors (D) determining health risk (R_i) for each i^{th} block of the cascade. Thus, in terms of digital technology, we can say that each i^{th} block of the central cascade ensures conversion of the risk factor dose arriving at the input to the health risk estimate R_i :

$$R_i = f_i(D),$$

where f_i is a functional relationship between the risk factor dose and the health risk. Construction (structural and parametric identification) of the functional dependence f_i for specific risk factors, specific health problems, and specific social and occupational population groups is a challenging problem requiring the joint effort of physicians and engineers (mathematicians). However, it is necessary to ensure the methodological approach “transparency” providing confidence in the risk estimates obtained. This, in particular, eliminates the possibility of using neural network technologies for calculation of health risk estimates. The methods and examples of effective solution of the problems of synthesis of the functional dependencies linking the risk factor dose and the health risk estimates are presented, in particular, in the papers [15–21].

The risk factor doses arriving at the factor dosimeter input are essentially exposure doses, while the doses at the factor dosimeter output are absorbed (effective) doses. Apparently, the following relationship is true for the risk factor doses:

$$D_1 \geq D_2 \geq D_3 \geq D_4 \geq D_5 \geq D_6 \geq D_7,$$

moreover, the equal sign is possible only in the case of ineffective functioning of all the blocks linked to the appropriate factor dosimeter.

A similar relationship is true for health risk:

$$R_1 \geq R_2 \geq R_3 \geq R_4 \geq R_5 \geq R_6 \geq R_7,$$

moreover, the equal sign is possible only in the case of ineffective functioning of the appropriate cascade block.

The theoretically possible situations, where the cascade block leads not to the decrease, but to the increase in the doses of factors and health risks, are not considered; the axiom about the good faith of the developers of the measures specified in the relevant blocks is accepted.

Three interrelated, continuously interacting cascades that constitute the cascade diagram of health changes (Fig.) are united by the blocks solving specific problems [6].

The first (central, core) cascade is a *cascade of health changes*, around which a system counteracting the negative influence of risk factors on health and minimizing the effects of such influence is formed. It describes the sequence of health risk formation and manifestation and includes the links of the influences considered, each of which corresponds to the block of this cascade. Specialists from many branches of science are engaged in the multifaceted study of the first cascade blocks, and the progress of such studies is considered to be associated with taking into account the increasing number of the cascade blocks characterizing various aspects and components of human health. In the Figure, the first cascade includes six sequentially linked blocks.

1. Human body under specific conditions of vital activity: determines health risk (R_1) based on the individual characteristics of the body, exposure and dose of the influencing health risk factors.

2. Immediate (acute and early) manifestations of health deterioration: determines the health risk (R_2) manifesting itself within a month from the date of the risk factor exposure termination.

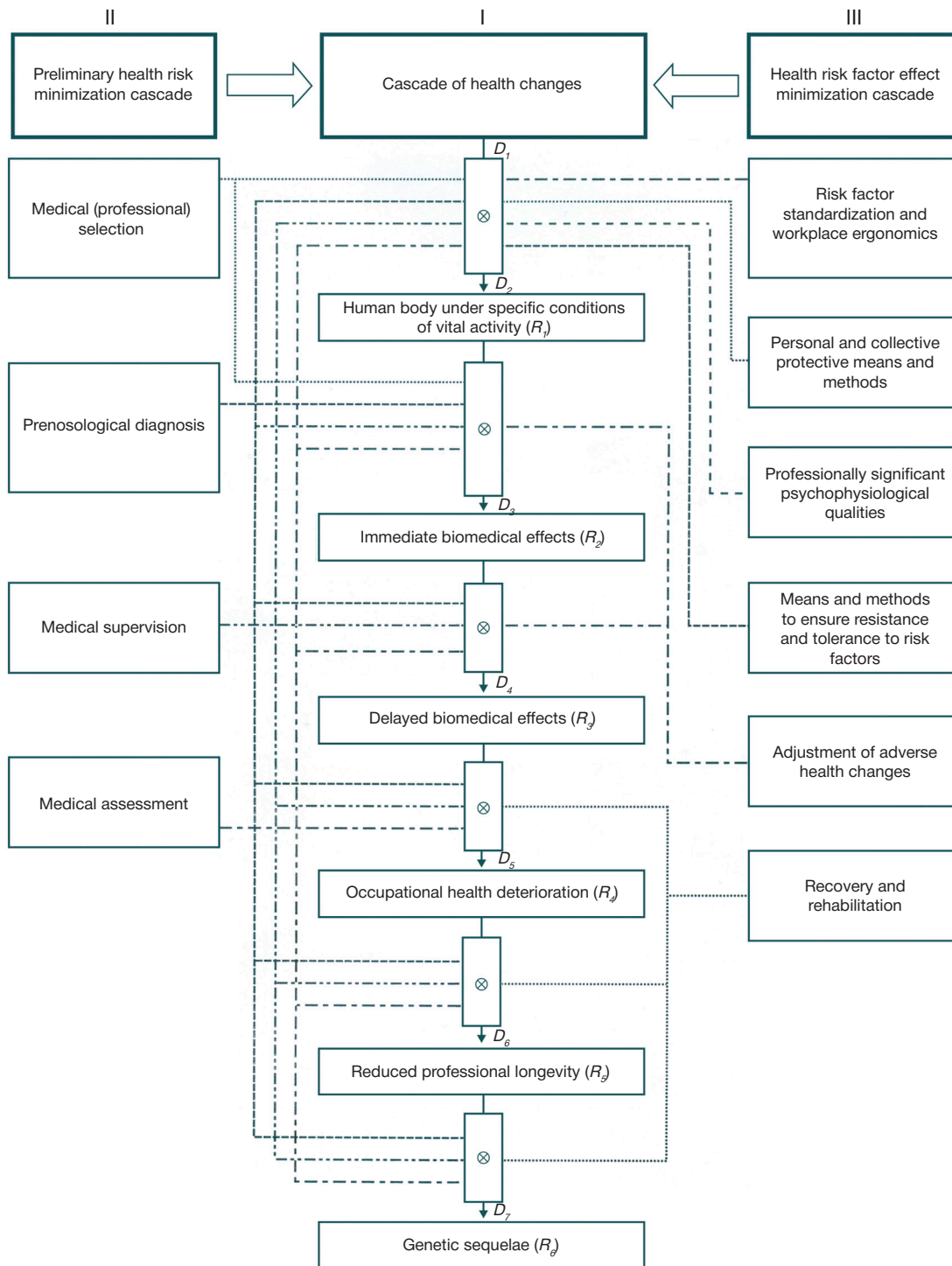


Fig. Block (cascade) diagram of health changes

3. Delayed manifestations of health deterioration: determines the health risk (R_3) manifesting itself within a period exceeding a month from the date of the risk factor exposure termination, as well as the risk resulting from the cumulative effect of such factors.

4. Occupational health deterioration: determines the health risk (R_4) characterized by the body's inability to maintain the compensatory and protective properties that ensure working capacity and human endeavor reliability under all conditions of professional activity implementation.

