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SOME HYGIENIC FEATURES OF THE LIFESTYLE OF MEDICAL STUDENTS

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Systematic and purposeful campaigns designed to promote a healthy lifestyle among the youth are a strategic task for the healthcare system and the state in general. This study aimed to explore the hygienic features of the lifestyle of medical students. It involved 109 students of medical faculties aged 18-26 years, who participated in an anonymous online survey created in Yandex Forms in accordance with MR (methodical recommendations) 2.1.10.0033-11. We calculated the relative values and their confidence intervals, and the significance of the differences was assessed using the chi-square test (χ^2) at $p < 0.05$. It was found that active smoking remains a significant behavioral risk among medical students, particularly males (27.3%). The majority of medical students do not engage in adequate levels of physical activity (64.2%) and do not get sufficient sleep at night (77.9%). As for the patterns of behavior in the context of medical assistance, those rather common among medical students are categorized as irresponsible: many visit a doctor only in case of serious symptoms of the disease (54.1%), undergo medical checkups in an untimely fashion (31.5%), do not follow doctor's instructions and stop course treatments early (37.6%), practice self-medication (85.3%), resort to traditional medicine (55.1%). Every fifth respondent did not follow the rules of hand washing, and 17.4% did not take daily care of their body. Unsafe forms of sexual behavior are typical for every fifth medical student. Thus, prevention and correction of the identified lifestyle risk factors hold significant potential for preserving the health of medical students.

Keywords: lifestyle, risk factors, medical students, addictive behavior, medical activity

Author contribution: Dementiev AA — study design and conceptualization, article editing; Tsurgan AM — statistical processing and analysis of data, article editing; Soloviev DA — article authoring; Kopaev IV — collection and primary processing of data; Osadets AYU — preparation of the sociological study.

Compliance with ethical standards: all students submitted the informed consent to participation in the study.

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НЕКОТОРЫЕ ГИГИЕНИЧЕСКИЕ ОСОБЕННОСТИ ОБРАЗА ЖИЗНИ СТУДЕНТОВ-МЕДИКОВ

А. А. Дементьев [✉], Д. А. Соловьев, А. М. Цурган, И. В. Кобаев, А. Ю. Осадец

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Системная целенаправленная работа по формированию установок здорового образа жизни среди молодежи является одной из стратегических задач государства и здравоохранения. Целью исследования было изучить гигиенические особенности образа жизни студентов-медиков. Объектом исследования стали 109 студентов медицинских факультетов в возрасте 18–26 лет. Анонимное онлайн-анкетирование с использованием сервиса Yandex Forms проведено в соответствии с МР 2.1.10.0033-11. Выполнен расчет относительных величин, их доверительных интервалов, значимость различий оценивали по критерию хи-квадрат (χ^2) при $p < 0,05$. Установлено, что активное курение продолжает оставаться актуальным поведенческим риском студентов-медиков, особенно студентов мужского пола (27,3%). Для большинства студентов-медиков характерны недостаточные двигательная активность (64,2%) и продолжительность ночного сна (77,9%). Среди студентов-медиков достаточно распространены рискованные формы безответственного медицинского поведения, такие как обращение к врачу только в случае серьезных симптомов заболевания (54,1%), несвоевременное прохождение медосмотров (31,5%), прерывание курса назначенного врачом лечения (37,6%), самолечение (85,3%), обращение к средствам народной медицины (55,1%). Каждый пятый респондент не соблюдал правила мытья рук, а 17,4% не осуществляли ежедневный уход за своим телом. Для каждого пятого студента-медика характерны небезопасные формы сексуального поведения. Таким образом, существенный потенциал сохранения здоровья студентов-медиков содержится в оптимизации профилактической работы по коррекции выявленных факторов риска образа жизни.

Ключевые слова: образ жизни, факторы риска, студенты-медики, аддитивное поведение, медицинская активность

Вклад авторов: А. А. Дементьев — концепция и дизайн исследования, редактирование текста статьи; А. М. Цурган — статистическая обработка и анализ данных, редактирование текста; Д. А. Соловьев — написание текста статьи; И. В. Кобаев — сбор и первичная обработка данных; А. Ю. Осадец — подготовка социологического исследования.

Соблюдение этических стандартов: все студенты подписали добровольное информированное согласие на участие в исследовании.

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Systematic and purposeful campaigns designed to promote a healthy lifestyle among the youth are a strategic task for the healthcare system and the state in general: this work supports replenishment of the country's labor force with healthy and able-bodied generations ready for the current challenges [1–5]. In this context, special attention should

be paid to the development of sound lifestyle values among students of medical universities. A conscious commitment to rational nutrition, regular physical activity, avoidance of smoking, excessive alcohol use, and other addictive behaviors, along with a responsible attitude toward medical checkups and self-preserving behavior, should be regarded as an essential

prerequisite for effective preventive work with patients [6, 7]. Despite being well aware of the impact of lifestyle on health, most medical students consider it acceptable to have bad habits, eat irregularly, disregard work–rest balance, and engage in physical activity at suboptimal levels [8–13]. The most common causes of risky behaviors among medical university students are lack of time and fatigue after classes due to high academic loads [8, 9, 14–18]. The trends registered often among them reveal the growing prevalence of bad habits (alcohol and tobacco use) that have a negative effect on their quality of life [19]. Intense studying, an imbalanced work–rest schedule, insufficient sleep, and poor nutrition lead to a significant deterioration in the health of medical students from their first to sixth years of university [20, 21].

Researchers are actively exploring the outlined problems, yet the study of the hygienic aspects of medical students' lifestyles remains an urgent issue. It is necessary to continue the search for the effective ways of elimination of the identified health risks, which supports the relevancy of this work.

This study aimed to explore the hygienic features of the lifestyle of medical students.

METHODS

The study was conducted in Pavlov Ryazan State Medical University. The sample included 109 students from all faculties aged 18–26 years; they participated in an anonymous online survey built in Yandex Forms. The survey questions were grouped into blocks as suggested in MR (methodological recommendations) 2.1.10.0033-11: addictive and forced behavior, physical activity insufficiency, irresponsible medical and hygienic behavior, non-compliance with personal hygiene rules, unsafe sexual behavior [22]. To be included, the participant had to be a student of Ryazan State Medical University and submit the answered survey. Failure to answer the questions in full or the provision of inadequate answers constitutes grounds for exclusion.

The statistical processing of the collected data included calculation of the relative values and their 95% confidence intervals (95% CI) using the Wilson CI method. The significance of differences was assessed using the chi-squared test (χ^2), the target level was $p < 0.05$. The data were prepared and processed in MS Excel 19 (Microsoft, USA).

RESULTS

The study showed that 12.8% of the surveyed medical students actively smoke, while 7.3% of respondents periodically resort to this bad habit (Table). Smoking was more common among male students: 27.3% versus 9.2% of female participants ($\chi^2 = 5.1$; $p = 0.024$). At the level of study years, though, we failed to identify significant differences in the prevalence of smoking within the considered cohort. It was found that 63.6% of smokers usually smoke up to five cigarettes a day, while the rest smoke 15 or more. For regular smokers, the median

intake of nicotine was 1.5 [0.0; 3.5] mg/day, which was slightly higher than that among students who smoked occasionally (0.0 [0.0; 0.15] mg/day; $p = 0.06$). On average, 64.9% [53.5; 74.8] of medical students regularly stay in smoking rooms.

As for alcohol, 62.4% [53.0; 70.9] of the surveyed medical students consume it, with the proportion of drinkers among male participants slightly higher than among females: 72.7% [51.9; 86.9] versus 59.8% [49.3; 69.5], respectively ($\chi^2 = 1.3$; $p = 0.263$). Year-wise, we did not reveal significant differences, but it was established that the share of medical students who drink alcohol was the lowest among freshmen and sophomores (59.2% [45.3; 71.8]), and highest among the third-year students (67.5% [52.0; 79.9]; $\chi^2 = 0.7$; $p = 0.702$). A retrospection of weekly alcohol consumption revealed that beer, preferred by 28.0% of the respondents, is the most popular drink among them, followed by wine and strong alcoholic beverages, which were consumed by 20.8 and 13.6% of the participating students, respectively. The median daily consumption of pure alcohol 0.7 [0.0; 4.9] g, and the maximum daily dose reached 29.9 g.

The survey revealed that 3.7% [1.4; 9.1] of the respondents had at least once taken narcotics without a prescription, although currently none of the respondents use them. However, a few students (2.7%) noted that they take non-narcotic psychoactive substances.

More than half of the surveyed medical students (64.2% [54.9; 72.6]) engaged in insufficient physical activity, defined as performing less than 150 minutes of moderate-intensity exercise per week. We uncovered a respective trend: from junior to senior years, the students to be physically active less and less (Fig.).

We have also revealed that a certain portion of participating medical students approaches medical checkups and assistance irresponsibly. For example, 54.1% [44.8; 63.2] them indicated that they consult a doctor only if serious symptoms of the disease appear. Only 68.5% [59.3; 76.5] of the participants underwent a medical examination once a year, while the rest took it less frequently. On average, 37.6% [29.1; 46.9] of medical students interrupted the course of treatment prescribed by a doctor, 85.3% [77.5; 90.8] resorted to self-medication, and 55.1% [45.7; 64.1] turned to traditional medicine. Gender and study year did not have a significant effect on the prevalence of such irresponsible medical behavior among the respondents.

The majority of medical students, regardless of gender and study year, habitually lacked proper sleep: 77.9% [69.3; 84.7] of the participants mentioned that they slept less than 7 hours per day. At the same time, 96.3% [90.9; 98.6] of the respondents followed the recommended routines of ventilation (once a day or more often) and wet cleaning of their homes (at least once a week). Almost every fourth participant failed to comply with the rules of personal hygiene. In particular, 25.7% [18.4; 34.6] of students brushed their teeth less than twice a day, 22.7% [15.9; 31.4] did not follow handwashing recommendations, and 17.4% [11.5; 25.6] did not take daily care of their bodies. Gender had no significant effect in the prevalence of these deviant behavioral patterns.

Table. Prevalence of active smoking among medical students

Attitude towards smoking		Male	Female	Total
Smoke	% [Q1; Q3]	27.3 [13.2; 48.2]	9.2% [4.7; 17.1]	12.8 [6.6; 19.1]
Smoke occasionally	% [Q1; Q3]	9.1 [2.5; 27.8]	6.9 [3.2; 14.2]	7.3 [3.8; 13.8]
Don't smoke	% [Q1; Q3]	63.6 [42.9; 80.3]	83.9 [74.8; 90.2]	79.8 [71.3; 86.3]

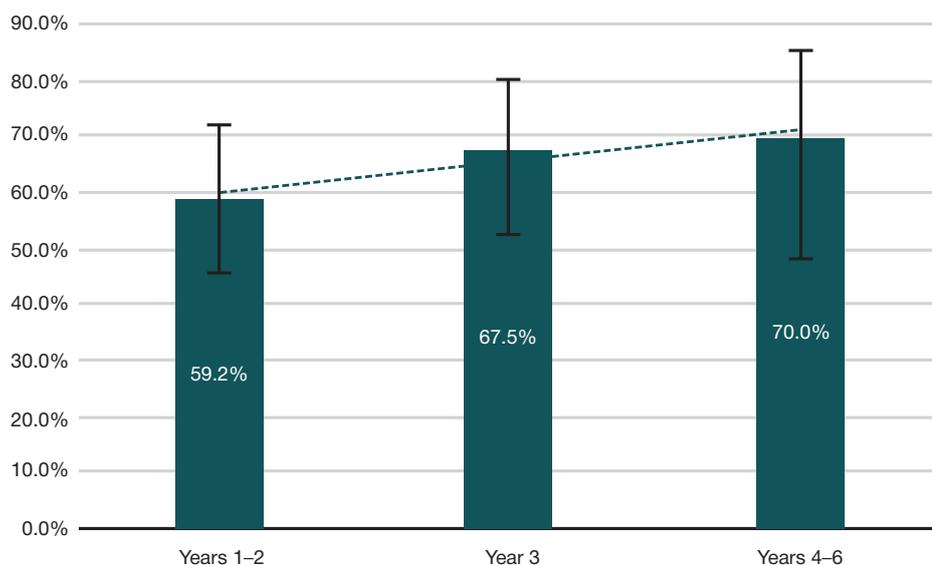


Fig. The proportion of students with insufficient physical activity, breakdown by study year, %

One in five medical students who participated in the study practiced unsafe sex. In particular, condoms or other means of contraception were not used by 22.9% [16.1; 31.7] and 19.4% [13.1; 27.9] of the respondents, respectively, when pregnancy was not a goal.

DISCUSSION

The study showed that among medical students, smoking remains an urgent problem associated with addictive behavior, and its prevalence even slightly exceeds the data reported by other authors [9]. At the same time, the discovered levels of alcohol consumption are generally consistent with the results of other studies [9, 23, 24]. None of the respondents had a daily dose of pure alcohol exceeding 30 g, which confirms lack of alcohol abuse patterns and allows disregarding drinking as a risk factor for the health of medical students [22].

We have found insufficient sleep and physical activity to be significant risk factors for the health of medical students; this is consistent with the findings of other authors [23, 24]. From 30 to 40% of the respondents were not satisfied with the quality of their sleep. The main reason behind it are the irrational mental work patterns [20]. According to some data, two thirds of students go to bed after midnight and lack sleep, which reduces the effectiveness of their mental activity and potentially underpins even greater disruption of the work–rest balance [25, 26].

Irresponsible attitude towards medical checkups and treatment may stem from the strong motivation to master a complex curriculum as well as professional overconfidence, especially in cases of self-medication and failure to fully comply with doctor's prescriptions. Researchers have reported previously that generally, medical students tend to neglect their health and disregard the need to follow the principles of health-saving behavior [27]. At the same time, the high prevalence of use of medications without prescriptions revealed in this study is confirmed by data from other authors [28].

The fact that nearly one in four students neglects personal hygiene rules calls for special efforts in hygiene education. In addition, special attention should be paid to the prevention

of unsafe forms of sexual behavior among students. The attitude of peers in the social environment has a significant impact on the motivation to follow the principles of a healthy living, which once again testifies to the importance of hygienic education [29]. According to the majority of students, the fundamental source of information on healthy lifestyle are the disciplines of the medical university's curriculum that systematically consider the elements thereof [18, 30].

The limitation of this study is the lack of assessment of the actual nutrition and nutritional status of the respondents as well as lack of the respective risk calculations.

CONCLUSIONS

Active smoking continues to be an urgent behavioral risk among medical students, especially male (27.3%). Alcohol consumption, while highly prevalent (62.4%), does not reach the abuse threshold. The use of drugs and non-narcotic psychoactive substances is generally uncommon for this cohort.

The majority of medical students (64.2%) do not engage in physical activity at an adequate level, and this problem worsens as they progress through their studies. Moreover, 77.9% report insufficient night sleep.

As for the patterns of behavior in the context of medical assistance, those rather common among medical students are categorized as irresponsible: many visit a doctor only in case of serious symptoms of the disease (54.1%), undergo medical checkups in an untimely fashion (31.5%), fail to follow doctor's instructions and stop course treatments early (37.6%), practice self-medication (85.3%), resort to traditional medicine (55.1%).

While most students observed home hygiene, one in four did not follow oral hygiene practices, one in five neglected proper handwashing, and 17.4% did not maintain daily body care.

Unsafe forms of sexual behavior — optional condom use during intercourse or neglecting contraception when pregnancy is not planned — remain relevant for every one in five medical students.

References

- Mingazov RN, Popel AE, Mingazova JeN. Zdorovyj obraz zhizni studentov — resurs sberezenija zdorov'ja trudospobnogo naselenija v blizhajshej perspektive. *Problemy social'noj gigieny, zdravoohraneniya i istorii mediciny*. 2024; 32 (7): 647–51 (in Rus.). DOI: 10.32687/0869-866X-2024-32-s1-647-651.
- Strategija razvitiya vospitaniya v Rossijskoj Federacii na period do 2025 goda. (In Rus.). Available from: <http://council.gov.ru/media/files/41d536d68ee9fec15756.pdf>.
- Koncepcija demograficheskoj politiki Rossijskoj Federacii na period do 2025 goda. (In Rus.). Available from: <https://docs.cntd.ru/document/902064587?marker=6580IP>.
- Osnovy gosudarstvennoj molodezhnoj politiki Rossijskoj Federacii na period do 2025 goda. (In Rus.). Available from: <https://docs.cntd.ru/document/420237592?marker=65A0IQ>.
- Vorotilkina IM, Bazhenova NG, Bazhenov RI. Sovremennye trendy zdorovogo obraza zhizni studentov. *Mir nauki. Sociologija, filologija, kul'turologija*. 2022; 13 (4): 1–15 (in Rus.). DOI: 10.15862/59SCSK422.
- Gureev SA, Mingazova JeN. Osobennosti sostojaniya zdorov'ja studentov v period ih obuchenija, v tom chisle v uslovijah COVID-19. *Menedzher zdravoohraneniya*. 2022; (3): 37–41 (in Rus.). DOI: 10.21045/1811-0185-2022-3-37-41.
- Vasilev VV. Zdorovyj obraz zhizni. Rol' vracha v formirovanii zdorovogo obraza zhizni. *Medicinskaja aktivnost' naselenija i ee parametry. Nauchno-prakticheskij podhod*. 2025; S2: 355–8 (in Rus.).
- Shapkina EV. Issledovanie samosohranitel'nogo povedeniya u studentov medicinskogo vuza. *Vestnik obshhestvennyh i gumanitarnyh nauk*. 2024; 5 (4): 14–9 (in Rus.).
- Shepeleva OM, Lazurina LP, Kurkina MP, Mal GS, Docenko VA, Zavidovskaja KV. Samoocenka kachestva zhizni i sformirovannosti zdorovogo obraza zhizni studentov-medikov. *Izvestija Jugo-Zapadnogo gosudarstvennogo universiteta. Serija: Upravlenie, vychislitel'naja tehnika, informatika. Medicinskoe priborostroenie*. 2023; 13 (2): 112–24 (in Rus.). DOI: 10.21869/2223-1536-2023-13-2-112-124.
- Shestera AA, Trankovskaya LV, Kaerova EV, Nagirnaya LN. Assessment of physical development and lifestyle in junior medical students. *Russian Bulletin of Hygiene*. 2024; (2): 22–8. DOI: 10.24075/rbh.2024.097.
- Akimenko GV, Seledcov AM, Kirina JuJu. K voprosu o razviti priverzhennosti k zdorovomu obrazu zhizni studentov medicinskogo universiteta. *Dnevnik nauki*. 2021; 4 (52). (In Rus.). Available from: https://dnevniknauki.ru/images/publications/2021/4/pedagogics/Akimenko_Seledtsov_Kirina.pdf.
- Gornostaeva JuD, Mihajlov AJu, Rahmanova OV. Otnoshenie studentov medicinskogo universiteta k zdorovomu obrazu zhizni. *Regional'nyj vestnik*. 2020; 1 (40): 17–9 (in Rus.).
- Naberezhnaja ZhB, Romahova AA. Pozicija studentov medicinskogo universiteta k zdorovomu obrazu zhizni. *Vestnik "Biomedicina i sociologija"*. 2023; 8 (1): 62–6 (in Rus.). DOI: 10.26787/nydha-2618-8783-2023-8-1-62-66.
- Lipošek S, Planinšec J, Leskošek B, Aleksander P. Physical activity of university students and its relation to physical fitness and academic success. *Annales Kinesiologiae*. 2019; (9): 89–104. DOI: 10.35469/ak.2018.171.
- Esimhanova A, Ivanova JuV. Motivacija k zdorovomu obrazu zhizni u studentov medicinskih special'nostej (obzor literatury). *Medicus*. 2025; 1 (67): 17–20 (in Rus.).
- Bychkov NV. Vospriyatie zdorovogo obraza zhizni i otnoshenie k sportu molodezhnoj auditorii. *Molodezhnaja nauka: tendencii razvitiya*. 2023; (2): 55–63 (in Rus.).
- Korjakina NI, Timofeev LF. Mediko-social'nyj analiz vlijaniya uchebnogo processa na sostojanie zdorov'ja studentov medicinskogo instituta. *Tendencii razvitiya nauki i obrazovanija*. 2023; (95-5): 29–32 (in Rus.). DOI: 10.18411/trnio-03-2023-225.
- Snegireva LV, Jeldinna NBMS. Izuchenie roli medicinskogo universiteta v formirovanii predstavlenij o zdorovom obraze zhizni u obuchaemyh. *Nauchnye vesti*. 2023; 6 (59): 12–6 (in Rus.).
- Koroleva AA, Yanushanets OI, Petrova NA, Bezzubenkova EF. Influence of the degree of adaptability and lifestyle on the quality of life of medical university students. *Russian Bulletin of Hygiene*. 2021; (2): 26–30. DOI: 10.24075/rbh.2021.011.
- Kolbanov VV. Obraz zhizni i zdorov'e studentov medicinskogo universiteta. *International Independent Scientific Journal*. 2020; (16-2): 44–6 (in Rus.).
- Geljastanov IH. Obraz zhizni studentov: dinamika izmenenij v processe obuchenija v universitete. *Matrica nauchnogo poznanija*. 2020; (11-2): 349–54 (in Rus.).
- MR 2.1.10.0033-11 "Ocenka riska, svjazannogo s vozdejstviem faktorov obraza zhizni na zdorov'e naselenija". M.: Federal'nyj centr gigieny i jepidemiologii Rospotrebnadzora, 2012. (In Rus.).
- Ponurkina PN, Tjutina AV, Tolmachev DA. Issledovanie sobljudenija studentami medicinskogo vuza zdorovogo obraza zhizni. *Dnevnik nauki*. 2024; 9 (93). (In Rus.). Available from: https://dnevniknauki.ru/images/publications/2024/9/medicine/Ponurkina_Tjutina_Tolmachev.pdf.
- Musaeva MM, Polunina NV, Ashanina NM, Soltamakova LS. Obraz zhizni studentov medicinskogo vuza. *Kardiovaskuljarnaja terapija i profilaktika*. 2023; 22 (S6): 75–6 (in Rus.).
- Tuhbatullina RA, Jamshhikova TV. Obraz zhizni studentov medicinskogo vuza i ego vlijanie na zdorov'e. *Dnevnik nauki*. 2024; 10 (94). (In Rus.). Available from: https://dnevniknauki.ru/images/publications/2024/10/medicine/Tukhbarukkina_Yamshchikova.pdf.
- Devrshov RD, Horosheva IV, Kudrjashева IA, Dauletova LA, Dashdamirova NA. Gigienicheskaja karakteristika osnovnyh komponentov obraza zhizni studentov medicinskih vuzov. *Medicina truda i jekologija cheloveka*. 2022; 2 (30): 177–86 (in Rus.). DOI: 10.24412/2411-3794-2022-2-177-186.
- Fedorishheva EK. Formirovanie zdorov' esberegajushhego povedeniya u studentov medicinskogo universiteta: k razrabotke koncepcii issledovanija. *Vlast' i upravlenie na Vostoke Rossii*. 2022; 2 (99): 210–19 (in Rus.). DOI: 10.22394/1818-4049-2022-99-2-210-219.
- Kijaev AHB, Volujko PA, Zhirnova SV. Svrnennie osobennostej primenenija lekarstvennyh preparatov s cel'ju samolechenija studentami-medikami starshih i mladshih kursov. *Molodezhnyj innovacionnyj vestnik*. 2021; 10 (S1): 217–9 (in Rus.).
- Zaharova MV, Nikulina TV, Veretennikova OM. Social'naja podderzhka studencheskoj molodezhi v vuze. *Nauchnye rezul'taty v social'noj rabote*. 2023; 2 (2): 86–92 (in Rus.). DOI: 10.18413/2949-267X-2023-2-2-3.
- Bendrikova AJu, Kalin DA. Vlijanie professional'nogo obuchenija na formirovanie zdorovogo obraza zhizni studentov medicinskogo vuza. *Mezhkul'turnaja kommunikacija v obrazovanii i medicine: nauchno-prakticheskoe setevoe izdanie*. 2022; (3): 33–41 (in Rus.).

Литература

- Мингазов Р. Н., Попел А. Е., Мингазова Э. Н. Здоровый образ жизни студентов — ресурс сбережения здоровья трудоспособного населения в ближайшей перспективе. *Проблемы социальной гигиены, здравоохранения и истории медицины*. 2024; 32 (7): 647–51. DOI: 10.32687/0869-866X-2024-32-s1-647-651.
- Стратегия развития воспитания в Российской Федерации на период до 2025 года. URL: <http://council.gov.ru/media/files/41d536d68ee9fec15756.pdf>.
- Концепция демографической политики Российской Федерации на период до 2025 года. URL: <https://docs.cntd.ru/document/902064587?marker=6580IP>.
- Основы государственной молодежной политики Российской Федерации на период до 2025 года. URL: <https://docs.cntd.ru/document/420237592?marker=65A0IQ>.
- Воротилкина И. М., Баженова Н. Г., Баженов Р. И. Современные тренды здорового образа жизни студентов.

- Мир науки. Социология, филология, культурология. 2022; 13 (4): 1–15. DOI: 10.15862/59SCSK422.
6. Гуреев С. А., Мингазова Э. Н. Особенности состояния здоровья студентов в период их обучения, в том числе в условиях COVID-19. Менеджер здравоохранения. 2022; (3): 37–41. DOI: 10.21045/1811-0185-2022-3-37-41.
 7. Васильев В. В. Здоровый образ жизни. Роль врача в формировании здорового образа жизни. Медицинская активность населения и ее параметры. Научно-практический подход. 2025; S2: 355–8.
 8. Шапкина Е. В. Исследование самосохранительного поведения у студентов медицинского вуза. Вестник общественных и гуманитарных наук. 2024; 5 (4): 14–9.
 9. Шепелева О. М., Лазурина Л. П., Куркина М. П., Маль Г. С., Доценко В. А., Завидовская К. В. Самооценка качества жизни и сформированности здорового образа жизни студентов-медиков. Известия Юго-Западного государственного университета. Серия: Управление, вычислительная техника, информатика. Медицинское приборостроение. 2023; 13 (2): 112–24. DOI: 10.21869/2223-1536-2023-13-2-112-124.
 10. Шестера А. А., Транковская Л. В., Каерова Е. В., Нагирная Л. Н. Оценка физического развития и образа жизни студентов младших курсов медицинского вуза. Российский вестник гигиены. 2024; (2): 22–8. DOI: 10.24075/rbh.2024.097.
 11. Акименко Г. В., Селедцов А. М., Кирина Ю. Ю. К вопросу о развитии приверженности к здоровому образу жизни студентов медицинского университета. Дневник науки. 2021; 4 (52). URL: https://dnevniknauki.ru/images/publications/2021/4/pedagogics/Akimenko_Seledtsov_Kirina.pdf.
 12. Горностаева Ю. Д., Михайлов А. Ю., Рахманова О. В. Отношение студентов медицинского университета к здоровому образу жизни. Региональный вестник. 2020; 1 (40): 17–9.
 13. Набережная Ж. Б., Ромахова А. А. Позиция студентов медицинского университета к здоровому образу жизни. Вестник «Биомедицина и социология». 2023; 8 (1): 62–6. DOI: 10.26787/nydha-2618-8783-2023-8-1-62-66.
 14. Lipošek S, Planinšec J, Leskošek B, Aleksander P. Physical activity of university students and its relation to physical fitness and academic success. *Annales Kinesiologiae*. 2019; (9): 89–104. DOI: 10.35469/ak.2018.171.
 15. Есимханова А., Иванова Ю. В. Мотивация к здоровому образу жизни у студентов медицинских специальностей (обзор литературы). *Medicus*. 2025; 1 (67): 17–20.
 16. Бычков Н. В. Восприятие здорового образа жизни и отношение к спорту молодежной аудитории. Молодежная наука: тенденции развития. 2023; (2): 55–63.
 17. Корякина Н. И., Тимофеев Л. Ф. Медико-социальный анализ влияния учебного процесса на состояние здоровья студентов медицинского института. Тенденции развития науки и образования. 2023; (95-5): 29–32. DOI: 10.18411/trnio-03-2023-225.
 18. Снегирева Л. В., Элдинна Н. Б. М. С. Изучение роли медицинского университета в формировании представлений о здоровом образе жизни у обучаемых. *Научные вестн.* 2023; 6 (59): 12–6.
 19. Королева А. А., Янушанец О. И., Петрова Н. А., Беззубенкова Е. Ф. Влияние степени адаптированности и образа жизни на качество жизни студентов медицинского университета. *Российский вестник гигиены*. 2021; (2): 29–34. DOI: 10.24075/rbh.2021.011.
 20. Колбанов В. В. Образ жизни и здоровье студентов медицинского университета. *International Independent Scientific Journal*. 2020; (16-2): 44–6.
 21. Гелястанов И. Х. Образ жизни студентов: динамика изменений в процессе обучения в университете. Матрица научного познания. 2020; (11-2): 349–54.
 22. МР 2.1.10.0033-11 «Оценка риска, связанного с воздействием факторов образа жизни на здоровье населения». М.: Федеральный центр гигиены и эпидемиологии Роспотребнадзора, 2012.
 23. Понуркина П. Н., Тютинина А. В., Толмачев Д. А. Исследование соблюдения студентами медицинского вуза здорового образа жизни. *Дневник науки*. 2024; 9 (93). URL: https://dnevniknauki.ru/images/publications/2024/9/medicine/Ponurkina_Tyutina_Tolmachev.pdf.
 24. Мусаева М. М., Полунина Н. В., Ашанина Н. М., Солтамакова Л. С. Образ жизни студентов медицинского вуза. Кардиоваскулярная терапия и профилактика. 2023; 22 (S6): 75–6.
 25. Тухбатуллина Р. А., Ямщикова Т. В. Образ жизни студентов медицинского вуза и его влияние на здоровье. *Дневник науки*. 2024; 10 (94). URL: https://dnevniknauki.ru/images/publications/2024/10/medicine/Tukhbarukkina_Yamshchikova.pdf.
 26. Девришов Р. Д., Хорошева И. В., Кудряшева И. А., Даулетова Л. А., Дашдамирова Н. А. Гигиеническая характеристика основных компонентов образа жизни студентов медицинских вузов. *Медицина труда и экология человека*. 2022; 2 (30): 177–86. DOI: 10.24412/2411-3794-2022-2-177-186.
 27. Федорищева Е. К. Формирование здоровьесберегающего поведения у студентов медицинского университета: к разработке концепции исследования. *Власть и управление на Востоке России*. 2022; 2 (99): 210–19. DOI: 10.22394/1818-4049-2022-99-2-210-219.
 28. Кияев А. Х. Б., Волуйко П. А., Жирнова С. В. Сравнение особенностей применения лекарственных препаратов с целью самолечения студентами-медиками старших и младших курсов. *Молодежный инновационный вестник*. 2021; 10 (S1): 217–9.
 29. Захарова М. В., Никулина Т. В., Веретенникова О. М. Социальная поддержка студенческой молодежи в вузе. *Научные результаты в социальной работе*. 2023; 2 (2): 86–92. DOI: 10.18413/2949-267X-2023-2- 2-3.
 30. Бендрикова А. Ю., Калинин Д. А. Влияние профессионального обучения на формирование здорового образа жизни студентов медицинского вуза. *Межкультурная коммуникация в образовании и медицине: научно-практическое сетевое издание*. 2022; (3): 33–41.

INCLUSION OF A PLANT-BASED PRODUCT IN THE DIET OF KNOWLEDGE WORKERS TO ENHANCE THEIR VITAMIN AND MINERAL STATUS

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Environmental conditions and strenuous cognitive workload necessitate optimization of nutrition. This study aimed to evaluate the effectiveness of a predominantly plant-based product in improvement of the vitamin and mineral status of people engaged in intellectual labor. The formula for the product was developed after assessment of the said status and working conditions of the participants. The treatment group ($n = 30$) has been supplementing its diet with the product for 21 days, while the control group ($n = 30$) has not. The blood plasma levels of vitamins (B9 and B12, and 25(OH)D) and minerals (K, Na, ionized and total Ca, Fe, Mg, and P) were determined. By degree of strain, the considered occupations were classified as harmful strenuous work (class 3.2). Initially, the level of vitamin B9 in each group was in the "low-normal" zone. Through the experiment, in the treatment group it increased by 3.2–3.8%, while in the control group the said level dropped by 3.7–3.9%; the level of vitamin B12 increased by 36.7–46.7% and decreased in 23.3–36.7%, respectively, and that of 25(OH)D increased by 3.0% ($p = 0.02$) and decreased by 3.3% ($p = 0.03$). The level of ionized calcium in the treatment group increased by 7.0% ($p = 0.001$) and decreased by 50.0–53.3% in the control group. Iron levels increased by 3.1% in 80% of the treatment group participants ($p = 0.04$), and sodium levels increased by 0.9% ($p = 0.04$), which was 46.7–60.0% higher than the baseline values; in the control group, sodium levels dropped by 23.3–26.7%. No significant changes were recorded for the levels of K, total Ca, P, Mg, but at the level of individual indicators we observed multidirectional changes. Thus, the use of the multicomponent plant-based product demonstrates the promise of this approach for preventing vitamin and mineral deficiencies.

Keywords: Subarctic, harmful strenuous work, vitamins, minerals, multicomponent plant-based product, efficiency

Author contribution: Rakhmanov RS — study concept and design, article authoring; Bogomolov ES — article editing, approval of its final version; Razgulin SA — literature data collection, participation in the interpretation of the results; Narutdinov DA — collection, systematization of primary data; Shurkin DA — analysis and statistical processing of data.

Compliance with ethical standards: the study was conducted in accordance with the World Medical Association Declaration of Helsinki and approved by the Ethics Committee of Privolzhsky Research Medical University (Minutes No. 4 of March 14, 2022). All participants have voluntarily signed informed consent forms.

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КОРРЕКЦИЯ ВИТАМИННО-МИНЕРАЛЬНОЙ НАСЫЩЕННОСТИ ОРГАНИЗМА ЛИЦ, ЗАНЯТЫХ УМСТВЕННЫМ ТРУДОМ, РАСТИТЕЛЬНОМ ПРОДУКТОМ

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Условия экологического неблагополучия и напряженный умственный труд обуславливают необходимость оптимизации питания. Целью работы было оценить эффективность коррекции витаминно-минерального статуса лиц, занятых умственным трудом, растительным продуктом. После оценки витаминно-минерального статуса организма, условий труда разработали рецептуру продукта для повышения стрессоустойчивости. Лица из основной группы ($n = 30$) 21 день в дополнение к рациону принимали продукт, группа сравнения ($n = 30$) рацион не меняла. В плазме крови определяли уровень витаминов (B9 и B12, 25-ОН витамина D), минералов (K, Na, Ca ионизированный и общий, Fe, Mg, P). Условия напряженности трудового процесса оценивали как вредный напряженный труд (класс 3.2). Исходно уровень витамина B9 в каждой группе находился в зоне «пониженный уровень-норма». При приеме продукта он повышался на 3,2–3,8%, а в группе сравнения снижался на 3,7–3,9%. Уровень витамина B12, соответственно, вырос у 36,7–46,7% и снизился у 23,3–36,7%. Уровень 25-ОН витамина D вырос на 3,0% ($p = 0,02$) и снизился на 3,3% ($p = 0,03$). Уровень ионизированного кальция у лиц основной группы повысился на 7,0% ($p = 0,001$), а в группе сравнения снизился у 50,0–53,3%. В основной группе повышение уровня железа имело место у 80,0%; в группе сравнения зафиксирован рост на 3,1% ($p = 0,04$). На 0,9% ($p = 0,04$) повысился уровень натрия (по этапам наблюдения был выше исходных значений у 46,7–60,0%), в группе сравнения отмечено снижение у 23,3–26,7%. По K, Ca общему, P, Mg значимых изменений не отмечено, но по индивидуальным показателям определены разнонаправленные изменения. Использование многокомпонентного растительного продукта подтверждает перспективность данного направления профилактики витаминно-минеральной недостаточности организма.

Ключевые слова: Субарктика, вредный напряженный труд, витамины, минералы, многокомпонентный растительный продукт, эффективность

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Соблюдение этических стандартов: исследование проведено в соответствии с Хельсинской декларацией Всемирной медицинской ассоциации и одобрено этическим комитетом ФГБОУ ВО «ПИМУ» Минздрава России (протокол № 4 от 14 марта 2022 г.). Все участники подписали добровольное информированное согласие на участие в исследовании.

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As a stress factor, strenuous cognitive workload causes fatigue, malaise, anxiety, worsens the quality of work, productivity of the individual, and handicaps the cognitive functions of the brain. Depending on the severity and time of exposure to this factor, the consequences may include depletion of the adaptive reserves of the body [1, 2]. In addition, strenuous cognitive workload increases the individual's need for nutrients, including vitamins and minerals [3, 4]. For example, vitamin C deficiency impairs cognitive function; replenishing it boosts motivation, improves concentration, and enhances productivity on attention-demanding tasks [5]. An association was established between affective disorders and vitamins B6 and B12 deficiency [6]. As for vitamins E, B9, and magnesium, their levels affect mental health [7, 8].

One strategy for maintaining normal brain function and the body's stress resistance is eliminating nutrient deficiencies caused by internal or external factors [9–11].

This study aimed to evaluate the effectiveness of a predominantly plant-based product in improvement of the vitamin and mineral status of knowledge workers employed in the Subarctic zone.

METHODS

The study was conducted in the Subarctic zone. We observed two groups of men (healthy and practically healthy), 30 in each, over the summer. All the participants held similar jobs and performed their duties in an anthropogenically polluted urban area (Norilsk). They were 34.2 ± 0.92 years of age, and their work experience in the North was 6.4 ± 0.6 years. We assessed their working conditions [12].

Relying on data available from the scientific literature, we designed a multicomponent food product (MCFP) from predominantly plant-based raw materials to enhance the body's stress resistance. Ingredients of the MCFP: beetroot, oats, red grapes, eggshells, celery, parsley, kelp. The production employed cryogenic technology [13], yielding a final product rich in vitamins and minerals, the content of which was calculated taking into account the fraction of water remaining after cryogenic processing [14].

The treatment group supplemented their usual home-cooked diet with 10 g (2 teaspoons) of MCFP, added to the second course of dinner, for 21 days. The control group maintained their usual home-cooked diet and refrained from taking vitamin or mineral supplements before and throughout the study, including the observation period. The range of food consumed by individuals in both groups was the same.

We measured plasma levels of the considered vitamins and minerals three times: before the MCFP course, at its completion (on day 22), and on the 32nd day of observation (to confirm the effect).

Table 1. Vitamin content per 100 g of product

Product	A*, mg	E, mg	C, mg	B1, mg	B2, mg	B5, mg	B6, mg	B9, µg	B12, mg	PP, mg	Biotin, µg	D, µg	K, µg
Beet	0.18	0.025	20.13	0.04	0.04	0.32	0.14	22.05	0	0.805	0.339	–	0.339
Oats	0.55	12.55	0	0.23	0.018	0.38	0.04	7.413	0	0.326	4.118	–	–
Red grapes	0.07	0.195	11.1	0.07	0.072	0.05	0.088	1.487	0	0.193	–	–	14.226
Eggshell	0.02	0.31	–	–	0.015	–	–	–	–	–	–	–	–
Celery	0.084	9.422	6.78	0.066	0.032	0.538	–	33.25	–	0.7	1.029	–	46.391
Parsley	0.064	0.144	164.38	0.055	0.048	0.164	0.109	9.835	0	0.603	2.45	–	830.93
Dried kelp	0.113	0.035	0.707	0.014	0.006	–	–	0.169	0.109	0.109	0.475	0.261	10.23
Total	1.081	22.68	203.1	0.475	0.231	1.452	0.377	74.204	0.109	2.736	8.411	0.261	902.116

Note: * — combined in terms of carotenoids.

The plasma content of electrolytes (total calcium, magnesium, inorganic phosphorus, iron) was determined using an AU5800 analyzer (Beckman Coulter; USA), the content of ionized calcium, potassium, and sodium was established with a Roche AVL9180 analyzer (Roche Diagnostics GmbH; Germany). The results were evaluated in accordance with accepted standards [15].