5. Reduced professional longevity: determines the health risk (R_5) characterized by the individual's inability to maintain professional working capacity, i.e. inability to execute professional

tasks at the desired level (with the desired quality) throughout the period of employment determined by society.

6. Genetic sequelae: determines the health risk (R_6) causing abnormal changes in the body that are transmitted to the next generation.

The second cascade is a cascade of a priori measures aimed to minimize the risk of adverse health changes. It combines medical and professional selection, prediction of human body resistance (including phenotyping), prenosological diagnosis, medical supervision, and medical assessment. In the Figure, the second cascade includes four independent blocks.

1. Medical (professional) selection: system of measures aimed to minimize the risk that an individual would be engaged

in the labor activities inconsistent with his/her health status and physical development level.

2. Prenosological diagnosis: system of measures aimed to minimize the risk of failure to reveal adverse changes in the body not registered as a diagnosis (prenosological dysfunction of the body).

3. Medical supervision: system of measures aimed to minimize health risk through continuous health monitoring, compliance with the sanitary, hygienic, and epidemiological standards and rules.

4. Medical assessment: system of measures aimed to minimize the risk that the citizens unable to perform activities due to their current health status would be allowed to perform such activities.

The third cascade is a *cascade for prevention of the developing health problems*. It characterizes a multi-level structure of biomedical and psychophysiological “restraints” to the effects of risk factors. In the Figure, the third cascade includes six independent blocks.

1. Risk factor standardization and workplace ergonomics improvement: system of measures aimed to minimize the health risk resulting from the fact that the risk factors exceed the acceptable (permissible) levels and from uncomfortable task execution conditions.

2. Personal and collective protective means: means for prevention or reduction of the effects of harmful and hazardous occupational factors, as well as for protection against the polluted environment.

3. Development of professionally significant psychophysiological qualities: system of measures aimed to minimize the health risk resulting from the individual’s inability to self-regulate his/her psychophysiological state when performing the activity.

4. Increasing resistance and tolerance to risk factors: system of measures aimed to minimize the health risk resulting from the exposure to the risk factors that are above the permitted standards.

5. Adjustment of adverse health changes: system of measures aimed to minimize the health risk resulting from the development of problems detected at the early stage and not requiring dismissal of an employee from the activities for health reasons.

6. Recovery and rehabilitation: system of measures aimed to minimize the health risk resulting from the reduced human body’s functional capabilities.

It is clear that the more blocks of the second and third cascades are connected to the first cascade, the less likely and severe are adverse health changes resulting from the risk factor exposure (the less are appropriate D_i and R_i values). That is why one of the priority directions of health risk management is the development of means and methods to determine the contribution of each block of the second and third cascades to health riskometry in the units of the decrease in the effective dose of each risk factor or the decrease in the risk of adverse effects of the exposure to each risk factor according to the “cost–benefit” criterion.

The cascade diagram is of fundamental nature and is in principle applicable for health monitoring in representatives of any social and professional population group. However, to date, it has been largely adapted for health monitoring in pilots and astronauts [15, 18, 20, 22]. The main reason is the centralized, systematic and continuous nature of medical care provided to pilots and astronauts.

Currently, thanks to healthcare digitalization, the centralized and systematic medical care is provided to representatives of all social and professional population groups, which opens up new scopes of the cascade diagram application [23–28].

Data-driven management of health

It should be emphasized that the produced digital platform for human health shaping, maintenance, and preservation throughout the life will be constructed in accordance with the data-driven management (DDM) principles, which will contribute to the effective practical use of the cascade diagram in digital healthcare.

The digital platform implementation in accordance with the data-driven management principles implies that information about human health is used not only for one-time or periodic support of making decisions about human health shaping, preservation, and restoration, but also for continuous support of such decision-making throughout human life (including perinatal period). The solution to such problems is achieved through implementation of business processes (sets of interrelated tasks and activities aimed at achieving certain goals or results within the framework of the digital platform) on the demand of users (on-demand) for data streaming resulting from the network communication of the digital platform participants aimed at performing certain actions precisely in those moments when it is necessary (realization of the “on-demand economy” concept) [29].

The data-driven management of human health shaping, preservation, and restoration is a cyclic process: health information from multiple sources is continuously collected on the servers; the information collected is processed and analyzed automatically, the results are provided to users online in accordance with the information access policy. The management efficiency largely depends on the organization of data handling that involves ensuring data acquisition, data storage, data analysis (processing), data exchange, communication between the process participants, and many other things. Furthermore, it is necessary to ensure [30]:

- consistency: all the information acquisition and handling processes, software applications and data repositories should constitute a single, continuously functioning system with the universal architecture;

- agility: the management processes should be realized based on the agile technology ensuring quick response to changes in the “external environment”, quick adaptation of services to user needs, continuous monitoring of the internal processes underlying the digital platform functioning aimed at ensuring continuous optimization of the processes;

- transparency: ensuring the possibility of tracking information at any time using the big data technologies and the distributed ledger technologies (blockchain technologies), continuous monitoring of costs and resources making the results accessible for all users in accordance with the policy of restricting access to information;

- parsimony: the digital platform single information space must ensure multiple use of the data accumulated for solving various applied problems, minimizing the costs of searching and processing data;

- efficacy: ensuring maximum satisfaction of the needs of the digital platform users with the constant increase in the number of users and the number of problems to be solved, along with the continuous minimization of the costs required to quickly achieve meaningful results.

Features of using the cascade diagram of health changes

The use of the cascade diagram of health changes is fully consistent with the concept of 4P-medicine; it ensures:

- prediction and prevention of diseases due to implementation of health risk monitoring and the possibility of risk management through preliminary risk minimization (the second cascade

of the diagram) and minimization of the risk factor effects (the third cascade of the diagram);

- healthcare personalization due to the possibility of individual monitoring of health changes;
- participative nature of healthcare due to the possibility of ensuring the patient's direct involvement in management of health changes through informing about the health risk and ways (methods, technologies) to minimize it.

The use of the cascade diagram of health changes is fully consistent with the data-driven management principle; it makes allows one to:

- implement continuous monitoring of health risk in representatives of all social and professional groups based on combining the results of health monitoring at the individual and population levels;
- ensure the a priori high potential efficacy of the implementation of health preservation and maintenance measures due

to the possibility to calculate the doses of risk factors and health risk by “connecting”, “disconnecting”, and changing the characteristics of the second and third diagram cascade blocks.

CONCLUSION

The study has shown the feasibility of using the cascade diagram of occupational health changes to solve the problems of health risk monitoring during implementation of the digital platform for human health shaping, maintenance, and preservation. For that it is necessary to expand the range of the health risk minimization cascade and risk factor effect minimization cascade blocks in order to consider all the health risk minimization potentialities, as well as to develop methodological support of the risk factor dose and health risk calculation in order to cover the larger number of social and professional population groups.