The level of 25(OH)D, an intermediate in vitamin D metabolism, enabled assessment of the saturation of the body's vitamin D status. The tests were performed on an AB SCIEX QTRAP 5500 mass spectrometer (SCIEX; Germany). The results were categorized as follows: severe deficiency (5–10 ng/ml); deficiency (10–20 ng/ml); insufficiency (20–30 ng/ml); optimal level (30–100 ng/ml) [16].

The level of cyanocobalamin (vitamin B12) was determined using the ARCHITECT® i2000 automated system (Abbott; USA). The normal range was taken as 25–165 pmol/L. Level < 32 pmol/L was considered vitamin B12 deficiency [17].

The level of folic acid (vitamin B9) was determined on an AB SCIEX QTRAP 5500 liquid chromatography-mass spectrometer (SCIEX; Germany). The range of normal values was taken as 5–9 ng/ml [18].

When statistically processing aggregate indicators in tables generated in MS Office Excel (Microsoft; USA) using the Statistica 6.1 (StatSoft; USA), after determining the type of distribution using the Kolmogorov-Smirnov test, we calculated the following: for normal distribution — means (M) and their standard deviations (σ), for non-normal distribution — median values (Me) and interquartile range (Q_1 – Q_3). The significance of the differences for paired samples was determined in the first case with the Student's *t*-test, in the second — with the Wilcoxon test, at $p < 0.05$. In addition, we assessed the dynamics of deviations of individual indicators from the reference boundaries.

RESULTS

By the intensity of labor, the working conditions of the participants were classified as harmful and strenuous (class 3, degree 2). The emotional stress associated with the responsibility for decisions made, the likely risk to one's own safety and the safety of others supported the conclusion. Cognitive workloads and working hours yielded similar classification: heuristic type of work, comprehensive assessment of information, control and assignment of tasks, irregular work hours, non-compliance with regulated breaks. Sensory loads were also harmful (class 3, grade 1) and stemmed from prolonged use of a computer.

The calculated content of vitamins and minerals in the MCFP is given in Tables 1 and 2. In addition, 100.0 g of MCFP contained 17.62 g of dietary fiber.

Table 2. Mineral content per 100 g of product

Product	F, µg	J, µg	Cu, mg	Zn, mg	Fe, mg	Mn, mg	Cr, µg	Se, µg	Mg, mg	P, mg	Na, mg	Ca, mg	K, mg
Beet	40.25	24.15	0.125	0.425	2.45	1.12	0.01	1.409	4.63	80.52	157	32.21	579.78
Oats	31.86	2.04	0.31	3.3	7.7	1.44	0.03	–	28.87	119.83	5.45	12.25	116.83
Red grapes	12.33	11.31	0.06	0.072	0.37	0	3.08	0.1	7.194	20.55	2.055	10.277	196.3
Eggshell	13.26	4.08	0.11	0.92	3.06	0	0.024	0.015	56.1	13.27	9.184	340	178.56
Celery	8.75	3.28	0.91	3.63	2.2	0.163	0.15	0.438	24.07	52.516	175.05	87.527	260
Parsley	126.03	13.7	0.82	3.2	3.94	0.08	0.23	0.082	35.07	41.644	60.274	119.45	279.45
Kelp	36.96	326.09	0.56	1.14	3.36	0.03	2.69	0.076	13.37	4.565	29.35	20.65	14.13
Total	269.44	384.65	2.895	12.687	23.08	2.833	6.214	2.12	169.3	332.9	438.36	622.364	1625.05

Initially, the Q1 values for vitamin B9 in each group were in the "low level" zone. In the treatment group, it increased by 3.2–3.8% during the follow-up period and reached the reference range, while in the control group, on the contrary, it dropped by 3.7–3.9%. On the level of individual indicators, the folic acid level in the treatment group was initially lower than normal in 30.0% of the participants; consumption of the MCFP decreased this value to 13.3% during the course and further to 10.0% during the follow-up period. In the control group, before the start of follow-up, the vitamin B9 level was below the reference limit in 25.0% of the participants. On the 22nd day, 35.7% exhibited a decrease thereof within the normal limits. On day 32, a decreased B9 level was registered in 28.6% of the participants, and another 28.6% had the value dropping but not beyond the normal range.

There was no significant dynamics of vitamin B12 content in the groups; it was normal. However, in the treatment group, on days 22 and 32 of the follow-up period, 36.7% and 46.7% of the examined individuals showed an increase in the blood plasma level of this vitamin. In the control group, on the contrary, the said level decreased in 23.3% and 36.7%.

As for the 25(OH)D balance, the changes were multidirectional. There were no significant changes in the treatment group by the end of the MCFP course. However, on the 32nd day of follow-up, the level of 25(OH)D was 3.0% than the baseline. The positive trend was created by the participants who initially showed a deficit of the micronutrient: their share decreased from 60.0% to 40.0%. At the same time, the share of those verging on having a deficit thereof increased by 10.0%. In the control group, on the contrary, the proportion of people with a deficit increased and the proportion of people with insufficiency decreased; on the 22nd and 32nd days, the drop reached 3.3% (Table 3).

The blood levels of ionized calcium in both groups were between the lower limit of the normal range and the range

of insufficiency. In the treatment group, after the MCFP course, it increased by 7.0%, and by the end of the follow-up it was 6.5% higher than the baseline value, that is, within the reference range. At the level of individual participants, 73.3% of them exhibited growing levels of ionized calcium, and 70% retained the achieved results until the end of the follow-up period. In the control group, the level of this micronutrient decreased in 50.0–53.3% of the participants; at all stages of the follow-up period, it was below the norm in 40.0% of individuals.

By the end of the MCFP course, blood iron levels in the treatment group increased by 3.1%, which is significant. This result was observed in 80.0% of the participants. On the 32nd day of follow-up, it remained the same in 66.7% of individuals. In the control group, blood iron dropped in 30.0–10.0% of the participants.

Sodium levels grew slightly (by 0.9%), but significantly: on the 22nd and 32nd days of follow-up, the increase was registered in 46.7–60.0% of the treatment group participants. In the control group, sodium levels decreased in 23.3 and 26.7%.

As for other substances, their mean values remained largely unchanged (no significant fluctuations) and within the reference limits, but considered individually, they exhibited multidirectional changes: in the treatment group, 46.7% of the participants had the levels of potassium growing, and in the control group they dropped in 23.3%; total calcium was higher than the baseline in 36.7–40.0% of the treatment group individuals, while in the control group the respective value decreased below the initial figures on 20.0–30.0% of the participants; the level of inorganic phosphorus grew in the treatment group (33.3–40.0% of the participants), and in the comparison group it dropped in 16.7–23.9%; magnesium was higher than the baseline in 56.7–60.0% of treatment group subjects, while in the control group, the drop in its levels was observed in 23.3–13.3% of the examined participants (Table 4).

Table 3. Comparative characteristics of blood plasma vitamin content in knowledge workers, Me (Q₂₅–Q₇₅)

Group	Follow-up period, M ± σ		
	Baseline	Day 22	Day 32
Vitamin B9, 5.0–9.0 ng/ml			
Treatment	4.65 (4.11–6.24)	4.96 (4.89–6.6)/0.04*	5.15 (4.94–6.65)/0.03* *0.018***
Control	4.35 (4.45–8.0)	4.32 (4.33–7.8)/0.001	4.19 (4.2–7.66)/0.001/0.317
Vitamin B12, 25.0–165.0 pmol/L			
Treatment	109.95 (64.0–128.0)	105.0 (73.0–124.0)/0.25	111.0 (71.0–123.0)/0.2/0.28
Control	97.0 (78.5–164.0)	94.0 (78.0–169.50)/0.08	94.0 (77.5–169.5)/0.07/0.3
25(OH)D, 30–100 ng/ml:			
Treatment	18.65 (13.2–21.0)	18.9 (15.0–21.2)/0.85	18.95 (15.25–21.85)/0.02/0.12
Control	24.6 (19.25–35.55)	21.9 (18.25–34.85)/0.03	22.05 (18.25–34.85)/0.02/0.54

Note: * — significance of differences (p) relative to the baseline; ** — significance of differences (p) relative to the baseline; *** — significance of differences (p) relative to the data recorded after the MCFP course.

Table 4. Absolute mineral content in blood

Group	Follow-up period, M ± σ		
	Baseline	Day 22	Day 32
Potassium, 3.5–5.1 mmol/L			
Treatment	4.82 ± 0.5	4.83 ± 0.46/0.93*	4.81 ± 0.46/0.85**/0.056***
Control	5.0 ± 0.46	4.99 ± 0.47/0.45	4.99 ± 0.43/0.63/0.33
Sodium, 136–145 mmol/L			
Treatment	144.1 (142.0–146.0)	145.0 (144.0–147.0)/0.04	145.1 (144.0–147.0)/0.04/0.423
Control	144.0 (142.0–144.0)	143.0 (141.0–144.0)/0.41	143.0 (141.0–144.0)/0.41/0.919
Ionized calcium, 1.15–1.35 mmol/L			
Treatment	1.16 (1.11–1.2)	1.19 (1.1–1.33)/0.001	1.2 (1.1–1.32)/0.002/0.035
Control	1.14 (1.11–1.17)	1.13 (1.11–1.117)/0.054	1.13 (1.1–1.18)/0.07/0.929
Calcium, 2.02–2.60 mmol/L			
Treatment	2.59 (2.32–2.74)	2.5 (2.31–2.57)/0.09	2.5 (2.31–2.56)/0.3/0.49
Control	2.54 (2.44–2.62)	2.53 (2.43–2.61)/0.63	2.5 (2.4–2.59)/0.63/0.91
Inorganic phosphorus, 0.7–1.8 mmol/L			
Treatment	1.19 ± 0.19	1.21 ± 0.17/0.21	1.21 ± 0.18/0.162/0.16
Control	1.09 ± 0.12	1.1 ± 0.12/0.31	1.1 ± 0.12/0.48/0.67
Magnesium, 0.66–1.03 mmol/L			
Treatment	0.91 ± 0.07	0.9 ± 0.08/0.987	0.9 ± 0.08/0.172/0.17
Control	0.92 ± 0.13	0.92 ± 0.13/0.731	0.92 ± 0.13/0.869/0.574
Iron, 9.5–30 mmol/L:			
Treatment	20.74 ± 4.5	21.16 ± 5.21/0.049	21.38 ± 5.07/0.04/0.68
Control	19.98 ± 5.52	21.8 ± 4.94/0.711	21.8 ± 4.94/0.5/0.081

Note: * — significance of differences (*p*) relative to the baseline; ** — significance of differences (*p*) relative to the baseline; *** — significance of differences (*p*) relative to the data recorded after the MCFP course; for nonparametric data — Me (Q₂₅–Q₇₅).

DISCUSSION

Norilsk is the most problematic city in the Arctic macroregion; here, the population's health is affected by a combination of natural and environmental factors [19]. Amid anthropogenic pollution and strenuous intellectual workloads, the vitamin and mineral status of the examined individuals deviated from normal levels, potentially impairing their cognitive functions. In particular, the baseline levels of vitamin B9, 25(OH)D, and ionized calcium were reduced; overall, the levels of the considered vitamins and minerals were decreasing in the control group.

Previously, it has been established that nutrients consumed with food can alleviate neuropsychiatric stress associated with intense mental work [20, 21]. Accordingly, there was formulated a multicomponent product that promotes detoxification (via beetroot and oats), boosts antioxidant protection (from red grapes), enhances overall resilience by supplying essential vitamins and minerals (from all herbal components), and eliminates heavy metals (using eggshell [22]). Since the considered group had a high incidence of diseases of the genitourinary system, the formula was complemented with parsley and celery [23].

Kelp was used to address the pronounced iodine deficiency common in northern regions. The said deficiency hampers cognitive functions and promotes development of a secondary immunodeficiency [24].

The MCFP contained both minor and biologically active substances:

- beetroot: betaine, organic acids, organic antioxidants;
- oats: beta-carotene, betaine, lutein, zeaxanthin, gum, beta-cryptoscanthin, methylmethionine sulfonium, phytosterols;
- red grapes: carotenoids, lutein, zeaxanthin, betaine, phytosterols, antioxidants, essential oils, phenolic compounds;

- celery: beta-carotene, lutein, zeaxanthin, methylmethionine sulfonium, phytosterols;

- parsley: gamma-tocopherol, beta-carotene, betaine, methylmethionine sulfonium, phytosterols, flavonoids, antioxidants, lycopene;

- kelp: beta-carotene, fucoxanthin.

These substances perform "the functions of exogenous regulators of metabolism and play an important role in the adaptive reactions of the body, maintaining health" [25]. They have a positive effect on mental endurance and stimulate the activity of the nervous system [26–32].

Analysis of micronutrient intake showed that the treatment group received the following additional amounts daily (percentage of the recommended daily amount): up to 20.3% for vitamin C, 12.0% for vitamin A, 25.7% for iodine, 29.0% for copper, 23.1% for iron, 14.2% for manganese, and 10.6% for zinc. The proportion of dietary fiber reached 8.8% of the daily requirement [25].

In our study, adding the MCFP to the participants' diets increased cyanobalamin saturation in almost half of them. The deficiency of vitamin B12 can negatively affect hematopoiesis, the body's energy metabolism, and the state of the nervous and antioxidant systems under extreme conditions. It can be assumed that the negative effects worsened in the control group: levels of vitamins (B9, B12, 25(OH)D) dropped, and those of minerals (ionized Ca, Fe, Na) decreased significantly.

In 20.0% of the treatment group, folic acid levels were within the reference limits by the end of the follow-up; initially, they were below these limits in 30.0% of the participants from this group. In the control group, deviations from the norm only increased. Vitamin B9 is involved in hematopoiesis and regeneration, it boosts the anabolic and adaptive processes

in the body. Being involved in the synthesis of nucleic acids, vitamin B9 affects the normal development and function of the brain not only during pregnancy and after birth, but also later in life.

Despite the fact that the study was conducted in the summer, a significant proportion of the subjects showed vitamin D deficiency (established by measuring its major metabolite). Vitamin D is associated with regulating neurohormonal effects in the brain and maintaining cognitive function, memory, and behavior. It plays an important role in the mechanism of oxidative stress and regulation of phosphorus-calcium metabolism [33]. In our study, participants' vitamin D levels increased despite its low content in the MCFP. This may relate to elevated minerals (calcium, phosphorus, magnesium) that facilitate vitamin D metabolism.

In addition to micronutrients, minor and biologically active substances, the product contained dietary fiber, which is important for the intestinal microbiota.

CONCLUSIONS

In this study, we have shown that environmental problems and strenuous mental work increase the body's need for micronutrients, which necessitates optimization of the diet in such conditions. Given the work conditions and the habitat factors, the use of the multicomponent plant-based product demonstrates the promise of this approach for preventing vitamin and mineral deficiencies.

References

- Dudareva VA. Stress i pitanie: sindrom hronicheskoj ustalosti i drugie asociirovannye so stressom sostojanija. *Vestnik terapevta*. 2018; 9 (33): 64 (in Rus.).
- Dudareva VA, Maksimov ML, Djadikova IG, Korbanov JaF, Ivashenko PA, Chizhik LV. Stress i pitanie (obzor literatury). *Vestnik nevrologii, psixiatrii i neirohirurgii*. 2023; (2): 116–28 (in Rus.). DOI: 10.33920/med-01-2302-05.
- Bremner JD, Moazzami K, Wittbrodt MT, Nye JA, Lima BB, Gillespie CF, et al. Diet, stress and mental health. *Nutrients*. 2020; 12 (8): 2428. DOI: 10.3390/nu12082428.
- Koloskova NV, Krecu DO. Problema pravil'nogo pitaniya pri povyshennyh umstvennyh nagruzkah. *Alleja nauki*. 2018; 9 (25): 6 p. (in Rus.).
- Sim M, Hong S, Jung S, Kim JS, Goo YT, Chun WY, et al. Vitamin C supplementation promotes mental vitality in healthy young adults: results from a cross-sectional analysis and a randomized, double-blind, placebo-controlled trial. *Eur J Nutr*. 2022; 61 (1): 447–59. DOI: 10.1007/s00394-021-02656-3.
- Basak S, Mallick R, Duttaroy A.R. Maternal docosahexaenoic acid status during pregnancy and its impact on infant neurodevelopment. *Nutrients*. 2020; 12 (12): 3615. DOI: 10.3390/nu12123615.
- Shah BR, Li B, Al Sabbah H, Xu W, Mráz J. Effects of prebiotic dietary fibers and probiotics on human health: with special focus on recent advancement in their encapsulated formulations. *Trends Food Sci Technol*. 2020; (102): 178–92. DOI: 10.1016/j.tifs.2020.06.010.
- Sofyan M, Fitriani DY, Friska D, Basrowi RW, Fuady A. B Vitamins, work-related stress and emotional mental disorders: a cross-sectional study among nurses in Indonesia. *Nurs Open*. 2022; 9 (4): 2037–43. DOI: 10.1002/nop2.1213.
- Muscaritoli M. The impact of nutrients on mental health and well-being: insights from the literature. *Front Nutr*. 2021; (8): 656290. DOI: 10.3389/fnut.2021.656290.
- Akarachkova ES, Beljaev AA, Kadyrova LR, Klimov LV, Kotova OV. Stress i pitanie. *RMZh. Medicinskoe obozrenie*. 2021; 5 (5): 316–21 (in Rus.). DOI: 10.32364/2587-6821-2021-5-5-316-321.
- Su KP, Matsuoka Y, Pae CU. Omega-3 polyunsaturated fatty acids in prevention of mood and anxiety disorders. *Clin Psychopharmacol Neurosci*. 2015; 13 (2): 129–37. DOI: 10.9758/cpn.2015.13.2.129.
- R 2.2.2006-05. Rukovodstvo po gigenicheskoj ocenke faktorov rabochej sredy i trudovogo processa. Kriterii i klassifikacija uslovij truda. (In Rus.).
- Gruzdeva AE. Sposob poluchenija biokorrektorov iz natural'nogo syr'ja. Patent na izobrenenie № 2399296. 2010.
- Skurihin IM, Tuteljan VA, redaktory. Himicheskij sostav rossijskih pishhevnyh produktov. M.: DeLi, 2002; 236 p. (in Rus.).
- Kishkun AA. Rukovodstvo po laboratornym metodam issledovanija. M.: GEOTAR-Media, 2007; 779 p. (in Rus.).
- Klinicheskie rekomendacii "Deficit vitamina D u vzroslyh: diagnostika, lechenie i profilaktika". Rossijskaja asociacija jendokrinologov. M., 2015; 75 p. (in Rus.).
- Krasnovskij AL, Grigorev SP, Alehina RM, Ezhova IS, Zolkina IV, Loshkareva EO. Sovremennye vozmozhnosti diagnostiki i lechenija deficita vitamina V12. *Klinicist*. 2016; 10 (3): 15–25 (in Rus.). DOI: 10.17650/1818-8338-2016-10-3-15-25.
- Klinicheskie rekomendacii "Folievodeficitnaja anemija". 2021-2022-2023 (08.09.2021) (in Rus.).
- Revich BA. Riski zdorov'ju naselenija v "gorjachih tochkah" ot khimicheskogo zagraznenija Arkticheskogo makroregiona. *Problemy prognozirovanija*. 2020; 2 (179): 148–57 (in Rus.).
- Taylor AM, Holscher HD. A review of dietary and microbial connections to depression, anxiety, and stress. *Nutr Neurosci*. 2020; 23 (3): 237–50. DOI: 10.1080/1028415X.2018.1493808.
- Bärboi OB, Ciortescu I, Chirilă I, Anton C, Drug V. Effect of inulin in the treatment of irritable bowel syndrome with constipation (Review). *Exp Ther Med*. 2020; 20 (6): 185. DOI: 10.3892/etm.2020.9315.
- Urjash V, Gruzdeva A. Termodinamika biologicheski aktivnyh veshhestv. LAP LAMBERT Academic Publishing, 2017; 692 p. (in Rus.).
- Osnovnye pokazateli dejatel'nosti medicinskih organizacij, okazyvajushih stacionarnuju pomoshh' naseleniju Krasnojarskogo kraja v 2023 g. *Statisticheskij sbornik. Krasnojarskij kraevoj medicinskij informacionno-analiticheskij centr. Krasnojarsk*, 2024; 91 p. (in Rus.).
- Barkovskaja IA, Kruchinin AG, Rozhkova IV. Deficit joda v Rossii: sovremennoe sostojanie problemy, mirovaja praktika i novye podhody k terapii. *Pishhevye sistemy*. 2024; 7 (2): 238–45 (in Rus.). DOI: 10.21323/2618-9771-2024-7-2-238-245.
- Metodicheskie rekomendacii MP 2.3.1.0253-21 "Normy fiziologicheskikh potrebnošej v jenerгии i pishhevnyh veshhestvah dlja razlichnyh grupp naselenija Rossijskoj Federacii" (in Rus.).
- Eliseeva T, Tkacheva N. Svekla (lat. Béta vulgaris). *Journal. edaplus.info*. 2019; 8 (2): 51–60 (in Rus.).
- Gerasimov SA, Polonskij VI, Sumina AV, Surin NA, Lipshin AG, Zjute SA. Vlijanie genotipa i uslovij vyrashhivaniya ovsa na sodержanie biologicheski aktivnyh komponentov v zerne. *Himija rastitel'nogo syr'ja*. 2020; (2): 65–71 (in Rus.). DOI: 10.14258/jcprm.2020025515.
- Pshukova IV, Kuleshova SA. Fotohimicheskoe izuchenie i ocenka farmakologicheskogo aktivnosti vodnyh izvlechenij travy sel'dereja pahučehogo. *Himija rastitel'nogo syr'ja*. 2013; (3): 207–12 (in Rus.). DOI: 10.14258/jcprm.1303207.
- Eliseeva T, Jampolskij A. Petrushka (lat. Petroselinum crispum). *Journal.edaplus.info*. 2020; 12 (2): 2–13 (in Rus.).
- Podkorytova AV, Roshhina AN. Morskie burje vodorosli — perspektivnyj istočnik BAV dlja medicinskogo, farmacevтичeskogo i pishhevogo primenenija. *Trudy VNIRO*. 2021; 186 (4): 156–72 (in Rus.).
- Aristova NI. Issledovanie novogo krasnogo tehničeskogo sorta vinograda Krasen' i biologicheski aktivnyh, mineral'nyh komponentov vinomateriala v uslovijah južnogo berega Kryma. *Teorija i praktika sovremennoj nauki*. 2016; 9 (15): 24–30 (in Rus.).
- Ageeva NM, Markovos VA, Muzychenko GF, Bessonov VV, Hanferjan RA. Antioksidantnye i antiradikal'nye svoystva krasnyh vinogradnyh vin. *Voprosy pitaniya*. 2015; 84 (2): 63–7 (in Rus.).