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ANALYSIS OF STUDENTS' AWARENESS OF MEASURES TO PREVENT INFECTIONS WITH FECAL-ORAL AND HEMATOGENIC TRANSMISSION MECHANISMS

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Great attention is traditionally paid to prevention of infectious diseases in pediatric population. Along with the institutional, therapeutic and preventive measures, it is necessary to control public awareness of such issues. The study was aimed to analyze awareness of primary school, high school, and senior school students, college and university students of the issues related to prevention of infections with fecal-oral and hematogenic transmission mechanisms. The study was carried out using the private online questionnaire consisting of three items (personal information, questions regarding awareness of the infections with fecal-oral and hematogenic transmission mechanisms). The properly filled questionnaires of the respondents, who had given to consent to participation in the study, were analyzed. It was found that schoolchildren aged 12–15 years were the least informed about the issues related to prevention of infections with fecal-oral and hematogenic transmission mechanisms, while the group of students aged 18–30 years was the most informed. It was hypothesized that parents influenced the choice of answer made by schoolchildren aged 6–11 during the online survey. It has been proposed to ensure raising of the 6–15-year-old students' awareness of the issues related to prevention of infectious diseases, including by means of hygienic education when mastering such school curriculum subjects, as Biology and Human Life Safety.

Keywords: risk factors, prevention, infectious diseases, fecal-oral transmission mechanism, hematogenic transmission mechanisms, students, hygienic education

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Compliance with ethical standards: the study was approved by the Ethics Committee of the Pirogov Russian National Research Medical University (protocol No. 159 dated 21 November 2016). The informed consent was obtained for all study participants. The study was in line with the principles of biomedical ethics and did not endanger the subjects.

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АНАЛИЗ ИНФОРМИРОВАННОСТИ ОБУЧАЮЩИХСЯ О МЕРАХ ПРОФИЛАКТИКИ ИНФЕКЦИЙ, ИМЕЮЩИХ ФЕКАЛЬНО-ОРАЛЬНЫЙ И ТРАНСМИССИВНЫЙ МЕХАНИЗМ ПЕРЕДАЧИ

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Профилактике инфекционных заболеваний среди детского населения традиционно уделяют большое внимание. Наряду с мерами организационного, лечебно-профилактического направления необходимо контролировать уровень информированности населения по этим вопросам. Целью проведенного исследования был анализ информированности обучающихся начальных, средних и старших классов, студентов колледжей и вузов по вопросам профилактики инфекций, имеющих фекально-оральный и трансмиссивный механизм передачи. Исследование выполняли с использованием анонимной онлайн-анкеты, состоящей из трех блоков вопросов (паспортная часть, вопросы, касающиеся информированности о мерах профилактики инфекций, имеющих фекально-оральный и трансмиссивный механизм передачи). Анализировали корректно заполненные анкеты респондентов, давших согласие на участие в исследовании. Установлено, что наименее информированными в вопросах профилактики инфекций, имеющих фекально-оральный и трансмиссивный механизм передачи, являются школьники 12–15 лет, а наиболее информированными — группа обучающихся 18–30 лет. Выдвинуто предположение о том, что на выбор ответа школьниками 6–11 лет в ходе онлайн-анкетирования повлияли родители. Предложено обеспечить повышение информированности обучающихся 6–15 лет в вопросах профилактики инфекционных заболеваний, в том числе формами и средствами гигиенического воспитания в ходе освоения предметов школьной программы «Биология», «Основы безопасности жизнедеятельности».

Ключевые слова: факторы риска, профилактика, инфекционные заболевания, фекально-оральный механизм передачи, трансмиссивный механизм передачи, обучающиеся, гигиеническое воспитание

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Consumption of substandard food and water, safety of which depends on the epidemiological well-being of the environment and is determined by changes in climatic parameters, is the most common cause of infectious diseases in children. According to the World Health Organization (WHO), the above factors affect the prevalence of 31 infectious diseases. Higher rate of the infectious diseases (including fatal cases) caused by substandard drinking water is reported in the medium and low-income countries, for example in Africa and Asia. Natural disasters (floods, mudflows, landslides, etc.), along with the extreme climate change and the associated water pollution, also increase the risk of parasitic diseases [1].

Diarrhea and acute respiratory infections are the leading causes of morbidity and mortality among children under the age of 5 years all over the world. There is evidence that breastfeeding reduces the risk of gastrointestinal and respiratory infections. The review prepared using the Medline, Embase and Scopus databases for the years 2010–2022 reports the analysis of 70 studies, of which 60 have confirmed a positive correlation between breastfeeding only and the reduced risk of some gastrointestinal, respiratory, and other infections in both low-income and high-income countries. The researchers have confirmed that the more prolonged breastfeeding protects against many infectious diseases [2].

The analysis of epidemiological situation for certain groups of infectious diseases in Poland has shown that gastrointestinal infections are among the most prevalent in the population. Furthermore, rotavirus infections predominate among children, while the infections caused by *Clostridium difficile* predominate among adults. The increase in the rate of intestinal infections caused by persistence of this anaerobic Gram-positive rod-shaped bacterium in the body represents a serious problem largely associated with the use of broad spectrum antibiotics. The spread of hepatitis A transformed into epidemic in 2017 [3].

According to the data provided by the researchers, the total share of the infectious diseases associated with climatic factors varies between 9.0 and 18.0%. It has been shown that socio-economic status and anthropometric parameters can modify the effects of climate on pediatric morbidity. Children suffering from growth retardation, exhaustion, and underweight are most susceptible to infectious diseases [4].

In a community of individuals, human is the main source of the spread of infectious diseases. Huang Y. et al performed a questionnaire survey in the populations of three Chinese cities in winter and summer. The study involved polling of 5818 participants, during which a total of 35,542 contacts were reported. The average number of contacts, including occupational ones, per individual per day was 16.7. Daily contacts, the average duration of which exceeded 4 h, occurred mostly at home and were most often physical. The number of physical contacts in winter was higher than that reported for summer months [5].

Great attention is paid to the prevalence of encephalitis in pediatric population. According to retrospective analysis of outpatient medical records in the city of Houston (USA), encephalitis can not only facilitate the development of neurological symptoms, but also lead to death, in both urban and rural populations [6]. Considering the possibility of infectious brain injury after the bite of the tick infected with the tick-borne encephalitis virus, prevention of this disorder in the population is relevant.

Timely vaccination in accordance with the national immunization schedule, affordable competent medical care represent effective methods to prevent infectious diseases in children and adolescents, as well as in adults. Assessment

of awareness of students at different levels of training of the risk factors and effective measures to prevent infectious diseases is relevant in terms of the search for and development of the most effective preventive programs and activities.

The study was aimed to analyze the students' awareness of the measures to prevent infections with fecal-oral and hematogenic transmission mechanisms.

METHODS

In 2023, we performed a random online questionnaire survey of students attending educational institutions of various levels of training: 322 primary school students, 238 high school students, 75 senior school students, as well as 76 students attending colleges and universities of various profiles.

The anonymous online questionnaire survey was performed using the questionnaire developed by experts of Rospotrebnadzor for the All-Russian Dictation on Public Health in autumn 2023 [7]. The questionnaire consisted of 21 questions. The questionnaire included personal information and the questions regarding the respondents' awareness of the measures to prevent infections with fecal-oral and hematogenic transmission mechanisms. The first item was focused on assessing awareness of the measures to prevent infections with fecal-oral transmission mechanism. The questionnaire contained questions, whether it is reasonable for several people to use the same glass for drinking; whether it is enough to use antiseptic instead of hand washing with soap; about the need to wash hands with soap before eating, after the use of the toilet, to wash fruits in the peel (such as bananas, oranges, tangerines) and eggs before cooking; about the sources of infections, modes of transmission and groups at risk of intestinal infection; what kind of water can be used for drinking while traveling; whether it is true that food that has fallen on the floor can be eaten without concerns about its safety if it has been on the floor for less than 5 s.

The second item focused on prevention of diseases with hematogenic transmission mechanism consisted of the following questions: how to dress properly before going to the forest in spring and summer; where the ticks most often wait for their victims; what to do if you find a tick on yourself; whether it is possible to get infected with malaria through mosquito bite; why you can't swim in the water bodies where there is a sign saying "Swimming is prohibited"; what are the main signs that a person has lice.

The questionnaires were divided into groups based on the surveyed students' age (6–11 years, 12–15 years, 16–17 years, 18–30 years). The properly filled questionnaires were included in the analysis.

Statistical data processing was performed using descriptive statistics. The analysis involved the use of parametric statistical methods; the mean (M) and error of the mean (m) were calculated. Student's t -test was used to assess significance of differences between mean values. The differences in the results were considered significant at $p < 0.05$.

RESULTS

Among surveyed students, nobody was there to give correct answers to the questions of the questionnaire about prevention of infections with fecal-oral and hematogenic transmission mechanisms. The mean share ($M \pm m$) of correct answers given by students was $88.9 \pm 1.8\%$.

The largest share of incorrect answers was reported for students aged 12–15 years (high school students).

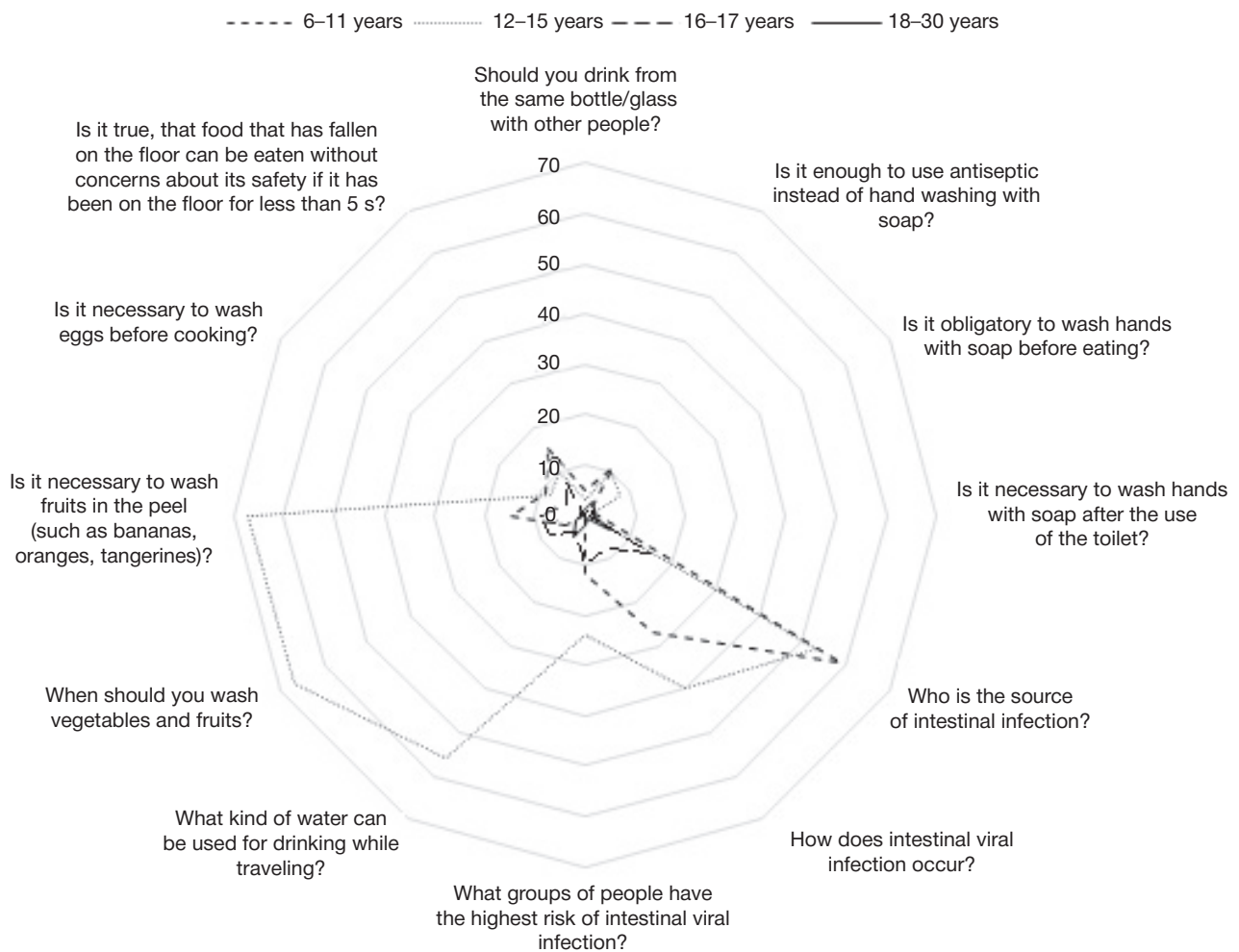


Fig. 1. The share of incorrect answers to the questions about the infections with fecal-oral transmission mechanism given by the respondents (%)

The questions that were given incorrect answers, compared to the answers given by the respondents from other groups ($p < 0.05$), were as follows: "Is it necessary to wash fruits in the peel?" (incorrect answer was given in 67.0% of cases); "When should you wash vegetables and fruits?" (67.0% of cases); "What kind of water can be used for drinking while traveling?" (56.0% of cases); "Who is the source of intestinal infection?" (53.0% of cases) (Fig. 1).

The question "Who is the source of intestinal infection?" also troubled primary school students (in 59.0% of cases) ($p < 0.05$) (Fig. 1).

Every fifth high school student gave a wrong answer to the question about the group at risk of getting infected with intestinal infection (Fig. 1).

The share of incorrect answers to the questions, whether it is reasonable for several people to use the same glass for drinking; whether it is enough to use antiseptic instead of hand washing with soap; about the need to wash hands with soap before eating, after the use of the toilet; about the need to wash eggs before cooking; whether it is reasonable to eat food that has fallen on the floor if it has been there for less than 5 s, among students of all age groups, including college and university students, was comparable and did not exceed 10%.