33. Maganeva IS, Pigarova EA, Shulpekova NV, Dzeranova LK, Eremkina AK, Miljutina AP, et al. Ocenka fosforno-kal'cievogo obmena i metabolitov vitamina D u pacientov s pervichnym

giperparatireozom na fone boljusnoj terapii kolekal'ciferolom. *Problemy endokrinologii*. 2021; 67 (6): 68–79 (in Rus.). DOI: 10.14341/probl12851.

Литература

1. Дударева В. А. Стресс и питание: синдром хронической усталости и другие ассоциированные со стрессом состояния. *Вестник терапевта*. 2018; 9 (33): 64.
2. Дударева В. А., Максимов М. Л., Дядикова И. Г., Корбанов Я. Ф., Иващенко П. А., Чижик Л. В. Стресс и питание (обзор литературы). *Вестник неврологии, психиатрии и нейрохирургии*. 2023; (2): 116–28. DOI: 10.33920/med-01-2302-05.
3. Bremner JD, Moazzami K, Wittbrodt MT, Nye JA, Lima BB, Gillespie CF, et al. Diet, stress and mental health. *Nutrients*. 2020; 12 (8): 2428. DOI: 10.3390/nu12082428.
4. Колоскова Н. В., Крецу Д. О. Проблема правильного питания при повышенных умственных нагрузках. *Аллея науки*. 2018; 9 (25): 6 с.
5. Sim M, Hong S, Jung S, Kim JS, Goo YT, Chun WY, et al. Vitamin C supplementation promotes mental vitality in healthy young adults: results from a cross-sectional analysis and a randomized, double-blind, placebo-controlled trial. *Eur J Nutr*. 2022; 61 (1): 447–59. DOI: 10.1007/s00394-021-02656-3.
6. Basak S, Mallick R, Duttaroy AR. Maternal docosahexaenoic acid status during pregnancy and its impact on infant neurodevelopment. *Nutrients*. 2020; 12 (12): 3615. DOI: 10.3390/nu12123615.
7. Shah BR, Li B, Al Sabbah H, Xu W, Mráz J. Effects of prebiotic dietary fibers and probiotics on human health: with special focus on recent advancement in their encapsulated formulations. *Trends Food Sci Technol*. 2020; (102): 178–92. DOI: 10.1016/j.tifs.2020.06.010.
8. Sofyan M, Fitriani DY, Friska D, Basrowi RW, Fuady A. B Vitamins, work-related stress and emotional mental disorders: a cross-sectional study among nurses in Indonesia. *Nurs Open*. 2022; 9 (4): 2037–43. DOI: 10.1002/nop2.1213.
9. Muscaritoli M. The impact of nutrients on mental health and well-being: insights from the literature. *Front Nutr*. 2021; (8): 656290. DOI: 10.3389/fnut.2021.656290.
10. Акарачкова Е. С., Беляев А. А., Кадырова Л. Р., Климов Л. В., Котова О. В. Стресс и питание. *РМЖ. Медицинское обозрение*. 2021; 5 (5): 316–21. DOI: 10.32364/2587-6821-2021-5-5-316-321.
11. Su KP, Matsuoka Y, Pae CU. Omega-3 polyunsaturated fatty acids in prevention of mood and anxiety disorders. *Clin Psychopharmacol Neurosci*. 2015; 13 (2): 129–37. DOI: 10.9758/cpn.2015.13.2.129.
12. Р 2.2.2006-05. Руководство по гигиенической оценке факторов рабочей среды и трудового процесса. Критерии и классификация условий труда.
13. Груздева А. Е. Способ получения биокорректоров из натурального сырья. Патент на изобретение № 2399296. 2010.
14. Скурихин И. М., Тутельян В. А., редакторы. *Химический состав российских пищевых продуктов*. М.: ДеЛи, 2002; 236 с.
15. Кишкун А. А. Руководство по лабораторным методам исследования. М.: ГЭОТАР-Медиа, 2007; 779 с.
16. Клинические рекомендации «Дефицит витамина D у взрослых: диагностика, лечение и профилактика». Российская ассоциация эндокринологов. М., 2015; 75 с.
17. Красновский А. Л., Григорьев С. П., Алехина Р. М., Ежова И. С., Золкина И. В., Лошкарева Е. О. Современные возможности диагностики и лечения дефицита витамина B12. *Клиницист*. 2016; 10 (3): 15–25. DOI: 10.17650/1818-8338-2016-10-3-15-25.
18. Клинические рекомендации «Фолиеводефицитная анемия». 2021-2022-2023 (08.09.2021).
19. Ревич Б. А. Риски здоровью населения в «горячих точках» от химического загрязнения Арктического макрорегиона. *Проблемы прогнозирования*. 2020; 2 (179): 148–57.
20. Taylor AM, Holscher HD. A review of dietary and microbial connections to depression, anxiety, and stress. *Nutr Neurosci*. 2020; 23 (3): 237–50. DOI: 10.1080/1028415X.2018.1493808.
21. Bărboi OB, Ciortescu I, Chirilă I, Anton C, Drug V. Effect of inulin in the treatment of irritable bowel syndrome with constipation (Review). *Exp Ther Med*. 2020; 20 (6): 185. DOI: 10.3892/etm.2020.9315.
22. Урьяш В., Груздева А. Термодинамика биологически активных веществ. LAP LAMBERT Academic Publishing, 2017; 692 с.
23. Основные показатели деятельности медицинских организаций, оказывающих стационарную помощь населению Красноярского края в 2023 г. Статистический сборник. Красноярский краевой медицинский информационно-аналитический центр. Красноярск, 2024; 91 с.
24. Барковская И. А., Кручинин А. Г., Рожкова И. В. Дефицит йода в России: современное состояние проблемы, мировая практика и новые подходы к терапии. *Пищевые системы*. 2024; 7 (2): 238–45. DOI: 10.21323/2618-9771-2024-7-2-238-245.
25. Методические рекомендации МР 2.3.1.0253-21 «Нормы физиологических потребностей в энергии и пищевых веществах для различных групп населения Российской Федерации».
26. Елисеева Т., Ткачева Н. Свекла (лат. *Béta vulgaris*). *Journal. edaplus.info*. 2019; 8 (2): 51–60.
27. Герасимов С. А., Полонский В. И., Сумина А. В., Сурин Н. А., Липшин А. Г., Зюте С. А. Влияние генотипа и условий выращивания овса на содержание биологически активных компонентов в зерне. *Химия растительного сырья*. 2020; (2): 65–71. DOI: 10.14258/jcrpm.2020025515.
28. Пшукова И. В., Кулешова С. А. Фотохимическое изучение и оценка фармакологической активности водных извлечений травы сельдерея пахучего. *Химия растительного сырья*. 2013; (3): 207–12. DOI: 10.14258/jcrpm.1303207.
29. Елисеева Т., Ямпольский А. Петрушка (лат. *Petroselinum crispum*). *Journal.edaplus.info*. 2020; 12 (2): 2–13.
30. Подкорытова А. В., Рощина А. Н. Морские бурые водоросли — перспективный источник БАВ для медицинского, фармацевтического и пищевого применения. *Труды ВНИРО*. 2021; 186 (4): 156–72.
31. Аристова Н. И. Исследование нового красного технического сорта винограда Красень и биологически активных, минеральных компонентов виноматериала в условиях южного берега Крыма. *Теория и практика современной науки*. 2016; 9 (15): 24–30.
32. Агеева Н. М., Марковос В. А., Музыченко Г. Ф., Бессонов В. В., Ханферьян Р. А. Антиоксидантные и антирадикальные свойства красных виноградных вин. *Вопросы питания*. 2015; 84 (2): 63–7.
33. Маганева И. С., Пигарова Е. А., Шульпекова Н. В., Дзеранова Л. К., Еремкина А. К., Милютин А. П. и др. Оценка фосфорно-кальциевого обмена и метаболитов витамина D у пациентов с первичным гиперпаратиреозом на фоне болюсной терапии колекальциферолом. *Проблемы эндокринологии*. 2021; 67 (6): 68–79. DOI: 10.14341/probl12851.

THE IMPACT OF ANXIETY ON ACADEMIC PERFORMANCE IN ADOLESCENCE

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Anxiety should be considered as impaired adaptation in a particular situation. It can negatively impact mental health, quality of life, overall well-being, and disrupt schoolchildren's education and development. The study aimed to assess how anxiety levels influence the academic achievement of today's adolescents using psychodiagnostic tools. The researchers assessed levels of school-related, situational, and personal anxiety among ninth graders in Voronezh using the School Anxiety Test by B.N. Phillips and the Spielberger–Hanin Anxiety Scale, analyzing gender differences and the subsequent impact of anxiety on academic performance. Statistical methods were applied to the test data. The study found that most participating schoolchildren showed a normal level of anxiety. However, girls had higher levels than boys. As for the link between anxiety and academic performance, we did not identify an interconnection that, influenced by certain factors, may have a positive or a negative effect on the education-related productivity of adolescents. The results of this study complement the existing body of knowledge on the issue.

Keywords: anxiety, teenagers, personal and situational anxiety, school anxiety, academic performance

Author contribution: Kuvshinova NM — article authoring, editing; Sokolova NV — study concept and design, article editing; Gubina OI, Karpukhina AV — data collection and processing, article authoring, editing.

Compliance with ethical standards: the study was conducted in accordance with the principles of biomedical ethics and did not endanger the participants. Voluntary informed consent form was filled for each participant.

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ВЛИЯНИЕ ТРЕВОЖНОСТИ НА УСПЕВАЕМОСТЬ ДЕТЕЙ ПОДРОСТКОВОГО ВОЗРАСТА

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Тревожность необходимо рассматривать как факт нарушения адаптации к конкретной ситуации. Она может отрицательно влиять на различные аспекты психического здоровья, качества жизни, общее благополучие, а также препятствовать нормальному ходу обучения и воспитания школьников. Целью исследования было выполнить психодиагностическую оценку уровня тревожности и его влияния на академическую успеваемость современных подростков. С использованием теста школьной тревожности Б. Н. Филлипса и шкалы самооценки уровня тревожности Spielberger–Ханина оценивали уровень общей школьной, ситуативной и личностной тревожности у девятиклассников одной из школ г. Воронежа; были проанализированы особенности проявления тревожности у мальчиков и девочек, рассмотрено влияние тревожности на успеваемость обучающихся. Полученные диагностические данные обрабатывали с применением методов математической статистики. Результаты исследования показали, что для большинства исследованных школьников характерен нормативный уровень тревожности. Установлено, что девочки имели более высокие показатели тревожности, чем мальчики. Между тревожностью и учебной успеваемостью подростков не была выявлена однозначная взаимосвязь, характер которой, в зависимости от влияния тех или иных факторов, может отклоняться как в позитивную, так и в негативную сторону, оказывая положительное или отрицательное воздействие на продуктивность учебной деятельности. Полученные в ходе исследования данные дополняют имеющиеся сведения об изучаемой проблеме.

Ключевые слова: тревожность, подростки, личностная и ситуативная тревожность, школьная тревожность, успеваемость

Вклад авторов: Н. М. Кувшинова — написание текста статьи, редактирование; Н. В. Соколова — концепция и дизайн исследования, редактирование; О. И. Губина, А. В. Карпукхина — сбор и обработка данных, написание текста статьи, редактирование.

Соблюдение этических стандартов: исследование было проведено в соответствии с принципами биомедицинской этики и не подвергало опасности участников. Для каждого участника получено добровольное информированное согласие.

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The problem of anxiety, which affects various aspects of life including education, remains urgent [1]. Educational activities and various environmental factors at school often trigger and exacerbate anxiety, tension, excitement, self-doubt, negative expectations, and emotional instability in children.

A.M. Prikhozhan interprets anxiety as a state of emotional discomfort associated with a premonition of impending danger and the expectation of trouble [2].

R.S. Nemov defines anxiety as a constant or situational tendency to experience agitation, fear, and apprehension within specific social contexts [3].

One of the most common anxiety frameworks is the Spielberger–Hanin scale, which distinguishes between trait (personal) and state (situational) anxiety. Trait anxiety is a stable individual characteristic reflecting the tendency to experience apprehension or worry in various situations. Situational

anxiety occurs in response to specific circumstances and events [4, 5].

There is no age immune to anxiety, but adolescence is justly considered the most vulnerable period of life in this respect, given the background of hormonal processes, emotional instability, and rapid social and physical development [2].

The factors triggering negative emotions include both individual variables, such as gender, personality traits, and age, and external influences, such as traumatic events and the immediate school environment [6].

As adolescents spend a significant portion of their time in educational institutions, school-related factors are among the primary contributors to their increased anxiety [7–9]. Such factors include high learning and school-related workloads, educational innovations, exams and tests, grades, a large amount of homework, conflicts with classmates, teachers, etc. [10, 11].

Symptoms of anxiety can include nervousness, agitation, increased excitability, insecurity, drowsiness, tension, absent-mindedness, fatigue, restlessness, emotional instability [5, 12]. They depend on the individual characteristics of the body, environmental factors, and the severity of anxiety.

The consequences of anxiety can be seen in all areas of human life, affecting psychological well-being, health, behavior, and relationships in society. Anxiety itself can impair cognitive functions and undermine educational outcomes. Its severity reduces schoolchildren's productivity and academic performance, hampers parenting efforts, weakens peer relationships, hinders adaptation to new conditions, and disrupts overall physiological health.

Employing psychodiagnostic tools, this study assessed how anxiety levels influence the academic achievement of today's adolescents.

METHODS

The study was conducted at the A. Platonov school in Voronezh; it involved 84 9th grade pupils, 45 girls and 39 boys. They filled out the B. Phillips School Anxiety Test and the Spielberger–Hanin Anxiety Scale for the purpose of determining the level of anxiety.

The Spielberger–Hanin psychodiagnostic scale distinguishes between trait (personal) and state (situational) anxiety, which allows assessing it as both a personal characteristic and a reaction to the current situation.

In addition to measuring the overall level of school-associated anxiety, the B. Phillips psychodiagnostic method enables analysis of several factors related to the learning process and educational activities of pupils, including frustration of the need to succeed, social stress, fear of self-expression, fear of knowledge tests, fear of not meeting the expectations of others, low physiological stress resistance, problems and fears in relationships with teachers.

At the next stage of the study, we calculated the mean academic performance score of the participants (all subjects) and assessed the relationship between academic performance and anxiety.

Statistical processing of the collected data involved methods of parametric and nonparametric analysis. We calculated relative values (P) and relative errors (mp). The Mann–Whitney U test was used to compare the obtained indicators, and Spearman's rank correlation coefficient (r_s) was used to analyze the relationship between the two variables. The differences were considered statistically significant at $p \leq 0.05$. Statistica 6.0 (StatSoft; USA) was used for statistical processing of the results.

RESULTS

The Spielberger–Hanin scale revealed a moderate level of situational anxiety in the majority of the participating schoolchildren. High level was recorded in $22.62 \pm 4.52\%$ of pupils, low level — in $15.48 \pm 3.95\%$. There were also gender differences: a stressful situation had a pronounced effect on $33.3 \pm 7.03\%$ of girls and $12.82 \pm 5.35\%$ of boys, and a weak effect on $15.56 \pm 5.40\%$ of girls and $15.38 \pm 5.78\%$ of boys.

Compared with state anxiety, the level of trait anxiety was higher: it was intense in $33.33 \pm 5.14\%$ of schoolchildren, moderate — in $57.14 \pm 5.40\%$, and low in $9.52 \pm 3.20\%$ of them. Gender-wise, we registered a high level of trait anxiety in $23.08 \pm 6.75\%$ of boys and $40\% \pm 7.3\%$ of girls.

The intensity of anxiousness varied depending on gender. The values of the anxiety indicators were higher in girls than in boys. Mathematical and statistical processing of the results using the Mann–Whitney U test ($p \leq 0.05$) confirmed the gender-modified significance of the differences in indicators of state ($U_{Emp} = 600$) and trait anxiety ($U_{Emp} = 593$). The empirical values obtained were in the zone of significance.

The B. Phillips test has shown the general anxiety level to be high in $7.14 \pm 2.81\%$ of respondents, increased — in $15.48 \pm 3.95\%$. For the overwhelming majority of the participants, school factors were not traumatic, and the state of anxiety was either mild or within the normal range. They exhibited a fairly even emotional background and an adequate assessment of the current situation. It should be noted that this test revealed high degree of anxiety only in female respondents. The study data confirm that boys tend to be more emotionally stable than girls, with statistically significant results ($U_{Emp} = 611$, $p < 0.05$).

The school anxiety factors, as determined by the B. Phillips test, differed in their severity (Table 1).

Fear of knowledge tests was the most common factor. It was registered in $60.67\% \pm 5.33\%$ of schoolchildren: $14.28 \pm 3.82\%$ had it at a high level, $46.43 \pm 5.44\%$ — at an elevated level. Anxiety caused by failure to meet the expectations of others was seen in $51.19 \pm 5.45\%$ of ninth graders ($9.52 \pm 3.2\%$ — high level, $41.67 \pm 5.38\%$ — elevated level). These schoolchildren worry about the grades they receive, depend on the opinions of other people, and focus on the others' evaluations of their actions and performance. Half of the respondents had a fear of self-expression: a high level thereof was registered in $13.10 \pm 3.68\%$ of participants, elevated level — in $36.90 \pm 5.26\%$ of them. This fear reflects the negative attitude of schoolchildren towards public speaking, the necessary demonstration of their knowledge, skills, and abilities in the presence of a personally significant audience of listeners. The fear of speaking in public can further provoke agitation, self-doubt, lack of self-reliance and trust in own capabilities. Problems in relations with teachers were a factor that manifested at a high level in $9.52 \pm 3.2\%$ of adolescents, at an elevated level — in $23.81 \pm 4.65\%$. The other stress factors considered — frustration of the need to succeed, social stress, low physiological resistance to stress — were at high and elevated levels in fewer participants, and their contribution to the overall level of school anxiety was less significant.

Anxiety has quite a significant effect on the learning process of adolescents. It manifests as subjectively experienced agitation, tension, and preoccupation, which are associated with various stressful situations: exams, knowledge control and verification papers, tests, surveys, etc.

In this connection, at the next stage of the study, we calculated the mean academic performance score for ninth graders

Table 1. Severity of school anxiety according to the B. Phillips test (%)

Factors	Normal level	Elevated level	High level
Frustration of the need to succeed	95.24 ± 2.32%	4.76 ± 2.32%	–
Social stress	80.95 ± 4.28%	16.67 ± 4.07%	2.38 ± 1.66%
Fear of self-expression	50 ± 5.46%	36.90 ± 5.26%	13.10 ± 3.68%
Fear of knowledge tests	39.29 ± 5.33%	46.43 ± 5.44%	14.28 ± 3.82%
Fear of not meeting the expectations of others	48.81 ± 5.45%	41.67 ± 5.38%	9.52 ± 3.2%
Low physiological resistance to stress	85.71 ± 3.82%	10.71 ± 3.37%	3.57 ± 2.02%
Problems and fears in relationships with teachers	66.67 ± 5.14%	23.81 ± 4.65%	9.52 ± 3.2%

(all subjects) and used Spearman's rank correlation coefficient to examine its relationship with anxiety.

The indicators of general (school-associated), state, and trait anxiety differed between groups with varying levels of academic achievement (Table 2). In most cases, children whose marks were primarily "good" and "satisfactory" exhibited high state anxiety. Those who predominantly got "good" grades had a high level of trait and school-associated anxiety more often than other groups of participants.

However, statistical analysis of the data obtained did not show a significant relationship between the studied academic performance indicators and anxiety. We registered a very weak negative relationship between school grades and state anxiety ($r_s = -0.078$), trait anxiety ($r_s = -0.008$), and school anxiety ($r_s = -0.241$). In our opinion, the link connecting anxiety and academic performance may be closer than initially thought. The complex cause-and-effect relationships between schoolchildren's levels of anxiety and their academic performance can be viewed from different angles: on the one hand, intense anxiety can lower grades; on the other, poor performance may heighten anxiety.

DISCUSSION

Academic performance reflects the degree of success of educational efforts. Anxiety can affect the effectiveness of learning in different ways, both positive and negative [18, 19].

Studies [20, 21] established that high academic performance is more often observed among students with a high degree of state and trait anxiety.

There is evidence to the contrary, though: studies [10, 22–25] have shown that high anxiety hinders academic performance. It has a comprehensive negative impact on cognitive processes, motivation, and educational success of adolescents.

Another study reported that moderate anxiety did not interfere with learning or academic performance [26]. Moreover, a certain level of anxiety motivates schoolchildren to successful learning activities.

Table 2. The impact of anxiety levels on academic performance (%)

Anxiety level		Academic performance		
		"Perfect"	"Good"	"Satisfactory"
State anxiety level	High level	23.53 ± 10.29%	42.59 ± 6.73%	46.15 ± 13.83%
	Moderate level	29.41 ± 11.05%	38.89 ± 6.63%	30.77 ± 12.8%
	Low level	47.06 ± 12.11%	18.52 ± 5.29%	23.08 ± 11.69%
Trait anxiety level	High level	23.53 ± 10.29%	38.89 ± 6.63%	23.08 ± 11.69%
	Moderate level	29.41 ± 11.05%	44.44 ± 6.76%	30.77 ± 12.80%
	Low level	47.06 ± 12.11%	16.67 ± 5.07%	46.15 ± 13.83%
School anxiety level	High level	11.76 ± 7.81%	22.22 ± 5.66%	7.69 ± 7.39%
	Moderate level	35.29 ± 11.59%	18.52 ± 5.29%	38.46 ± 13.49%
	Low level	52.94 ± 12.11%	59.26 ± 6.69%	53.85 ± 13.83%

Studies [18, 27–29], same as our work, have not revealed unambiguous relationship between anxiety and academic performance.

The data from our study show the complexity and ambiguity of the relationship between anxiety and academic performance. It can be assumed that this relationship can become both positive and negative, depending on the influence of certain factors.

Prevention of anxiety is necessary for maintaining the emotional health of schoolchildren. Preventive and psychocorrective efforts should be comprehensive, involving all participants in the educational process: children, parents, teachers, psychologists, social educators, and others.

CONCLUSIONS

The findings indicate that the majority of ninth graders exhibit a normal level of anxiety. The figures were as follows: 22.62 ± 4.52% of children had elevated and high levels of general school anxiety, 33.33 ± 5.14% — high levels of trait anxiety, and 22.62 ± 4.52% showed high levels of state anxiety. The most stressful situations were associated with knowledge tests, fear of not meeting the expectations of others, fear of self-expression, and problems and fears in relationships with teachers. The intensity of disturbing emotions was gender-dependent: girls were more prone to anxiety than boys. Statistical analysis did not reveal an unambiguous influence of trait, state, and general school anxiety on the academic success of ninth graders. In all likelihood, the impact of anxiety on the learning activities of schoolchildren can be both negative and positive, depending on various factors. At the same time, we assume that there is no direct causal relationship between anxiety and academic performance. This relationship depends on many factors, including relationships with parents and peers, the level of self-esteem and attitudes towards academic performance in general, as well as the conditions this study has been conducted in.

References

1. Popov VI, Berezhnova TA, Kulincova JaV. Uroven' trevozhnosti u detej v vozraste 8–12 let Voronezhskoj oblasti. Vestnik psihoterapii. 2015; 54 (59): 151–8 (in Rus.).
2. Prihozhan AM. Psihologija trevozhnosti: doskol'nyj i shkol'nyj vozrast. SPb.: Piter, 2007; 282 p. (in Rus.).
3. Nemov RS. Psihologija: uchebnik dlja studentov vysshih pedagogicheskikh uchebnyh zavedenij. M.: Gumanit. izd. centr VLADOS, 2001; 640 p. (in Rus.).
4. Voronova RM, Gunko VV, Kazbekova KA. Trevozhnost' kak faktor, vlijajushhij na psihojemocional'noe sostojanie i funkcional'nost' podrostkov. Nauka i real'nost'. 2024; 1 (17): 53–63 (in Rus.).
5. Kostjushina EV, Shhukin AJu. Vlijanie trevozhnosti na uspešnost' obuchenija v podrostkovom vozraste. Nauka i obrazovanie. 2021; 4 (1): 8 p. (in Rus.).
6. Soboleva LG, Novak NG, Sharshakova TM. Ocenka urovnja trevozhnosti detej shkol'nogo vozrasta g. Gomelja. Problemy zdorov'ja i jekologii. 2013; 4 (38): 123–8 (in Rus.).
7. Careva EV, Mikulec JuD, Chapanova ES. Issledovanie urovnja trevozhnosti podrostkov. Problemy sovremennogo pedagogicheskogo obrazovanija. 2023; 5 (3): 370–3 (in Rus.).
8. Popov MV. Jelektronnaja sreda kak faktor riska zdorov'ju obuchajushhij. Molodezhnyj innovacionnyj vestnik. 2020; 9 (52): 63–4 (in Rus.).
9. Astashenko AP, Gubina OI, Popov MV, Jashhenko IN, Sazonova OV, Gavryushin MJu. Analiz fenomena "smeshhenija vnimanija" kak markera psihojemocional'nogo naprjazhenija. Gigiena truda i promyshlennaja jekologija. 2022; 62 (4): 247–53 (in Rus.).
10. Jushkova NB. Shkol'naja trevozhnost' kak faktor, vlijajushhij na uspešnost' obuchenija shkol'nikov srednego zvena. Social'noe upravlenie. 2023; 5 (3): 84–9 (in Rus.).
11. Panova VJu, Kartysheva SI, Kuvshinova NM. Analiz obraza zhizni sovremennyh shkol'nikov. V sbornike: Novoj shkole — zdorovyje deti. Materialy VIII Vserossijskoj nauchno-praktičeskoj konferencii s mezhdunarodnym uchastiem; 25 oktjabrja 2024 g.; g. Voronezh. Voronezh: Izdatel'stvo VGPU, 2024; 208–10 (in Rus.).
12. Manturova NM. Projavlenie trevozhnosti i jemocional'noj napravlenosti v podrostkovom vozraste i ih vlijanie na shkol'nuju uspevaemost'. SMALTA. 2025; (1): 77–90 (in Rus.).
13. Kosyh JuF, Sokolova NV. Gendernye osobennosti projavlenija trevozhnosti u podrostkov i puti ee korekcii v uslovijah shkol'nogo obrazovanija. Molodezhnyj innovacionnyj vestnik. 2018; 7 (S3): 53–4 (in Rus.).
14. Popov VI. Gigieničeskaja harakteristika podhodov, harakterizujushhij vozrastnye osobennosti detej, podrostkov i molodezhi. Zdravoohranenie Rossijskoj Federacii. 2019; 63 (4): 199–204 (in Rus.).
15. Popov VI, Nastausheva TL, Zhdanova OA. Sostojanie zdorov'ja i fizičeskaja aktivnost' detej v period obuchenija v shkole. Zdravoohranenie Rossijskoj Federacii. 2021; 65 (3): 238–44 (in Rus.).
16. Nikitjuk DB, Popov VI, Milushkina OJu, Skoblina NA, Sazonova OV, Levushkin SP, et al. Normativy dlja ocenki fizičeskogo razvitija detej i podrostkov Rossijskoj Federacii. Chast' 2. M.: Nauchnaja kniga, 2023; 446 p. (in Rus.).
17. Evdokimov VI, Popov VI, Rut AN. Problemy innovacionnyh issledovanij v gigiene. Gigiena i sanitarija. 2015; 94 (9): 5–8 (in Rus.).
18. Ivannikova AA. Vlijanie trevozhnosti na uspevaemost' mladshih shkol'nikov. Modern Science. 2020; (5-1): 429–33 (in Rus.).
19. Dmitrieva SN, Evdokarova TV, Popova II. Vlijanie trevozhnosti na uspevaemost' podrostkov. Sovremennoe pedagogičeskoe obrazovanie. 2019; (12): 104–6 (in Rus.).
20. Zozuk AA, Melnikova AA, Sibekina AS, Ustinova AO. Vlijanie trevozhnosti na akademičeskiju uspevaemost' studentov-psihologov. V sbornike: Vesennie psihologo-pedagogičeskie čtenija. Materialy IV Mezhtregional'noj nauchno-praktičeskoj konferencii, posvjashhennoj pamjati početnogo professora AGU A. V. Burovoj; 19 aprilja 2020 g.; g. Astrahan'. Astrahan': Izdatel'skij dom "Astrahanskij universitet", 2020; 100–3 (in Rus.).
21. Gasanova PG, Daudova D. M., Kimpaeva Je. A. Vlijanie trevozhnosti na uchebnuju dejatel'nost' studentov. Evrazijskij sojuz uchenyh. 2015; 7–6 (16): 56–8 (in Rus.).
22. Pasynkova NB. Svjaz' urovnja trevozhnosti podrostkov s jeffektivnost'ju ih intellektual'noj dejatel'nosti. Psihologičeskij žurnal. 1996; (1): 169–74 (in Rus.).
23. Kurtyševa OR. Vzaimosvjaz' trevozhnosti i uchebnoj dejatel'nosti podrostkov. Studenčeskaja nauka i XXI vek. 2024; 21 (1 (24)): 156–8 (in Rus.).
24. Tkachenko VA, Tkachenko LM. Struktura uchebnoj motivacii starsheklassnikov. Vestnik Cheljabinskogo pedagogičeskogo universiteta. 2013; (12-2): 170–83 (in Rus.).
25. Pashukova AD, Savina TV. Vzaimosvjaz' urovnja trevozhnosti i uspevaemosti v uslovijah obrazovatel'nogo prostranstva. Vserossijskij nauchno-praktičeskij žurnal social'nyh i humanitarnyh issledovanij. 2024; 4 (15): 67–75 (in Rus.).
26. Davletbaeva ZK, Bikčentaeva KF. Vzaimosvjaz' shkol'noj uspevaemosti i trevozhnosti obuchajushhij. Kazanskaja nauka. 2024; (12): 50–2 (in Rus.).
27. Antipkina NP, Rud NA, Baranova MB. Shkol'naja trevozhnost' kak odin iz faktorov riska dlja zdorov'ja obuchajushhij. V sbornike: Novoj shkole — zdorovyje deti. Materialy V Vserossijskoj nauchno-praktičeskoj konferencii; 26–27 oktjabrja 2018 g.; g. Voronezh. Voronezh: Izdatel'stvo VGPU, 2018; 5–7 (in Rus.).
28. Pozdnjakova AJu. Vzaimosvjaz' trevozhnosti s uspevaemost'ju sredi uchashhij starshih i srednih klassov. Central'nyj nauchnyj vestnik. 2017; 2 (4 (21)): 31–2 (in Rus.).
29. Fedorova JuA, Nabieva AR. Pedagogičeskoe issledovanie vzaimosvjazi shkol'noj uspevaemosti i trevozhnosti u podrostkov. Vestnik Bashkirskogo gosudarstvennogo pedagogičeskogo universiteta im. M. Akmully. 2021; 1 (58): 107–9 (in Rus.).
30. Suhareva NF, Zheltenkova ID. Psihoprofilaktika shkol'noj trevozhnosti v podrostkovom vozraste. Aktual'nye problemy i perspektivy razvitija sovremennoj psihologii. 2019; (1): 217–24 (in Rus.).

Литература

1. Попов В. И., Бережнова Т. А., Кулинцова Я. В. Уровень тревожности у детей в возрасте 8–12 лет Воронежской области. Вестник психотерапии. 2015; 54 (59): 151–8.
2. Прихожан А. М. Психология тревожности: дошкольный и школьный возраст. СПб.: Питер, 2007; 282 с.
3. Немов Р. С. Психология: учебник для студентов высших педагогических учебных заведений. М.: Гуманит. изд. центр ВЛАДОС, 2001; 640 с.
4. Воронова Р. М., Гунько В. В., Казбекова К. А. Тревожность как фактор, влияющий на психоэмоциональное состояние и функциональность подростков. Наука и реальность. 2024; 1 (17): 53–63.
5. Костюшина Е. В., Щукин А. Ю. Влияние тревожности на успешность обучения в подростковом возрасте. Наука и образование. 2021; 4 (1): 8 с.
6. Соболева Л. Г., Новак Н. Г., Шаршакова Т. М. Оценка уровня тревожности детей школьного возраста г. Гомеля. Проблемы здоровья и экологии. 2013; 4 (38): 123–8.
7. Царева Е. В., Микулец Ю. Д., Чапанова Е. С. Исследование уровня тревожности подростков. Проблемы современного педагогического образования. 2023; 5 (3): 370–3.
8. Попов М. В. Электронная среда как фактор риска здоровью обучающихся. Молодежный инновационный вестник. 2020; 9 (52): 63–4.
9. Асташенко А. П., Губина О. И., Попов М. В., Яценко И. Н., Сазонова О. В., Гаврюшин М. Ю. Анализ феномена «смещения

- внимания» как маркера психоэмоционального напряжения. Гигиена труда и промышленная экология. 2022; 62 (4): 247–53.
10. Юшкова Н. Б. Школьная тревожность как фактор, влияющий на успешность обучения школьников среднего звена. Социальное управление. 2023; 5 (3): 84–9.
 11. Панова В. Ю., Картышева С. И., Кувшинова Н. М. Анализ образа жизни современных школьников. В сборнике: Новой школе — здоровые дети. Материалы VIII Всероссийской научно-практической конференции с международным участием; 25 октября 2024 г.; г. Воронеж. Воронеж: Издательство ВГПУ, 2024; 208–10.
 12. Мантурова Н. М. Проявление тревожности и эмоциональной направленности в подростковом возрасте и их влияние на школьную успеваемость. СМАЛЬТА. 2025; (1): 77–90.
 13. Косых Ю. Ф., Соколова Н. В. Гендерные особенности проявления тревожности у подростков и пути ее коррекции в условиях школьного образования. Молодежный инновационный вестник. 2018; 7 (S3): 53–4.
 14. Попов В. И. Гигиеническая характеристика подходов, характеризующих возрастные особенности детей, подростков и молодежи. Здравоохранение Российской Федерации. 2019; 63 (4): 199–204.
 15. Попов В. И., Настаушева Т. Л., Жданова О. А. Состояние здоровья и физическая активность детей в период обучения в школе. Здравоохранение Российской Федерации. 2021; 65 (3): 238–44.
 16. Никитюк Д. Б., Попов В. И., Милушкина О. Ю., Скоблина Н. А., Сазонова О. В., Левушкин С. П. и др. Нормативы для оценки физического развития детей и подростков Российской Федерации. Часть 2. М.: Научная книга, 2023; 446 с.
 17. Евдокимов В. И., Попов В. И., Рут А. Н. Проблемы инновационных исследований в гигиене. Гигиена и санитария. 2015; 94 (9): 5–8.
 18. Иванникова А. А. Влияние тревожности на успеваемость младших школьников. Modern Science. 2020; (5-1): 429–33.
 19. Дмитриева С. Н., Евдокарлова Т. В., Попова И. И. Влияние тревожности на успеваемость подростков. Современное педагогическое образование. 2019; (12): 104–6.
 20. Зозук А. А., Мельникова А. А., Сибекина А. С., Устинова А. О. Влияние тревожности на академическую успеваемость студентов-психологов. В сборнике: Весенние психолого-педагогические чтения. Материалы IV Межрегиональной научно-практической конференции, посвященной памяти почетного профессора АГУ А. В. Буровой; 19 апреля 2020 г.; г. Астрахань. Астрахань: Издательский дом «Астраханский университет», 2020; 100–3.
 21. Гасанова П. Г., Даудова Д. М., Кимпаева Э. А. Влияние тревожности на учебную деятельность студентов. Евразийский союз ученых. 2015; 7–6 (16): 56–8.
 22. Пасынкова Н. Б. Связь уровня тревожности подростков с эффективностью их интеллектуальной деятельности. Психологический журнал. 1996; (1): 169–74.
 23. Куртышева О. Р. Взаимосвязь тревожности и учебной деятельности подростков. Студенческая наука и XXI век. 2024; 21 (1 (24)): 156–8.
 24. Ткаченко В. А., Ткаченко Л. М. Структура учебной мотивации старшеклассников. Вестник Челябинского педагогического университета. 2013; (12-2): 170–83.
 25. Пашукова А. Д., Савина Т. В. Взаимосвязь уровня тревожности и успеваемости в условиях образовательного пространства. Всероссийский научно-практический журнал социальных и гуманитарных исследований. 2024; 4 (15): 67–75.
 26. Давлетбаева З. К., Бикчентаева К. Ф. Взаимосвязь школьной успеваемости и тревожности обучающихся. Казанская наука. 2024; (12): 50–2.
 27. Антипкина Н. П., Рудь Н. А., Баранова М. Б. Школьная тревожность как один из факторов риска для здоровья обучающихся. В сборнике: Новой школе — здоровые дети. Материалы V Всероссийской научно-практической конференции; 26–27 октября 2018 г.; г. Воронеж. Воронеж: Издательство ВГПУ, 2018; 5–7.
 28. Позднякова А. Ю. Взаимосвязь тревожности с успеваемостью среди учащихся старших и средних классов. Центральный научный вестник. 2017; 2 (4 (21)): 31–2.
 29. Федорова Ю. А., Набиева А. Р. Педагогическое исследование взаимосвязи школьной успеваемости и тревожности у подростков. Вестник Башкирского государственного педагогического университета им. М. Акмуллы. 2021; 1 (58): 107–9.
 30. Сухарева Н. Ф., Желтенкова И. Д. Психопрофилактика школьной тревожности в подростковом возрасте. Актуальные проблемы и перспективы развития современной психологии. 2019; (1): 217–24.