The smallest share of incorrect answers to the questions about the infections with fecal-oral transmission mechanism was reported for the respondents aged 18–30 years (Fig. 1).

The vast majority of high school students gave incorrect answers to the questions "What are the main signs that a person has lice?" (in 80.0% of cases) and "Is it possible

to get infected with malaria through mosquito bite?" (in 46.0% of cases) ($p < 0.05$) (Fig. 2).

The question "Is it possible to get infected with malaria through mosquito bite?" also troubled primary school students (in 57.0% of cases) ($p < 0.05$) (Fig. 2).

Every fifth high school student gave a wrong answer to the question "Why can't you swim in the water bodies where there is a sign saying "Swimming is prohibited"?" (Fig. 2).

The smallest share of incorrect answers to the questions about the infections with hematogenic transmission mechanism was reported for the respondents aged 18–30 years (Fig. 2).

DISCUSSION

The study showed that the group of students aged 12–15 years was the least informed about the issues related to prevention of infections with fecal-oral and hematogenic transmission mechanisms. The 18–30-year-old students were the most informed.

The results of the questionnaire survey of students aged 6–11 years, based on the main answers to the questions about prevention of infections with fecal-oral and hematogenic transmission mechanisms, were comparable with the answers of students aged 18–30 years, except for answers to the questions about the source of intestinal infection and the possibility of getting infected with malaria through mosquito bite. Such results were likely to be obtained due to the fact that parents controlled and corrected the answers given by students during the questionnaire survey.

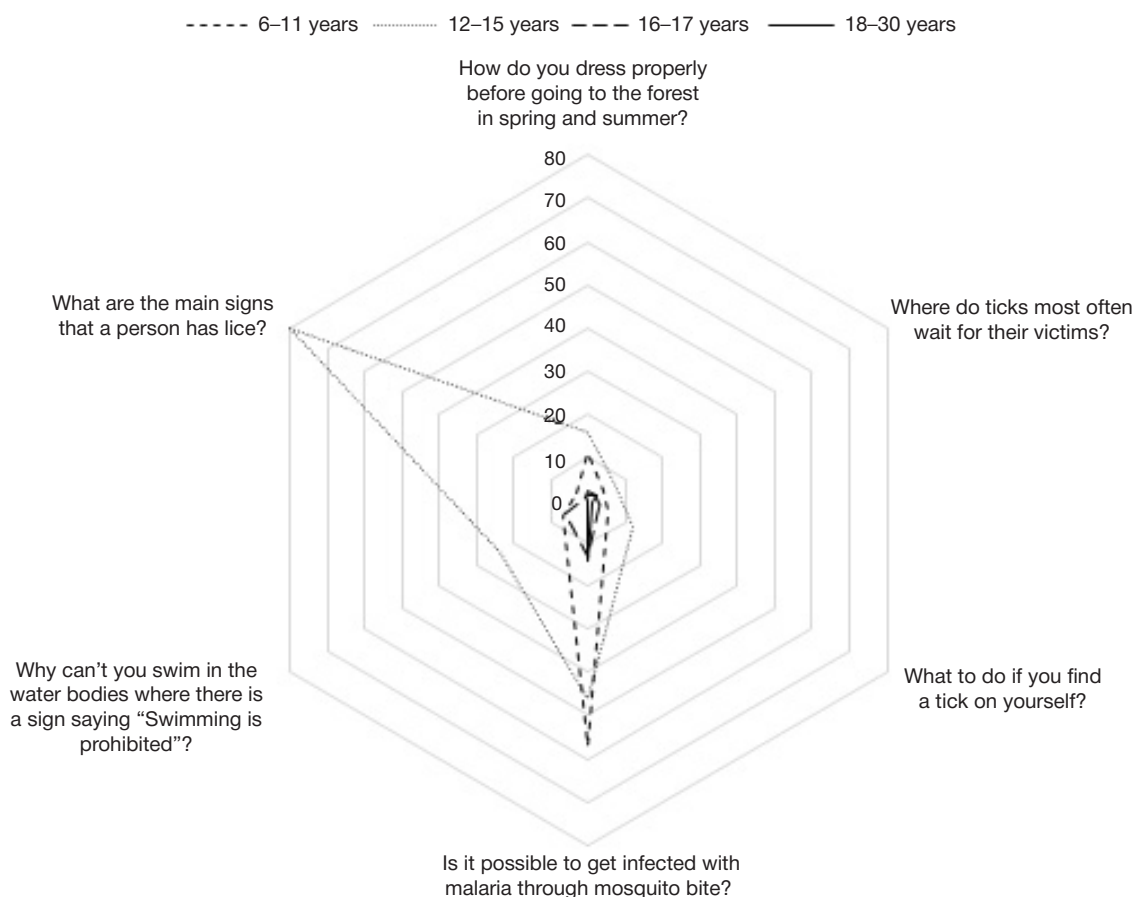


Fig. 2. The share of incorrect answers to the questions about the infections with hematogenic transmission mechanism given by the respondents (%)

Summarizing the data obtained, it can be concluded that schoolchildren aged 6–15 years are the least informed about the issues related to prevention of infections with fecal-oral and hematogenic transmission mechanisms. In our opinion, raising awareness of this category of students, including using the hygienic training forms and means, seems to be the most topical.

The data from social media and mass media is usually the main source of information about prevention of infectious diseases for children and parents. Such data often have low reliability [8].

To prevent infections with fecal-oral and hematogenic transmission mechanisms, such hygienic training means, as lectures, seminars, webinars, preparation of memos and booklets, presentations (including by students themselves) can be used that can be implemented within the framework of school curriculum when mastering such subjects, as Biology and Human Life Safety. This will make it possible to increase the students' motivation to learn about the principles of healthy

lifestyle as the measure to prevent diseases, including infectious ones [9–11].

The findings suggest the need to encourage medical professionals (pediatricians, family doctors, etc.) to take part in realization of educational programs for schoolchildren and their parents focused on prevention of infectious diseases in the form of lessons and training webinars or extracurriculars on the issue, which would contribute to reduction of the rate of infectious diseases among both schoolchildren and parents.

CONCLUSIONS

Thus, it has been shown that the knowledge of students aged 6–11 years and 12–15 years about prevention of infections with fecal-oral and hematogenic transmission mechanisms is insufficient, which requires developing effective hygienic training forms and means that can be implemented in educational institutions.

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ECOLOGICAL AND HYGIENIC ASPECTS OF SOLID WASTE DISPOSAL

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Disposal of solid domestic waste (SDW) is an important environmental and hygienic problem, but it causes not only environmental, but also great economic damage. From January 1, 2019, it was planned to carry out a reform of solid waste management. Many regions were not ready for waste reform. The problem of waste disposal is especially acute in federal cities. The goal is to study the readiness of regional operators in large cities (Moscow, St. Petersburg, Sevastopol) and students to solve the problem of waste disposal. A total of 100 solid waste collection sites were examined in the central and peripheral regions of Moscow, St. Petersburg and Sevastopol. An online survey of 356 medical students was conducted. When examining districts of three cities, the main difficulties in the peripheral regions were insufficient lighting, lack of fences and protective soil coverings, in the central regions — non-compliance with zoning in the location of sites in relation to the housing stock, lack of lids on containers, which worsens the sanitary and epidemiological situation. The main motivations for students to participate in separate waste collection were the convenience of container location and incentives; environmental problems were of interest to only 4% of respondents. The results of the study revealed the need to continue reforming the primary level of solid waste management and conducting environmental and hygienic education of the population, including youth and students, in terms of the importance of waste management using modern technologies.

Keywords: solid domestic waste, separate waste collection, students, survey, environmental and hygienic education

Author contribution: Staheeva AA — full-scale experiment and online surveys, study results processing and description; Zakharova AA — research and online surveys, study results processing and description; Umnov NM — study results processing and description; Drugova ED — study results processing, visual content of the article; Korolik VV — literature selection and processing, article editing; Sheina NI — article conceptualization, literature selection and processing, study results description, article authoring and formatting.

Compliance with ethical standards: anonymous online survey did not infringe on human rights, did not endanger the participants, and met the biomedical ethics requirements.

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ЭКОЛОГО-ГИГИЕНИЧЕСКИЕ АСПЕКТЫ УТИЛИЗАЦИИ ТВЕРДЫХ БЫТОВЫХ ОТХОДОВ

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Утилизация твердых бытовых отходов (ТБО) является важной эколого-гигиенической проблемой, однако она наносит не только экологический, но и большой экономический ущерб. С 1 января 2019 г. предполагалось провести реформу обращения с ТБО. Многие регионы оказались не готовы к мусорной реформе. Особенно остро проблема утилизации отходов ощущается в городах федерального значения. Целью работы было изучить готовность региональных операторов крупных городов (Москвы, Санкт-Петербурга, Севастополя) и студентов к решению проблемы утилизации мусора. Обследованы 100 площадок для сбора ТБО в центральных и периферийных районах Москвы, Санкт-Петербурга и Севастополя. Проведен онлайн-опрос 356 студентов-медиков. Обследование районов трех городов показало, что основными трудностями периферических районов были недостаточное освещение, отсутствие ограждений и защитных покрытий почвы, а центральных районов — несоблюдение зональности в расположении площадок по отношению к жилому фонду, отсутствие крышек на контейнерах, что ухудшало санитарно-эпидемиологическую ситуацию. Основными мотивами участия студентов в раздельном сборе мусора были удобство расположения контейнеров и поощрения. Экологические проблемы интересовали только 4% респондентов. Результаты исследования выявили необходимость продолжения реформирования первичного звена обращения с ТБО и проведения эколого-гигиенического воспитания населения, в том числе молодежи и студентов, в отношении важности управления отходами, с использованием современных технологий.

Ключевые слова: твердые бытовые отходы, раздельный сбор мусора студенты, анкетирование, гигиеническое воспитание

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The environmental safety of any country largely depends on how it solves the problem of waste disposal. Accumulated waste, landfills, and deposits of toxic substances cause both environmental and economic damage of significant scale. Moreover, solid domestic waste (SDW) collection sites that are set up with violations of sanitary and hygienic requirements for their location and equipment present risks of infectious, parasitic, and other diseases [1].

Currently, there are three practiced methods of waste disposal: burial, incineration, and recycling, the latter being the safest for the environment. Until recently, the common approach to waste disposal in Russia was of extensive nature, i.e., the number of landfills was growing, and not all of them met the established hygienic requirements for the SDW burial grounds design and maintenance. A comparative assessment of the approaches to waste disposal in Russia has shown that

93–95% of garbage is buried, and only 7–5% — recycled. In the countries of the European Union, 40% of the wastes are buried, another 40% recycled into materials, and 20% processed into energy [2, 3].

The sphere of solid waste disposal management has been undergoing reformation for over 20 years; the process started with adoption of the Federal Law "On Industrial and Domestic Wastes" in 1998 [4].

The so-called "waste reform", a set of measures designed as part of the effort to improve environmental situation, was supposed to have been launched in the Russian regions on January 1, 2019. The specifics of waste management are given in a number of federal level regulations [5–11].

The waste reform aimed to fill the gaps in the existing legislation and relay the priorities of the state in this matter. *Inter alia*, it provided legal basis for waste sorting (separate collection of waste) and recycling. The reform focused on several interrelated problems simultaneously and sought to eliminate illegal landfills, popularize the concept of waste sorting, legalize this practice among waste disposal facility operators, and make sorting and recycling mandatory for the said operators.

According to the researchers, Russian regions were largely unprepared for the waste reform: the number of allocated landfills was insufficient, waste recycling plants remained unbuilt, there were no separate waste collection practices implemented. This was the state of affairs in Vladikavkaz, Omsk, Irkutsk region, and Krasnoyarsk [12–16].

Currently, the problem of solid waste disposal is particularly urgent in large cities. In this connection, Moscow, St. Petersburg, and Sevastopol were allowed to not comply with the provisions of the Federal Law 89-FZ that prescribed new ways of waste management from January 1, 2022, i.e., the waste reform was postponed in these cities for 3 years in order to let them develop the respective policies [3]. As highlighted by the researchers, a more difficult task is to change people's attitude towards the matter of waste generation and recycling itself, since one of the most important aspects of SDW management is awareness and understanding of the essence of the problem on the part of the population, especially young people [17, 18].

Thus, the topic of solid waste management is large and very complex. Review of the literature has shown that there are not many papers covering it, and most of them are part of conference proceedings, formalized as short articles or lists of statements. They mainly deal with legal, financial, and economic aspects of the matter, or have to do with administrative regulation of the problem.

This study aimed to investigate the readiness of regional operators in large cities (Moscow, St. Petersburg, Sevastopol) and young people (students) to become part of the solution to the problem of waste generation and recycling.

METHODS

Following the sanitary and hygienic requirements [1], in 2022, we surveyed SDW collection sites in the urbanized areas. The sites were located in the central (historically established) and peripheral (developing) areas of three federal cities: Moscow (Tverskaya, Filevsky Park, Konkovo districts), St. Petersburg (Admiralteysky, Vyborgsky districts, Kronstadt), and Sevastopol (Leninsky, Ostryaki districts). In each districts, we worked with 10 sites.

Surveying the sites, we considered the following parameters: zoning (distance between the site and the residential area, should have been in the range between 20 and 100 m); site surface type (asphalt, concrete, soil); fencing, if any (brick,

concrete, metal), and greenery; convenient access roads and waster sorting arrangements; the number of containers on the site and their marking; container covers, if any, and roof above the site; lighting, if any. The study relied on the empirical method: observation, measurement of distance with a laser ruler, comparison.

Addressing the problem of waste sorting and SDW recycling, we surveyed medical students using an online questionnaire developed by the authors of this article. Three hundred and fifty six students of the N.I. Pirogov Russian National Research Medical University (aged 17 through 22 years) took the survey.