AWARENESS OF PEOPLE OVER THE AGE OF 60 ABOUT INFECTIOUS SKIN DISEASES AND PREVENTION MEASURES

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Infectious skin diseases significantly reduce the quality of life in people over the age of 60 and can be considered age-related due to involutive skin changes and aging of the body. Older people with a difference in the clinical picture of the disease from the classical manifestations are more susceptible to individual dermatoses. The elderly are most at risk of contracting scabies. The aim of the work is to analyze the awareness of people over the age of 60 about infectious skin diseases and their prevention measures. A multicenter, cross-sectional study was conducted using an online questionnaire in 2023–2025. The number of respondents over the age of 60 was 41 respondents, and all respondents were retirees in terms of social status. The study was conducted on the basis of Pirogov University and the Federal Medical Research Center of the FMBA of Russia, where, in case of hospitalization, patients were examined by a dermatovenerologist, and laboratory diagnostics were performed if infectious dermatoses were suspected. Some of the respondents did not demonstrate adherence to the principles of a healthy lifestyle: alcohol consumption is the highest among the risk factors for developing chronic noncommunicable diseases (75.0% for men and 40.0% for women). Respondents also note a high level of stress in daily life, 87.8%. The Internet is a source of information about a healthy lifestyle and the prevention of skin diseases for 34.1% of respondents. Among the surveyed respondents, there is a group of 20.0% who are insufficiently informed about "healthy skin" issues. Educating various groups of the population, increasing the level of medical literacy and medical activity can become a reserve for reducing the incidence rate and maintaining the incidence rate within controlled values.

Keywords: scabies, public awareness, healthy skin, prevention

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ИНФОРМИРОВАННОСТЬ ЛИЦ В ВОЗРАСТЕ СТАРШЕ 60 ЛЕТ О ЗАРАЗНЫХ БОЛЕЗНЯХ КОЖИ И МЕРАХ ИХ ПРОФИЛАКТИКИ

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Заразные болезни кожи существенно снижают качество жизни у людей в возрасте старше 60 лет и могут рассматриваться как возраст-ассоциированные в связи с инволютивными изменениями кожи и старением организма. Отдельным дерматозам более подвержены люди старшего возраста, при этом у них клиническая картина заболевания отличается от классических проявлений. Наиболее подвержены риску заражения чесоткой пожилые люди. Целью работы было проанализировать информированность лиц в возрасте старше 60 лет о заразных болезнях кожи и мерах их профилактики. В 2023–2025 гг. проведено многоцентровое поперечное исследование с использованием онлайн-опросника. Число опрошенных лиц старше 60 лет — 41 человек, по социальному статусу все опрошенные являлись пенсионерами. Исследование проводили на базе Пироговского университета и ФЦМН ФМБА России, где в случае госпитализации пациентов осматривал врач-дерматовенеролог, а при подозрении на заразные дерматозы проводилась лабораторная диагностика. Часть опрошенных не продемонстрировала приверженность принципам здорового образа жизни: среди факторов риска развития хронических неинфекционных заболеваний наиболее высокие показатели демонстрирует употребление алкоголя (75,0% у мужчин и 40,0% у женщин). Помимо этого респонденты отмечают высокий уровень стресса в повседневной жизни (87,8%). Источником информации о здоровом образе жизни и профилактике заболеваний кожи для 34,1% респондентов является Интернет. Среди респондентов присутствует группа лиц (20,0%), недостаточно информированных по вопросам «здоровой кожи». Просвещение различных групп населения, повышение уровня медицинской грамотности и медицинской активности могут стать резервом для снижения уровня заболеваемости и поддержания уровня заболеваемости в пределах контролируемых значений.

Ключевые слова: чесотка, информированность населения, здоровая кожа, профилактика

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Соблюдение этических стандартов: исследование одобрено локальными этическими комитетами РНИМУ Н. И. Пирогова Минздрава России (протокол № 244 от 21 октября 2024 г.) и ФЦМН ФМБА России (протокол № 02/17-02-25 от 17 февраля 2025 г.). Исследование выполнено в соответствии со стандартами надлежащей клинической практики (Good Clinical Practice) и принципами Хельсинкской декларации.

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From 2010 to 2019, the absolute number of diseases of the skin and subcutaneous tissue among seniors (age above 60) has increased in Russia [1]. Making medical assistance and preventive measures more readily available to elderly people is one of the urgent and important tasks for the national healthcare system. In this population group, the epidermal barrier repair capabilities deteriorate, the immune system malfunctions, and neurodegenerative disorders develop, which translates into atypical and severe course of infectious dermatoses, especially against the background of other somatic diseases [2, 3]. Infectious skin diseases, scabies in particular, are socially significant, therefore, healthcare professionals should learn and factor in the level of awareness and the maturity of the respective prevention skills among seniors [4]. Knowing the gaps in elderly patients' awareness of infectious skin diseases allows medical staff to better educate them on prevention measures and skin self-examination, and to tailor care to their real needs.

This study aimed to analyze awareness of infectious skin diseases and their prevention among people aged over 60.

PATIENTS AND METHODS

This cross-sectional study used an online questionnaire "The Core Role of Primary Prevention of Skin Diseases of Various Origins," which was designed and tested by the specialists of the Pirogov University. The respondents took an anonymous online survey (56 questions) in 2023–2025. The survey took about 20–25 minutes; the participants used their own devices to fill it out. The results were analyzed by a dermatovenerologist. The questions were single- or multiple-choice.

The questions were developed on the basis of a literature review that investigated the awareness about skin diseases of various origins (including scabies) among people aged 60 years and above. By their social status, all respondents were retirees. The questions were checked for clarity and readability by experts and laypersons, and clarified based on their feedback. The questionnaire was divided into three sections. The first

section included demographic and anamnestic data. The multiple-choice questions in the second section covered knowledge of skin diseases from various origins (including scabies), their transmission patterns, diagnosis, and clinical presentation. The third section investigated the respondents' awareness of the sources of information about skin diseases and the actions taken upon discovering symptoms of skin diseases. For participants, the study ended once they completed and submitted the online survey. The survey was created using Yandex Forms, an online service that also handled data collection. The resulting dataset was then formatted in Microsoft Excel 2016 (Microsoft, USA), and analyzed by the authors of the study.

Study design

The study was conducted in 2023–2025; it involved 41 people (6 men and 35 women). All the respondents were over 60, the mean age was 67 ± 0.61 years (from 63 years to 71 years).

Inclusion and exclusion criteria

Inclusion criteria: age over 60 years; signed voluntary informed consent form; correctly completed questionnaire; and retiree status (the studied population group). Exclusion criteria: lack of signed voluntary informed consent form and a completed questionnaire; age below 60 years; status of a healthcare professional.

Statistical analysis

Statistical data processing was performed using Statistica 10.0 (StatSoft; USA) and MS Office Excel 2016 (Microsoft; USA).

The normality of the distribution was analyzed using the Kolmogorov–Smirnov, Lilliefors, and Shapiro–Wilk tests. For non-normally distributed data, we report the median (Me), first quartile (Q1), third quartile (Q3), and 95% confidence intervals (95% CI). The chi-square test (χ^2) was used to assess

Table 1. Characteristics of respondents, Me, %

Indicators	Participants of the study		Significance
	Male	Female	
	6	35	
Total, <i>n</i> , %	41		100%
Age, Me [1Q; 3Q]	67 [63; 71]		Variance 1
Chronic diseases, <i>n</i> , % [95% CI]	27; 65.9% [52.0–80.0]		
Continued intake of medications, <i>n</i> , % [95% CI]	33; 73.2% [60.0–86.0]		
Low level of physical activity, <i>n</i> , % [95% CI]	13; 31.7% [18.0–46.0]		
Moderate stress level in daily life, subjective assessment, <i>n</i> , % [95% CI]	36; 87.8% [77.0–97.0]		
Daily and frequent consumption of high-calorie and/or unhealthy foods, <i>n</i> , % [95% DI]	12; 29.3% [16.0–43.0]		
Average sleep time in hours, Me [1Q; 3Q]	7 [6; 6]		
Average daily water consumption, L, Me [1Q; 3Q]	1 [1; 2]		
Alcohol consumption, <i>n</i> , % [95% DI]	3; 50.0% [50.0–100.0]	14; 40.0% [20.0–60.0]	$\chi^2 = 7.333$ $p = 0.033$ between men and women
Smoking, <i>n</i> , % [95% CI]	1; 16.7% [5.0–45.0]	8; 22.9% [3.0–43.0]	$\chi^2 = 0.555$ $p = 0.800$ between men and women
Presence of pets, <i>n</i> , % [95% CI]	17; 41.5% [26.0–57.0]		

Table 2. Risk factors for skin diseases and respondents' awareness of their prevention, %

Indicators	Retirees
Family history of skin diseases, <i>n</i> ; % [95% CI]	5; 12.2% [2.0–23.0]
Personal history of skin diseases, <i>n</i> ; % [95% CI]	13; 31.7% [18.0–46.0]
Allergic reactions to drugs, food products or other substances, <i>n</i> ; % [95% CI]	13; 31.7% [18.0–46.0]
Chronic skin diseases, <i>n</i> ; % [95% CI]	2; 4.9% [1.0–9.0]
Unaware of where a dermatovenerologist's office is, <i>n</i> ; % [95% CI]	4; 9.8% [1.0–18.0]
Have never been to a dermatovenerologist's appointment, <i>n</i> ; % [95% CI]	24; 58.5% [43.0–73.0]
Unaware of having skin diseases, <i>n</i> ; % [95% CI]	5; 12.2% [2.0–23.0]
Unaware of which skin diseases are contagious, <i>n</i> ; % [95% CI]	2; 4.9% [1.0–9.0]
Not interested in the subject of health preservation, <i>n</i> ; % [95% CI]	2; 4.9% [1.0–9.0]
Not ready to discuss the subject of health with anyone, <i>n</i> ; % [95% CI]	9; 22.0% [10.0–32.0]
Seek health-related advice online, <i>n</i> ; % [95% CI]	14; 34.1% [20.0–48.0]
Seek health-related advice from a medical doctor, <i>n</i> ; % [95% CI]	31; 75.6% [62.0–89.0]
Believe that skin diseases can be prevented, <i>n</i> ; % [95% CI]	25; 60.9% [45.0–75.0]
Believe that they will not get skin diseases if they are prevented, <i>n</i> ; % [95% CI]	6; 14.6% [5.0–25.0]
Believe that they cannot get skin diseases, <i>n</i> ; % [95% CI]	5; 12.2% [2.0–23.0]
Unaware that scabies is a contagious skin disease, <i>n</i> ; % [95% CI]	5; 12.2% [2.0–23.0]
Believe that scabies can be prevented, <i>n</i> ; % [95% CI]	25; 60.9% [45.0–75.0]
Believe that scabies can be treated with a cream/hormonal cream/remedy recommended by a pharmacist, <i>n</i> ; % [95% CI]	2; 4.9% [1.0–9.0]
Unaware that pediculosis is a contagious skin disease, <i>n</i> ; % [95% CI]	8; 19.5% [8.0–30.0]
Believe that pediculosis can be prevented, <i>n</i> ; % [95% CI]	17; 41.5% [26.0–57.0]
Believe that pediculosis can be treated with a cream/hormonal cream/remedy recommended by a pharmacist, <i>n</i> ; % [95% CI]	18; 43.9% [29.0–59.0]
Unaware that mycosis is a contagious skin disease, <i>n</i> ; % [95% CI]	25; 60.9% [45.0–75.0]
Believe that mycosis can be prevented, <i>n</i> ; % [95% CI]	16; 39.0% [24.0–54.0]
Unaware that molluscum contagiosum is a contagious skin disease, <i>n</i> ; % [95% CI]	26; 63.4% [48.0–78.0]
Believe that molluscum contagiosum can be prevented, <i>n</i> ; % [95% CI]	9; 22.0% [10.0–32.0]

the significance of the differences between unrelated groups. The differences were considered significant at $p \leq 0.05$.

RESULTS

The main results of the study

The survey included questions aimed at identifying risk factors for chronic noncommunicable diseases (Table 1).

According to the survey, 65.9% of respondents have chronic diseases. The most common are arterial hypertension, coronary heart disease, and type 2 diabetes mellitus. Other

results: 73.2% of the participants take medications on a regular basis; 31.7% reported a low level of physical activity; 87.8% assessed their routine stress level as "average"; 29.3% admitted consuming high-calorie and unhealthy foods daily and often; and 27% complained of only 5–6 hours of nightly sleep. Some respondents had bad habits: 16.7% of men and 22.9% of women were smokers. Most participants noted that they rarely drink alcohol, and reported drinking 1 liter of water per day on average (insufficient amount). As for pets, 41.5% of the respondents have them.

In general, the survey revealed a picture typical of the studied population [5].

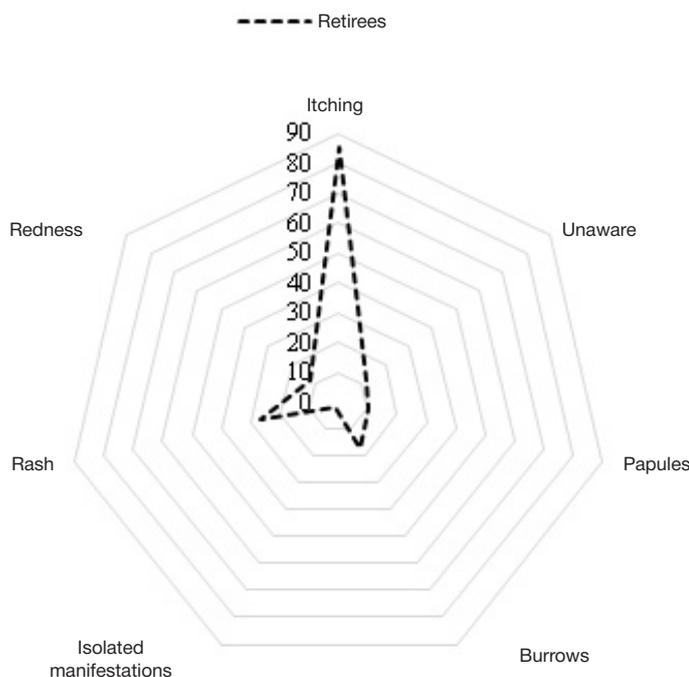


Fig. 1. Awareness of respondents about scabies symptoms, %

As the survey results show, 31.7% of respondents have a history of skin diseases, including 4.9% with chronic varieties — predominantly atopic dermatitis; another 31.7% mentioned a history of skin diseases in their families; and another 31.7% reported allergic reactions to drugs, food products, and other substances (Table 2).

The participating seniors showed insufficient interest in medicine. This is evident from some respondents' reported lack of interest, their reluctance to discuss the topic, unawareness of the dermatovenerologist's office location, no prior visits to a dermatovenerologist, and general ignorance of skin diseases, including contagious ones.

At the same time, 75.6% of respondents noted that the main source of health information for them is a medical doctor, and 34.1% of the participants seek for health-related advice online.

Nearly two-thirds of respondents (60.9%) assume skin diseases are preventable; 14.6% believe prevention fully protects them from contracting one; and 12.2% think they fundamentally cannot get a skin disease.

Among survey participants, 4.9% assumed scabies was noncontagious and planned to treat it with pharmacist-recommended cream. For pediculosis, 19.5% believed it could not be transmitted and were also willing to use a cream suggested in a pharmacy. Some respondents replied that they would not do anything (isolated cases).

Most of the seniors surveyed know that a symptom of scabies is severe itching. However, only 27% of the respondents know about rash, and as low as 17% are aware of burrows (Fig. 1).

Seventy-three percent of respondents consider it necessary to consult a dermatovenerologist at the first signs of skin diseases.

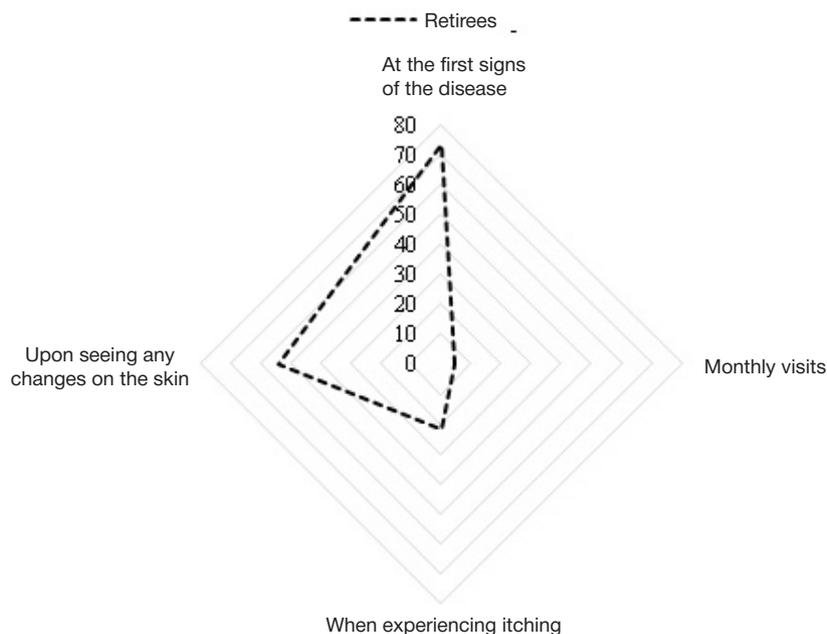


Fig. 2. Respondents' visits to a doctor when scabies is suspected, %

However, the participants were not fully informed about the symptoms of contagious skin diseases, which undermines their ability to seek assistance "at the first sign" (Fig. 2). A quarter (25%) of the surveyed seniors expressed their readiness to schedule a routine check-up with a dermatovenerologist.

Thus, part of the seniors surveyed are not sufficiently aware of what healthy skin is and what diseases can develop on it.

DISCUSSION

An increase in life expectancy has led to more cases of chronic diseases, including skin diseases — which is interesting given the rise of multimorbidity in old age [6].

In addition to somatic diseases, aging causes certain pathomorphological and functional changes in the skin, with involutive processes there contributing to the development of age-related disorders, which points to the need to improve the practiced prevention and treatment methods [7, 8].

A survey of dermatovenerologists showed that they need more details about the patterns of rendering medical assistance to seniors in their field [9]. Many medical specialists (84.1%) noted the need to expand knowledge about the psychology of the elderly and the specifics of providing medical care for skin diseases associated with multimorbid conditions [10].

At the same time, when discussing infectious skin diseases, it should be noted that the pathomorphosis of scabies caused by diagnostic errors is a factor in the formation of spreading family foci. Other contagious dermatoses (molluscum contagiosum, mycoses, pediculosis) can be prevented by measures designed for senior populations, and timely treatment can reduce the risk of a severe course. The epidemiological significance of such diseases stems from their high invasive potential, which indicates the need to improve the complex of diagnostic, therapeutic, and preventive measures [11–13].

Insufficient knowledge and skills among the population for finding and using essential medical and other information can hinder timely access to care and a healthy lifestyle [5]. It is necessary to assess the ability of various population groups to effectively interact with the healthcare system

and improve the health literacy of the public, which is quite low in many countries [14]. Analysis of the survey data revealed critical behavioral errors in patients who suspect they have a skin disease. Such errors can be categorized as follows: unwillingness to take an interest in their own health and visit a specialist doctor; confidence that skin diseases cannot be contracted; seeking medical advice from a pharmacist at a pharmacy. A pharmacist can sell certain medications without a doctor's prescription or confirmed diagnosis. This leads to missed clinical cases and, for contagious diseases, sustains local infections and triggers epidemiological outbreaks.

Since our research shows that some older participants lack sufficient knowledge about "healthy skin" issues, hygienic education is needed to prevent family outbreaks. This should account for how skin diseases progress amid multimorbidity in old age. Contact with a pathogen can infect the skin, so prevention measures against contagious skin diseases can stop the disease before it develops. Early diagnosis and medical treatment prevent epidemiological outbreaks.

Study limitations

The limitations of this study include its conduct in the Moscow region and the small sample size. The latter complicates identifying significant relationships between lifestyle and awareness of infectious skin disease contagiousness/prevention among seniors over 60.

CONCLUSIONS

The survey confirmed that older people are not sufficiently informed about the infectious skin diseases prevention measures. Hygienic education for older people (e.g., through the Healthy Skin school), along with efforts to boost medical knowledge and activity, can serve as a reserve for reducing incidence rates and keeping them at controlled levels in the studied cohort. In the future, a thorough analysis of the reasons for the lack of awareness of older people about "healthy skin" issues is needed in order to develop preventive measures.

References

- Kubanov AA, Bogdanova EV. Jepidemiologija boleznej kozhi i podkozhnoj kletchatki i okazanie specializirovannoj medicinskoj pomoshhi v treh vozrastnyh gruppah naselenija v 2010–2020 gg. v Rossijskoj Federacii. Nacional'noe zdravooohranenie. 2022; 3 (1): 15–24 (in Rus.). DOI: 10.47093/2713-069X.2022.3.1.15-24.
- Tlish MM, Kuznecova TG, Naatyzh ZhJu, Erohina EV. Social'no-jepidemiologicheskie osobennosti chesotki u gerontologicheskikh bol'nyh. RMZh. 2022; 30 (3): 55–8 (in Rus.).
- Gajdina TA, Dvornikov AS, Milushkina OJu, Gamidova AA. Diagnostika i profilaktika chesotki u malomobil'nyh pacientov s kognitivnymi narushenijami. Arhiv vnutrennej mediciny. 2023; 13 (3): 232–40 (in Rus.). DOI: 10.20514/2226-6704-2023-13-3-232-24.
- Gajdina TA, Milushkina OJu, Skoblina NA, Tairova RT. Chesotka u komorbidnogo pacienta s tjazhelej nevrologicheskoy patologiej: klinicheskij sluchaj. Medicinskij alfavit. 2024; (31): 46–51 (in Rus.). DOI: 10.33667/2078-5631-2024-31-46-51.
- Pivovarov JuP, Milushkina OJu, Skoblina NA, Markelova SV, Fedotov DM, Okolnikov FB, et al. Ispol'zovanie internet-oprosov v ocenke osvedomlennosti ob osnovah zdorovogo obraza zhizni. Sovremennye problemy zdravooohranenija i medicinskoj statistiki. 2020; (2): 398–413 (in Rus.). DOI: 10.24411/2312-2935-2020-00055.
- Odinec AV, Ivanova MA. Zabolevaemost' boleznyami kozhi i podkozhnoj kletchatki v obshej populjacii naselenija i sredi lic starshe trudospobnogo vozrasta v Stavropol'skom krae, 2017 po 2020 gg. Sovremennye problemy zdravooohranenija i medicinskoj statistiki. 2021; (3): 411–23 (in Rus.). DOI: 10.24412/2312-2935-2021-3-411-423.
- Urakova AV, Perlamutrov JuN, Olhovskaja KB. Kliniko-morfologicheskie aspekty dermatozov v geriatrii. JEFFektivnaja farmakoterapija. 2024; 20 (23): 12–5 (in Rus.). DOI: 10.33978/2307-3586-2024-20-23-12-15.
- Rodin AJu. Sovremennye kliniko-jepidemiologicheskie, diagnosticheskie i terapevticheskie aspekty chesotki. Vestnik Volgogradskogo gosudarstvennogo medicinskogo universiteta. 2021; 4 (80): 180–4 (in Rus.). DOI: 10.19163/1994-9480-2021-4(80)-180-183.
- Gajdina TA, Tairova RT, Milushkina OJu, Ljang OV, Ievleva OV, Skoblina NA, et al. Gigienicheskie aspekty profilaktiki chesotki:

- informirovannost' naselenija i novye podhody k snizheniju zabolevaemosti. RMZh. 2025; 31 (5): 421–30 (in Rus.).
10. Odinec AV, Ivanov MA. Organizacionnye aspekty optimizacii medicinskoj pomoshhi naseleniju starshe trudospobnogo vozrasta po profilju "Dermatovenerologija". Sovremennye problemy zdavoohranenija i medicinskoj statistiki. 2021; (2): 669–79 (in Rus.). DOI: 10.24412/2312-2935-2021-2-669-679.
 11. Sokolova TV, Lopatina JuV, Maljarchuk AP, Novolockaja KM. Kriterii jepidemiologicheskoj znachimosti semejnyh ochagov pri redkih variantah techenija chesotki. Klinicheskaja dermatologija i venerologija. 2021; 20 (3-2): 157–75 (in Rus.). DOI: 10.17116/klinderma202120032157.
 12. Gajdina TA, Silin AA. Diagnostika chesotki u komorbidnyh malomobil'nyh pacientov i metody ee profilaktiki. Kardiovaskuljarnaja terapija i profilaktika. 2025; 24 (S5): 37 (in Rus.).
 13. Uzun S, Durdu M, Yürekli A, Mülayim MK, Akyol M, Velipaşaoğlu S, et al. Clinical practice guidelines for the diagnosis and treatment of scabies. Int J Dermatol. 2024; 63 (12): 1642–56. DOI: 10.1111/ijd.17327.
 14. Shelegova DA, Lopatina MV, Chigrina VP, Samofalov DA, Medvedev VA, Tjufilin DS, et al. Ocenka gramotnosti naselenija v voprosah zdorov'ja, vkljuchaja navigacionnuju gramotnost'. Moskva, 2023. (in Rus.). DOI: 10.21045/978-594116-106-5-2023.

Литература

1. Кубанов А. А., Богданова Е. В. Эпидемиология болезней кожи и подкожной клетчатки и оказание специализированной медицинской помощи в трех возрастных группах населения в 2010–2020 гг. в Российской Федерации. Национальное здравоохранение. 2022; 3 (1): 15–24. DOI: 10.47093/2713-069X.2022.3.1.15-24.
2. Тлиш М. М., Кузнецова Т. Г., Наатыж Ж. Ю., Ерохина Е. В. Социально-эпидемиологические особенности чесотки у геронтологических больных. РМЖ. 2022; 30 (3): 55–8.
3. Гайдина Т. А., Дворников А. С., Милушкина О. Ю., Гамидова А. А. Диагностика и профилактика чесотки у маломобильных пациентов с когнитивными нарушениями. Архивъ внутренней медицины. 2023; 13 (3): 232–40. DOI: 10.20514/2226-6704-2023-13-3-232-24.
4. Гайдина Т. А., Милушкина О. Ю., Скоблина Н. А., Таирова Р. Т. Чесотка у коморбидного пациента с тяжелой неврологической патологией: клинический случай. Медицинский алфавит. 2024; (31): 46–51. DOI: 10.33667/2078-5631-2024-31-46-51.
5. Пивоваров Ю. П., Милушкина О. Ю., Скоблина Н. А., Маркелова С. В., Федотов Д. М., Окольников Ф. Б. и др. Использование интернет-опросов в оценке осведомленности об основах здорового образа жизни. Современные проблемы здравоохранения и медицинской статистики. 2020; (2): 398–413. DOI: 10.24411/2312-2935-2020-00055.
6. Одинец А. В., Иванова М. А. Заболеваемость болезнями кожи и подкожной клетчатки в общей популяции населения и среди лиц старше трудоспособного возраста в Ставропольском крае, 2017 по 2020 гг. Современные проблемы здравоохранения и медицинской статистики. 2021; (3): 411–23. DOI: 10.24412/2312-2935-2021-3-411-423.
7. Уракова А. В., Перламутров Ю. Н., Ольховская К. Б. Клинико-морфологические аспекты дерматозов в гериатрии. Эффективная фармакотерапия. 2024; 20 (23): 12–5. DOI: 10.33978/2307-3586-2024-20-23-12-15.
8. Родин А. Ю. Современные клинико-эпидемиологические, диагностические и терапевтические аспекты чесотки. Вестник Волгоградского государственного медицинского университета. 2021; 4 (80): 180–4. DOI: 10.19163/1994-9480-2021-4(80)-180-183.
9. Гайдина Т. А., Таирова Р. Т., Милушкина О. Ю., Лянж О. В., Иевлева О. В., Скоблина Н. А. и др. Гигиенические аспекты профилактики чесотки: информированность населения и новые подходы к снижению заболеваемости. РМЖ. 2025; 31 (5): 421–30.
10. Одинец А. В., Иванов М. А. Организационные аспекты оптимизации медицинской помощи населению старше трудоспособного возраста по профилю «Дерматовенерология». Современные проблемы здравоохранения и медицинской статистики. 2021; (2): 669–79. DOI: 10.24412/2312-2935-2021-2-669-679.
11. Соколова Т. В., Лопатина Ю. В., Малярчук А. П., Новолоцкая К. М. Критерии эпидемиологической значимости семейных очагов при редких вариантах течения чесотки. Клиническая дерматология и венерология. 2021; 20 (3-2): 157–75. DOI: 10.17116/klinderma202120032157.
12. Гайдина Т. А., Силин А. А. Диагностика чесотки у коморбидных маломобильных пациентов и методы ее профилактики. Кардиоваскулярная терапия и профилактика. 2025; 24 (S5): 37.
13. Uzun S, Durdu M, Yürekli A, Mülayim MK, Akyol M, Velipaşaoğlu S, et al. Clinical practice guidelines for the diagnosis and treatment of scabies. Int J Dermatol. 2024; 63 (12): 1642–56. DOI: 10.1111/ijd.17327.
14. Шелегова Д. А., Лопатина М. В., Чигрина В. П., Самофалов Д. А., Медведев В. А., Тюфилин Д. С. и др. Оценка грамотности населения в вопросах здоровья, включая навигационную грамотность. Москва, 2023. DOI: 10.21045/978-594116-106-5-2023.

THE IMPACT OF SMOKING AND ENERGY DRINKS ON THE QUALITY OF LIFE OF STUDENTS

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The high prevalence of smoking and consumption of energy drinks among students is a significant medical and social problem. This study aimed to investigate the impact of these harmful habits on the quality of life of students of the Burdenko Voronezh State Medical University, and to assess their awareness of the risks associated with such bad habits. We invited 442 second- and third-year students from the medical, pediatric, and dental faculties to complete O.I. Gubina's Quality of Life Assessment questionnaire. Energy drink drinking was found to be more prevalent than smoking; male participants practiced these habits significantly more often than female. Electronic cigarettes were the most common form of nicotine consumption. We established significant correlations of smoking with respiratory symptoms (the closest — with cough, $r = 0.489$; $p < 0.05$), and consumption of energy drinks — with tachycardia ($r = 0.864$; $p < 0.05$), sleep disorders ($r = 0.251$; $p < 0.05$), and headache ($r = 0.217$; $p < 0.05$). The quality of life was significantly lower in the groups of students with harmful habits, and the median values were minimal when the said habits were combined, especially on the "Health" and "Spirituality and Healthy Lifestyle" scales. Despite the awareness of harm, a significant part of students do not intend to give up harmful habits. The results of the study emphasize the need to develop prevention programs aimed at risk groups, primarily young men and people with combined addiction.

Keywords: quality of life, students, smoking, energy drinks, harmful habits, lifestyle

Author contribution: the authors have made equal contributions to this publication.

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 submitted a signed informed consent form before the survey.

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ВЛИЯНИЕ КУРЕНИЯ И ЭНЕРГЕТИЧЕСКИХ НАПИТКОВ НА КАЧЕСТВО ЖИЗНИ СТУДЕНЧЕСКОЙ МОЛОДЕЖИ

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Высокая распространенность курения и употребления энергетических напитков среди студенческой молодежи представляет значительную медико-социальную проблему. Целью работы было изучить влияние указанных вредных привычек на качество жизни студентов Воронежского государственного медицинского университета имени Н. Н. Бурденко и оценить их осведомленность о связанных с этими вредными привычками рисках. В анонимном анкетировании приняли участие 442 студента 2–3 курсов лечебного, педиатрического и стоматологического факультетов. Были использованы авторская анкета и опросник «Способ оценки качества жизни» О. И. Губиной. Установлено, что среди студентов распространенность употребления энергетических напитков выше распространенности курения, при этом обе привычки значительно чаще отмечали у юношей. Наиболее часто встречающейся формой потребления никотина было использование электронных сигарет. Установлены значимые корреляции курения с респираторными симптомами (наиболее тесная — с кашлем, $r = 0,489$; $p < 0,05$), а употребления энергетических напитков — с тахикардией ($r = 0,864$; $p < 0,05$), нарушениями сна ($r = 0,251$; $p < 0,05$) и головной болью ($r = 0,217$; $p < 0,05$). Качество жизни было значимо ниже в группах студентов с вредными привычками, достигая минимальных медианных значений при наличии сочетания вредных привычек, особенно по шкалам «Здоровье» и «Духовность и ЗОЖ». Несмотря на осознание вреда, значительная часть студентов не намерена отказываться от вредных привычек. Результаты исследования подчеркивают необходимость разработки профилактических программ, ориентированных на группы риска — прежде всего на юношей и лиц с сочетанным пристрастием.

Ключевые слова: качество жизни, студенты, курение, энергетические напитки, вредные привычки, образ жизни

Вклад авторов: все авторы внесли равный вклад в подготовку публикации.

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

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Student health issues are becoming increasingly relevant [1, 2]. There are many risk factors that affect the quality of life of this population group: health status and access to medical care, financial situation, level of education and career prospects, social environment, cultural and spiritual values, psychological well-being, etc. [3–5].

Today, studying at a higher education institution involves high cognitive loads, chronic psycho-emotional stress, and a lack

of free time, placing intense demands on students [6–8]. The need to multitask, process vast amounts of information, and constantly adapt to social environments often drives young people toward harmful stress-relief methods. Some of the most common of those methods are smoking and drinking energy drinks. The combination of these two harmful habits poses a special hazard for students, creating a medical and social problem that demands a comprehensive solution.

Smoking is one of the most common harmful habits among students. This problem is not confined to Russia, it is international [9, 10]. According to statistical studies, almost every fourth medical student resorts to smoking [11]. Electronic cigarettes, vapes, and hookahs are becoming increasingly popular among the youth. The health risks associated with them have become a concern for medical professionals and the public. Many young people believe that alternative methods of nicotine consumption have fewer negative consequences than smoking traditional cigarettes and are more fashionable and socially acceptable. However, studies show that e-cigarettes can be even more harmful to the body than traditional tobacco products. At the same time, the awareness about the potential negative consequences of such forms of nicotine consumption remains quite low [12, 13].

It should be noted that smoking significantly increases the risk of serious respiratory diseases, including chronic obstructive pulmonary disease and emphysema. In addition, it is the main cause of lung cancer, which remains one of the leading causes of cancer-related deaths. Smokers are more likely to develop cardiovascular pathologies due to narrowing and damage to blood vessels, including coronary heart disease, myocardial infarction, and stroke. There is another risk factor linked to both regular cigarettes and e-cigarettes that is relevant for students: lower intellectual and cognitive abilities [14, 15].

Currently, with the ever-accelerating rhythm of life, people are increasingly sacrificing proper rest, and thus feel the need for special aids that can quickly increase mental and physical performance [16]. Energy drinks are very popular among students during the academic year, especially before tests and exams. Students often get less sleep than they need and feel fatigued after busy days, so they turn to these drinks [17–19]. The composition of energy drinks includes high levels of caffeine and other stimulants like taurine, guarana, and glucose, which can harm the body's cardiovascular and nervous systems. Their excessive consumption can lead to arterial hypertension, tachycardia, arrhythmia, insomnia, and other sleep disorders [20, 21]. Taken regularly, caffeine can cause drug dependence, and have a psychostimulating effect, manifested by anxiety and irritability. In addition, under certain conditions, some components of energy drinks are capable of triggering allergic reactions and other side effects [21–23].

This study aimed to investigate the effects of smoking and energy drink consumption on the quality of life among students at the Burdenko Voronezh State Medical University, and to assess their awareness of the associated health risks.

METHODS

The study was conducted at Burdenko Voronezh State Medical University. We offered 2nd- and 3rd-year students from the medical, dental, and pediatric faculties a two-block electronic questionnaire. The first block asked how often respondents smoked or consumed tonic drinks, why they started these habits, what health consequences they experienced, and their level of awareness about the dangers of such habits. The second

block contained O.I. Gubina's Quality of Life Assessment questionnaire (O.I. Gubina, 2007).

We analyzed the collected data using the methods of descriptive statistics and correlation analysis using StatTech 4.2.7 (Stattech; Russia). The Mann–Whitney test was used to compare the ranks between independent groups. The assessment of the strength and direction of the relationship between the studied indicators was performed using the Spearman correlation coefficient (r). Differences and correlations were considered significant at $p \leq 0.05$.

RESULTS

The analysis of the data collected by anonymously surveying medical university students revealed the following trends. The prevalence of smoking among the respondents is 26.5% (Table 1), and 70.1% of them smoke on a daily basis. The average smoking experience is 1–3 years for 52.1% of students, and more than 3 years for 30.8%. As for patterns of tobacco and nicotine consumption, the most popular devices are electronic cigarettes (66.7 per 100 smokers), followed by vapes (30.8 per 100), hookah (26.5 per 100), IQOS tobacco heating systems (17.9 per 100), and regular cigarettes (15.4 per 100). The vast majority of students who smoke (98.3%) admit that there are people in their immediate environment who also smoke. Students cited the influence of friends (35.9%), problems in academic activities or family (34.2%), and other personal circumstances as the main reasons for starting smoking.

Smoking prevalence varied significantly by gender: 40.0% for males and 20.8% for females ($p < 0.001$). Males also dominated in practicing various patterns of tobacco and nicotine consumption (e.g., e-cigarettes, vaping, hookah, IQOS tobacco heating systems; $p < 0.001$). They had longer smoking experience ($p < 0.001$), significantly higher nicotine dependence as measured by craving strength ($p < 0.001$), and were less likely to think about quitting and to report unsuccessful prior quit attempts (both $p < 0.001$). Almost a fifth (19.7%) of smoking students exhibited a low level of motivation to quit. The prevalence of harmful habits did not vary significantly by faculty.

A subjective assessment of the health status of smoking students revealed a number of characteristic complaints. Every fourth respondent reported a cough, while 20.5% reported sputum. Other common symptoms included shortness of breath with minimal exertion (23.9%), tooth deterioration (12.0%), and headaches with dizziness (10.3%). The correlation analysis showed a significant positive correlation between smoking frequency and duration and these subjective symptoms. The correlation was closest for respiratory symptoms, in particular, cough ($r = 0.489$). The associations were also significant for sputum formation, headache, dizziness, and tooth deterioration ($p < 0.05$). The statistical analysis has also revealed gender to be a significant factor affecting the nature of the complaints. More than half of male smokers had a cough, whereas none was reported among female smokers. Moreover, male students were significantly more likely to experience sputum production, bad breath, and tooth decay (Table 2).

Table 1. Prevalence of harmful habits among students, by gender and faculty, n (%)

Indicator	All students	Males	Females	p
Denying smoking and consuming energy drinks	177 (40.1)	38 (29.2)	139 (44.6)	$p < 0.001$
Smokers	117 (26.5)	52 (40.0)	65 (20.8)	$p < 0.001$
Consumers of energy drinks	233 (52.7)	83 (63.8)	150 (48.1)	$p < 0.005$
Combined consumption	85 (19.2)	43 (33.1)	42 (13.5)	$p < 0.001$

Table 2. Prevalence of smoking-related symptoms among students, %

Symptom	Males (<i>n</i> = 52)	Females (<i>n</i> = 65)	<i>p</i>
Deterioration of health	9.6	6.2	<i>p</i> > 0.05
Nausea	7.7	1.5	<i>p</i> > 0.05
Shortness of breath with minimal exertion	26.9	21.5	<i>p</i> < 0.05
Cough	59.6	0	<i>p</i> < 0.05
Sputum production	32.7	10.8	<i>p</i> < 0.001
Headache and dizziness	13.5	7.7	<i>p</i> > 0.05
Digestive disorders	7.7	3.1	<i>p</i> > 0.05
High blood pressure	9.6	0	<i>p</i> < 0.05
Bad breath	13.5	3.1	<i>p</i> < 0.01
Tooth decay	15.4	9.2	<i>p</i> < 0.05
Chest pain	7.7	3.1	<i>p</i> > 0.05

The respondents' attitude towards smoking was ambiguous: the vast majority of them (91.5%) recognized this habit as dangerous to their health, but 18.8% of the participating students said they would start smoking again, and 23.9% found it difficult to answer the question about their attitude to smoking.