To analyze the number of solid waste collection containers in the central and peripheral districts of Moscow, St. Petersburg, and Sevastopol, we used StatTech software (Stattech; Russia). To avoid the effect of multiple comparisons, we applied the Newman–Keuls test after one-way ANOVA. Student's *t*-test was used for comparison of the peripheral and central districts of each city. The differences, after processing with application of the Newman–Keuls and Student's tests, were considered significant at the confidence level of 0.95.

RESULTS

The purpose of surveying sanitary and hygienic condition of waste collection sites in the peripheral and central districts of three cities of federal significance was to comparatively analyze their readiness for the waste reform. The results are given in Table 1.

We found that the surveyed sites have some specific features, but, overall, reformation of the front line of the waste management system is generally prepared and proceeds as planned. The zoning of inner yards of residential buildings was better realized in relatively young (Konkovo) districts and those located far from the city center (Vyborgsky, Ostryaki). The distance between the residential area and the waste collection site was often out of the regulated range (80–100% of cases) in districts that are closer to the city center or inside it, which probably stems from the specifics of development of such historical areas. Sanitary and hygienic regulations suggest covering waste collection sites with concrete or asphalt, a recommendation commonly followed in all districts of Moscow, Admiralteysky district of St. Petersburg, and Leninsky district of Sevastopol. In Vyborgsky district and Ostryaki, there are sites (10–20%) without any protective coating, i.e., their surface is soil.

An important sanitary requirement is for the site to have a fence made of brick, concrete or metal. In two districts of Moscow, Tverskoy and Filevsky Park, we have found a significantly lower number of sites meeting this requirement.

Compared to the peripheral districts, central districts of Moscow, St. Petersburg, and Kronstadt had less sites surrounded with greenery. There, the share of such was only 30–40%. All the surveyed sites had convenient access ways, with the share thereof insignificantly lower in the Tverskoy district of Moscow and districts of Sevastopol.

Separate waste collection (recyclable materials and mixed waste) is practiced in Moscow and St. Petersburg, but there are fewer such sites (40–60%) in the central districts of these cities. In Sevastopol, there are separate containers for cardboard and plastic only; mixed waste, apparently, is collected through in-building garbage chutes. Therefore, we believe that waste sorting, as defined in SanPiN 2.1.3684-21, was not implemented at the time of the study.

All the surveyed sites had 2 to 5 containers for separate waste collection. As for the number of SDW containers, we

Table 1. Share (%) of the surveyed SDW sites in central and peripheral districts (cities of federal significance) that meet the sanitary and hygienic requirements (SanPIN 2.1.3684-21)

City	District	Zoning	Surface	Fencing	Greenery	Convenient access ways	Separate waste collection	Lids on containers and spanning roof	Lighting
Moscow	Tverskoy	20	100a	30m	30	90	40	50/10	30
	Filevsky Park	0	80a 20c	45b	60	100	100	100/50	40
	Konkovo	80	100a	80b	60	100	100	100/50	90
Saint Petersburg	Admiralteysky	0	80a 20c	80b 10m	40	100	60	20/30	80
	Vyborgsky	60	40a 50c 10s	100b	40	100	80	10/10	30
	Kronstadt	20	100a	50b 10cc 30m	30	100	70	30/30	40
Sevastopol	Leninsky	40	10a 90c	10cc 80m	100	80	0 70c* 20p*	100/100	90
	Ostryaki	100	20a 60c 20s	60m	100	80	0 40cp**	40/40	40

Note: a — asphalt, c — concrete, s — soil (types of site surface); cc — concrete, b — brick, m — metal (site fencing material); c* — cardboard, p* — plastic, cp** — cardboard and plastic.

have found that the district occupying central part of Sevastopol had significantly more of them than the district in Moscow's center (Tverskoy) (Table 2). Residents of the peripheral districts of St. Petersburg had more SDW containers at their disposal than residents of similar districts of Moscow and Sevastopol. In addition, we registered significantly fewer containers in the center of St. Petersburg compared to the remote districts of this city.

On many sites, containers were lidless, and there were no common spanning roof over them. This issue requires attention from regional operators. Leninsky district of Sevastopol was the exception: there, 100% of containers had lids, and the collection sites were under roof. As for lighting of the sites, many lacked it (all the included cities), with only Konkovo, Admiralteysky, and Leninsky districts having lamps over 80–90% of the SDW collection sites (Table 1).

In order to assess the commitment of students, who are the most mobile and active part of the young population, to waste sorting, we set up an online survey. According to the results thereof, about 90% of students believe that SDW disposal is an important task of the federal level, and separate collection of domestic waste (waste sorting) is one of the effective methods of solving it. Over 40% of students mentioned that the number of containers for SDW in the courtyards of residential buildings has increased in the year preceding the survey. However, only about 30% of the respondents actually sorted their garbage. The key motivation behind waste sorting, according to the majority (62%) of the participants of the survey, could closeness of the containers to the buildings and their convenient location,

and 30% of the students noted that they would like to receive various incentives for separate garbage collection. Over 70% of the respondents claimed readiness to not use an in-house trash chute, if there is one, and sort waste.

According to the survey, only 16% of the participants used recyclables collection points, with 30% and 18% of them bringing waste paper and plastics there. The rest mentioned remoteness of the collection points, lack of habit, or their own ignorance of the recycling possibilities as the reasons for not practicing it. And only a small part of the students (4%) understood and realistically assessed the environmental problems caused by pollution generated by SDW (Figure).

DISCUSSION

Studies by various authors show that, despite adoption of a number of laws and regulations, from 1998 to the present, the waste reform is being implemented very slowly. Today, it is easy learn the best practices of waste management from other countries, starting with sorting, through removal, to recycling, and burial.

In the leading European countries — Germany, Austria, Sweden, the Netherlands, Denmark, Belgium, etc. — there is a stepwise solution to the problem, which starts with explaining the population how and why to sort waste, then arrangement of the removal routines, further sorting, and construction of a high-end waste recycling plant. In Sweden, after careful sorting, about half of the solid waste is burned and converted into energy: for example, food waste becomes biogas. Another half is recycled. Only less than 1% of the wastes is buried [2, 3].

Table 2. Average number of SDW containers, central and peripheral districts of three cities

City	Average number of containers in the city's districts (<i>n</i>)		
	central and peripheral	central	peripheral
Moscow	2.67 ± 1.77 (<i>n</i> = 20)	2.00 ± 1.41 (<i>n</i> = 10)	3.27 ± 1.90 (<i>n</i> = 10)
Saint Petersburg	3.80 ± 1.61 (<i>n</i> = 20)	2.70 ± 0.95**** (<i>n</i> = 10)	4.90 ± 1.37* (<i>n</i> = 10)
Sevastopol	3.25 ± 1.55 (<i>n</i> = 20)	3.80 ± 1.55** (<i>n</i> = 10)	2.7 ± 1.42*** (<i>n</i> = 10)

Note: significant differences ($p \leq 0.05$), as shown by the Newman-Keuls test, between cities: * — Moscow and St. Petersburg, ** — Moscow and Sevastopol, *** — St. Petersburg and Sevastopol; significant differences ($p \leq 0.05$), as shown by the Student's *t*-test: **** — between central and peripheral districts.

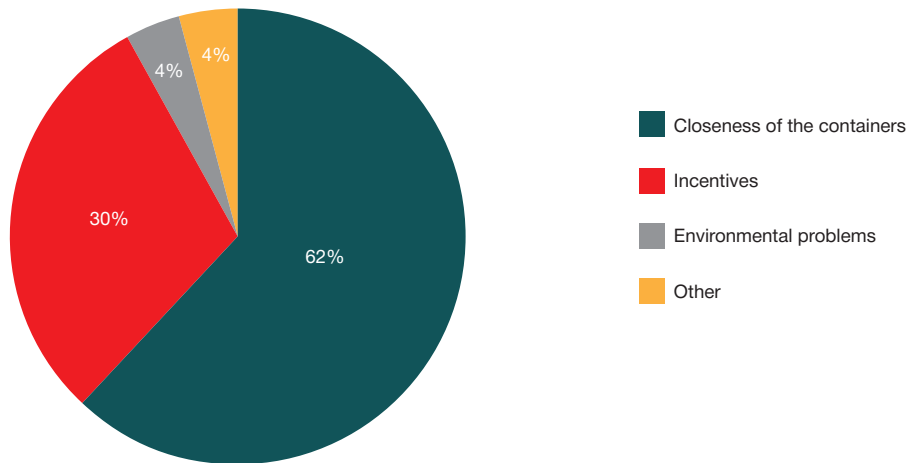


Fig. Distribution of students by their motivation for separate collection of SDW (%)

The Japanese garbage recycling system is as relevant. Compared to our country, Japan lacks territory for landfills, so Japanese use their waste-free system. The municipality determines the days and hours when certain type of garbage is collected and removed. Local authorities impose fines for violations of the order of garbage collection/removal [19, 20].

Some authors believe that Russian reform is better compatible with the Asian approach to the problem; according to them, application thereof will create new jobs and reduce the number of landfills, provide production capacities with cheap raw materials, and protect the country's ecology and public health [16].

Earlier, it was shown that in Moscow, regional operators started working in the context of the waste reform (prepared SDW collection sites, brought lidded containers for separate collection of solid waste) in 2019. The best results were registered in the developing peripheral areas (Savelovskiy, Khoroshevskiy). Unfortunately, in the Tverskoy district, it was hard to meet the sanitary and hygienic requirements for SDW collection sites due to the historical features of city center.

None of the surveyed sites was perfect. The flaws had to do with incorrect distance to the residential zone, and number of the sites without fences and separate garbage collection arrangements [21].

Our study has shown that cities of the federal level also tackle the task of improvement of the primary component of the waste reform. However, the sites located in the central or peripheral parts of each city meet the sanitary and hygienic requirements only partially. For example, in the Tverskoy and Admiralteyskiy districts, which lie in the central parts of the cities, many sites were allocated incorrectly, and, consequently, had insufficient amount of containers and poor greenery around them. In Sevastopol, on the contrary, 100% of garbage sites are surrounded by greenery, but they do not always have fencing and concrete or asphalt on the soil. The common advantage of all the surveyed sites were the convenient access roads.

At the same time, scientists believe that at the outset, the key to success of the waste reform is ecological and hygienic education of the young people and the general population. Surveying students of the Kuban State Technological University, the authors found that the ongoing environmental and hygienic reforms in the field of housing and utility services are perceived by the majority of young people positively, not negatively. However, there are psychological barriers preventing waste sorting from becoming a daily habit: students lack confidence in the feasibility of the relevant program and do not wish to incur additional costs in connection with the new waste management system [22].

Previously, there was conducted a survey of about 1500 residents of 41 districts of the Moscow region. Having analyzed its results, the authors of the paper based thereon concluded that it is advisable to intensify educational efforts aimed at the population that teach ecological culture and promote interactions with the regional operator in the context of solving pressing issues [18].

Despite the paucity of literature of this kind, the results of our study are consistent therewith.

An online survey of students at the N.I. Pirogov Russian National Research University has shown that the majority of them (90%) understood the importance of separate garbage collection, but less than 50% of the respondents actually sorted SDW.

Asked about the key incentive to adopt the waste sorting practice, students mentioned availability and convenient location of the respective containers but not the ecological and hygienic consequences of restraining from separate garbage collection. This indicates that they are not fully aware of the seriousness of the problem of waste management for the environment and human health. Therefore, it is necessary to actively explain the issues to the students and the general population using clear visual materials.

It is also important to popularize the recyclables collection points. As opposed to foreign countries, in Russia, this approach to waste management is rarely realized. According to the survey, only a small portion of the students (16%) brought waste (mostly paper) to such points, irregularly, with the main reason being remoteness of the recycling points and students' own ignorance. Therefore, we should practically work on making the youth understand the better effectiveness of processing of separately collected recyclables compared to production of the items from raw materials [23]. At the N.I. Pirogov Russian National Research Medical University, this problem was addressed: in the recreation areas, there were mounted separate garbage collection bins for waste paper, plastic lids, pens, batteries, blisters, small computer accessories, etc., which students and teachers use constantly. In addition to waste sorting, people can consume resources, such as water and electricity, rationally and economically, practicing the approach called "reasonable consumption." This allows solving not only ecological and hygienic, but also economic problems.

As the site surveys have shown, regional operators continue to actively work on the preparation of the primary component of the system of separate SDW collection and subsequent disposal. However, as our study has shown, a more difficult task is to educate the youth in the field of ecology and hygiene.

CONCLUSIONS

A sanitary and hygienic assessment of the SDW collection sites has shown that even at the initial stage of the waste reform, all cities of the federal level implemented measures enabling waste sorting, but the process has some specific features.

In the peripheral districts of the cities included in the study the main flaws about SDW collection sites were insufficient lighting and lack of fences and protective soil covering, and in the central districts the problems stemmed from incorrect allocation respective to the residential buildings, lack of greenery, lack of lids on containers or a common roof (Moscow, St. Petersburg) above the site, which worsened the sanitary and epidemiological situation.

According to the survey, about 80% of students are ready to sort garbage if there are the respective containers

available. The main motives for SDW sorting were convenience of container location and incentives; only 4% of the respondents mentioned environmental issues in this connection.

Only 16% of respondents brought waste to the recyclables collection points, and the rest cited remoteness thereof, lack of habit or their own ignorance as the reasons for not doing so.

Based on the above, it is recommended to:

- use modern technologies to enable and intensify efforts aimed at educating population, young people and students in particular, about the importance of waste management and waste sorting;

- teach students how to sort SDW correctly, since properly sorted garbage can be processed more easily, faster and better;

- minimize the use of waste that cannot be recycled and does not decompose for a long time.

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