Energy drink consumption was more common than smoking (Table 3): 52.7% of the respondents admitted drinking them, and the proportion of males among them (63.8%) was significantly larger than that of females (*p* < 0.005). Almost half of the respondents (46.8%) started using tonic drinks at the age of 15–18, mainly seeking to improve performance (75.5%). A significant correlation between consumers' exposure to tonic drinks in their social circles and their own usage (*r* = 0.399) underscores the role of social influence. The vast majority of respondents (61.8%) consume energy drinks less than once a month, 4.3% — daily. The common dose for 91.8% of the participants is one drink at a time. Energy drinks are most often consumed to maintain working capacity (77.7%) and relieve fatigue (44.2%); 28.7% of students noted that their effect lasts for more than three hours.

Correlation analysis revealed a positive link between energy drink consumption and heart palpitations (*r* = 0.864 at *p* < 0.05), as well as associations with sleep disorders (*r* = 0.251 at *p* < 0.05), headache (*r* = 0.217 at *p* < 0.05), nervousness (*r* = 0.227 at *p* < 0.05) and elevated blood pressure (*r* = 0.178 at *p* < 0.05). Young men were more likely to have trouble sleeping (11.5% and 4.5%, respectively; *p* < 0.01) and experience muscle cramps (4.6% and 0.6%, respectively; *p* < 0.01). Over a half of respondents (63.5%) who have this harmful habit are aware of the associated health risks, but 52.4% of them admitted unwillingness to quit it in the near future. When asked if they would start drinking energy drinks again with full knowledge of their negative health effects, 52.4% said yes, while 25.8% were unsure.

Almost a fifth (19.2%) of the sample combined smoking and energy drink consumption; 72.6% of them were primarily identified as smokers, 36.5% — as energy drink consumers.

Table 3. Energy drink consumption rates among students, *n* (%)

Indicator	All students (<i>n</i> = 442)	Males (<i>n</i> = 130)	Females (<i>n</i> = 312)	<i>p</i>
Consume energy drinks	233 (52.7)	83 (63.8)	150 (48.1)	<i>p</i> < 0.005
Have consumers in their social circles	383 (86.7)	118 (90.8)	265 (84.9)	<i>p</i> > 0.05
Planning to quit	122 (27.6)	54 (41.5)	68 (21.8)	<i>p</i> < 0.001
Have quit before	176 (39.8)	59 (45.4)	101 (32.4)	<i>p</i> < 0.005
Consider dangerous	302 (68.3)	76 (58.5)	226 (72.4)	<i>p</i> < 0.005
Would start consuming again	115 (26.0)	29 (22.3)	86 (27.6)	<i>p</i> < 0.001

There is a number of specific features that distinguish this group from all students, as well as from those with only one of the studied harmful habits.

Compared to students who only smoke, people with a combined addiction started using tobacco at an earlier age, and they smoke more frequently. The respondents from this group were significantly more often mentioning social circles and "other" factors as the cause of their harmful habit (*p* < 0.05). For them, nicotine dependence was more pronounced, as confirmed by more intense craving for smoking and the greater number of unsuccessful attempts to quit (*p* < 0.05).

Compared to those who only consume energy drinks, this group differs significantly: they formed the habit at an earlier age, consume more frequently, take larger single doses, and have nearly three times the daily intake (*p* < 0.05). Another important finding: the members of the combined use group were significantly more likely to complain about symptoms associated with energy drinks, including sleep disorders, increased nervousness, tachycardia, and elevated blood pressure (*p* < 0.05). Paradoxically, despite their pronounced negative symptoms, this group of respondents demonstrates a lower assessment of the potential harm of such drinks and remains eager to resume their use.

Students who combine smoking with drinking energy drinks subjectively rated their physical well-being worse than other groups within the sample. They were significantly more likely to express dissatisfaction with their level of performance and give a lower assessment of their own health and physical fitness (*p* < 0.05). This behavioral pattern is probably rooted in the family environment: the immediate relatives of students with a combined addiction are less inclined to lead a healthy lifestyle and have a more tolerant attitude towards alcohol consumption (*p* < 0.05).

A comparative analysis of students' quality of life by behavioral patterns (Table 4) revealed significant differences across several scales. The median quality of life score in the entire sample was 5.2. This indicator was lower among smokers (5.1), and reached

Table 4. Quality of life indicators, for students with various harmful habits, Me [Q₁; Q₃]

Quality-of-life indicator	All students (n = 442)	Denying smoking and consuming energy drinks (n = 177)	Energy drinks consumers (n = 233)	Combined consumption (n = 85)	<i>p</i>
General standard of living	5.6 [5.0; 6.4]	6.0 [5.0; 6.6]	5.4 [4.8; 6.2]	5.4 [4.8; 6.0]	$p^{1,2} > 0.05$ $p^{1,3} < 0.01$ $p^{2,3} > 0.05$
Professional relations	5.8 [5.2; 6.6]	6.0 [5.4; 6.8]	5.6 [5.0; 6.4]	5.6 [4.8; 6.4]	$p^{1,2} > 0.05$ $p^{1,3} < 0.001$ $p^{2,3} > 0.05$
Health	4.6 [3.8; 5.2]	5.0 [4.0; 5.4]	4.2 [3.6; 5.0]	4.0 [3.6; 4.8]	$p^{1,2} > 0.05$ $p^{1,3} < 0.001$ $p^{2,3} < 0.005$
Family	5.2 [4.6; 5.8]	5.0 [4.6; 5.8]	5.0 [4.6; 5.8]	5.0 [4.4; 5.6]	$p^{1,2} > 0.05$ $p^{1,3} < 0.005$ $p^{2,3} < 0.05$
Spirituality and healthy lifestyle	4.8 [4.2; 5.4]	5.0 [4.4; 5.6]	4.6 [4.0; 5.2]	4.6 [4.0; 5.0]	$p^{1,2} > 0.05$ $p^{1,3} < 0.005$ $p^{2,3} > 0.05$
Average QOL score	5.2 [4.7; 5.7]	5.0 [4.8; 5.8]	5.0 [4.4; 5.5]	5.0 [4.4; 5.5]	$p^{1,2} > 0.05$ $p^{1,3} < 0.001$ $p^{2,3} < 0.005$

Note: $p^{1,2}$ — significance of differences between those who deny harmful habits and those who consume energy drinks; $p^{1,3}$ — significance of differences between those who consume energy drinks and students with combined consumption; $p^{2,3}$ — significance of differences between those who deny harmful habits and students with combined consumption.

minimum values (5.0) among those combining smoking and energy drink consumption.

Behavioral factors had the most pronounced effect on physical well-being. For the entire sample, the median Health scale score was 4.6; it decreased consistently across the groups with harmful habits: 4.4 for smokers, 4.2 among energy drink consumers, and 4.0 (minimum) for those with a combined habit. Moreover, the combined addiction group had a significantly different score compared to both smokers and energy drink consumers ($p < 0.005$).

A similar downward trend, although not statistically significant, was observed for the Spirituality and Healthy Lifestyle scale: the median score decreased from 4.8 in the general sample to 4.6 in the group with a combination of habits.

Satisfaction rates with professional and family relationships were generally lower among students with behavioral risks; the combination of two habits yielded the minimal median values (5.6 and 5.0, respectively) However, there were no significant differences in the assessment of professional relations between the groups.

The comparison of students who denied having harmful habits with the combined addiction group revealed significant differences across all sections of the quality of life questionnaire.

There is a weak positive correlation between smoking and drinking energy drinks ($r = 0.240$ at $p < 0.05$), which suggests a general pattern of behavior associated with the use of psychoactive substances.

The combined effect of these harmful habits on well-being manifests in correlations: smoking is associated with a complex of symptoms, including poorer physical condition ($r = 0.240$ at $p < 0.05$) and higher blood pressure ($r = 0.178$ at $p < 0.05$). Consumption of energy drinks, in turn, is significantly related to symptoms such as headache ($r = 0.217$ at $p < 0.05$) and sleep disturbance ($r = 0.251$ at $p < 0.05$).

An important result of the study was the discovery of a feedback link between the studied habits and the quality of life. Thus, smoking is negatively associated with a lower mean quality of life score ($r = -0.138$ at $p < 0.05$), same as consumption of energy drinks ($r = -0.128$ at $p < 0.05$).

DISCUSSION

In our study, the smoking prevalence rate (26.5%) falls within the same range as previously reported for this university (37.2%). Both studies record the dominance of e-cigarettes among all forms of nicotine consumption: according to our survey, 66.7% of smoking students prefer them, which is close to the previously noted 75% [11]. This trend reflects a shift in the preferences of young people towards alternative products, which are often mistakenly perceived as less harmful. The contradiction lies in the fact that the majority of smoking respondents (91.5%) admit the harm of the habit, but continue to smoke. This underscores insufficiency of the awareness increase efforts in this area, and necessitates the development of a comprehensive program that combines psychological support, improvement of stress management skills, and sustainable motivation to quit smoking.

The higher involvement of young men, their greater smoking experience and addiction to vapes, hookahs and IQOS systems may stem from differences in their approach to stress relief and the influence of same-sex peers. This harmful habit is traditionally common among males, as opposed to females [24]. Thus, preventive measures primarily designed for this population should factor these facts in.

Energy drinks consumption turned out to be an even more popular habit, practiced by 52.7% of the respondents, with males dominating in this cohort (63.8%). The primary reasons mirror those reported in 2022 at this university: warding off fatigue and boosting performance amid heavy academic demands. The most alarming is the confirmation of the negative effects of energy drinks. We identified a correlation between the consumption of such drinks and palpitations ($r = 0.864$ at $p < 0.05$), sleep disorders, headache, and nervousness. This data is consistent with the results of a 2022 study, in which more than half of consumers reported elevated blood pressure, arrhythmia, tremor, and excitability. It is possible that quality of life deteriorates because stimulants desynchronize the body's internal rhythms, cause vegetative imbalance, and increase anxiety, thereby heightening the already chronic stress of learning [22].

Special attention should be paid to the group that combines smoking and consumption of energy drinks. There is a positive correlation between these habits ($r = 0.240$ at $p < 0.05$); it supports a unified reason, the wish to use stimulants to quickly change the psychophysiological state. In combination, nicotine and caffeine exacerbate one another's cardiotoxicity and neurotoxicity. The harmful effects of this combination on the physical condition are further evidenced by the most pronounced differences in Health scale scores ($p < 0.005$).

CONCLUSIONS

The prevalence of harmful habits among medical university students remains high. Over a half of the surveyed students (52.7%) consume energy drinks, and more than a quarter

smoke, which is undoubtedly a significant medical and social problem. The proportion of males who combine harmful habits is significantly greater than that among females. Virtually every fifth respondent belongs to the combined addiction group, which is concerning finding. This group scored the lowest on all quality of life assessment scales, especially in the Health and Spiritual Well-being sections. While realizing the harm, a significant part of the respondents do not intend to give up the habits, which indicates insufficiency of the awareness increase efforts. Thus, targeted preventive measures are needed, including promoting alternatives to energy drinks, encouraging smoking cessation, and working with at-risk groups, primarily young men and those with multiple harmful habits. The implementation of such programs can contribute to improving the health and living standards of students.

References

1. Popov VI. Aktualizatsiya problemy okhrany zdorov'ia studencheskoi molodezhi. *Voprosy shkol'noi i universitetskoi meditsiny i zdorov'ia*. 2021; (4): 46–7 (in Rus.).
2. Dubrovina EA, Goncharova GA. Preservation of health of medical students, including those with special educational needs: current problems. *Russian Bulletin of Hygiene*. 2023; (2): 21–7. DOI: 10.24075/rbh.2023.070.
3. Tarasov AV, Rakhmanov RS, Bogomolova ES, Skoblina NA, levleva OV. Modern factors determining the status of students' health. *Russian Bulletin of Hygiene*. 2022; (1): 4–8. DOI: 10.24075/rbh.2022.034.
4. Koroleva AA, Yanushanets OI, Petrova NA, Bezzubenkova EF. Influence of the degree of adaptability and lifestyle on the quality of life of medical university students. *Russian Bulletin of Hygiene*. 2021; (2): 26–30. DOI: 10.24075/rbh.2021.011.
5. Fertikova TE, Komissarova OV, Sapina AE, Trofimova AS. Quality of life and lifestyle assessment in students of medical and humanitarian faculties of Voronezh universities. *Russian Bulletin of Hygiene*. 2024; (4): 44–9. DOI: 10.24075/rbh.2024.117.
6. levleva OV. Estimating harmful effects of mobile electronic gadgets on health of medical students. *Russian Bulletin of Hygiene*. 2022; (2): 33–6. DOI: 10.24075/rbh.2022.048.
7. Shultz KV, Potseluev NY, Nagomyak AS, Zhukova OV, Kazizaeva AS. Hygienic assessment of the medical students' mental performance in relation to class time and drinking regime. *Russian Bulletin of Hygiene*. 2023; (1): 8–11. DOI: 10.24075/rbh.2023.062.
8. Shestera AA, Trankovskaya LV, Kaerova EV, Nagirnyaya LN. Assessment of physical development and lifestyle in junior medical students. *Russian Bulletin of Hygiene*. 2024; (2): 22–8. DOI: 10.24075/rbh.2024.097.
9. Ulianov IA, Nehaenko NE, Ostroushko NI, Meremyanin LV, Ulianova AV, Petrova TN, et al. Organizational model for prevention of smoking among young adults in Voronezh: regional experience. *Russian Bulletin of Hygiene*. 2024; (2): 34–8. DOI: 10.24075/rbh.2024.099.
10. Aminova OS. Lifestyle-associated risk factors affecting young people. *Russian Bulletin of Hygiene*. 2023; (2): 15–20. DOI: 10.24075/rbh.2023.069.
11. Zacepina IV, Kochetkova IV, Fursova EA, Petrova TN. Rasprostranennost' kurenija sredi studentov medicinskogo vuza. *Profilakticheskaya medicina*. 2024; 27 (6): 29–35 (in Rus.). DOI: 10.17116/profmed20242706129.
12. Skvorcova ES, Mamchenko MM. Kurenije elektronnyh sigaret kak mediko-social'naya problema. *Profilakticheskaya medicina*. 2021; 24 (8): 89–94 (in Rus.).
13. El Golli N, Jrad-Lamine A, Neffati H, Rahali D, Dallagi Y, Dkhili H, et al. Impact of e-cigarette refill liquid with or without nicotine on liver function in adult rats. *Toxicol Mech Methods*. 2016; 26 (6): 433–40. DOI: 10.3109/15376516.2016.1160963.
14. Prokhorov PYu. Correlation between behavioral factors, physical activity, and academic performance of medical students. *Russian Bulletin of Hygiene*. 2025; (2): 19–22. DOI: 10.24075/rbh.2025.129.
15. Schwartz BD, Pellerine LP, Bray NW, Fowles JR, Furlano JA, Morava A, et al. Binge drinking and smoking are associated with worse academic performance in Canadian undergraduate students. *J Am Coll Health*. 2025; 73 (2): 684–90. DOI: 10.1080/07448481.2023.2232871.
16. Novikova II, Shevkun IG, Gavrish SM, Savchenko OA, Sorokina AV, Shepeleva OA. Toniziruiushchie napitki — dopolnitel'nyi faktor riska zdorov'iu detei i podrostkov. *Meditsina truda i ekologiya cheloveka*. 2022; (4): 142–56.
17. Eliashevich SO, Zimina PA, Koncevaya AV, Drapkina OM. Obzor vliyaniya potrebleniya bezalkogol'nyh energeticheskikh i toniziruyushchih napitkov na zdorov'e detei i podrostkov. *Profilakticheskaya medicina*. 2024; 27 (2): 111–8 (in Rus.).
18. Veselova OM, Fisyuk EA, Morozov AM. Otsenka osvedomlennosti studentov o vozdeystvii energetikov na organizm. *Formy i metody sotsial'noj raboty v razlichnykh sferakh zhiznedeyatel'nosti: materialy KhIII Mezhdunarodnoj nauchno-prakticheskoy konferentsii, posvyashchennoj Godu sem'i v Rossii, Ulan-Ude, 19–20 sentyabrya 2024 goda. Ulan-Ude: FGBOU VPO Vostochno-Sibirskij gosudarstvennyj universitet tekhnologii i upravleniya*, 2024; 52–4 (in Rus.).
19. Guzik AS, Elizarova OV, Shepeleva OA. Energeticheskie napitki. Obosnovanie neobkhodimosti provedeniya sanitarno-prosvetitel'noj raboty sredi molodezhi. *Eksperimental'nye i teoreticheskie issledovaniya v sovremennoj nauke: sbornik statej po materialam CIX Mezhdunarodnoj nauchno-prakticheskoy konferentsii, Novosibirsk, 29 yanvarya 2025 goda. Novosibirsk: Sibirskaya akademicheskaya kniga*, 2025; 15–21 (in Rus.).
20. Fetter AD, Malekpur KhA, Kavekhe Vernusfaderani Mina GA, Budaev GG, Novozhilova N. E. Vzglyady, znaniya i praktika studentov-stomatologov v otnoshenii upotrebleniya energeticheskikh napitkov. *Stomatologiya: teoriya i praktika*. 2025; 3 (1): 19–24 (in Rus.). DOI: 10.24412/3034-4840-2025-0030.
21. Al-Shaar L, Vercammen K, Lu C, Richardson S, Tamez M, Mattei J. Health effects and public health concerns of energy drink consumption in the United States: a mini-review. *Front Public Health*. 2017; (5): 225. DOI: 10.3389/fpubh.2017.00225.
22. Shcherbakova VA, Melikhova EP. Analyzing the composition of energy drinks and the effect that they can have on students. *Russian Bulletin of Hygiene*. 2022; (2): 37–40. DOI: 10.24075/rbh.2022.041.
23. Gorelova ZhYu, Guryanova MP, Kurganskij AM. Obzor issledovaniy po izucheniyu vliyaniya bezalkogol'nykh toniziruyushchikh napitkov na zdorov'e detei i podrostkov, provedennykh v period s 2015 po 2023 god. *Meditsinskij alfavit*. 2023; (29): 28–32 (in Rus.). DOI: 10.33667/2078-5631-2023-29-28-32.

24. Vsemirnaya organizatsiya zdravookhraneniya. Doklad VOZ o tendentsiyakh potrebleniya tabaka: tabachnoj zavisimost'yu do sikh por stradaet kazhdyy pyatyy vzroslyj [Internet]. Available

from: <https://www.who.int/ru/news/item/06-10-2025-who-tobacco-trends-report-1-in-5-adults-still-addicted-to-tobacco>.

Литература

1. Попов В. И. Актуализация проблемы охраны здоровья студенческой молодежи. Вопросы школьной и университетской медицины и здоровья. 2021; (4): 46–7.
2. Дубровина Е. А., Гончарова Г. А. Актуальные проблемы здоровьесбережения студентов-медиков, в том числе лиц с особыми образовательными потребностями. Российский вестник гигиены. 2023; (2): 22–8. DOI: 10.24075/rbh.2023.070.
3. Тарасов А. В., Рахманов Р. С., Богомолова Е. С., Скоблина Н. А., Иевлева О. В. Современные факторы, определяющие состояние здоровья студенческой молодежи. Российский вестник гигиены. 2022; (1): 4–9. DOI: 10.24075/rbh.2022.034.
4. Королева А. А., Янушанец О. И., Петрова Н. А., Беззубенкова Е. Ф. Влияние степени адаптированности и образа жизни на качество жизни студентов медицинского университета. Российский вестник гигиены. 2021; (2): 29–34. DOI: 10.24075/rbh.2021.011.
5. Фертикова Т. Е., Комиссарова О. В., Сапина А. Е., Трофимова А. С. Оценка качества и образа жизни студентов медицинских и гуманитарных специальностей вузов г. Воронежа. Российский вестник гигиены. 2024; (4): 46–52. DOI: 10.24075/rbh.2024.117.
6. Иевлева О. В. Оценка риска использования мобильных электронных устройств для здоровья студентов-медиков. Российский вестник гигиены. 2022; (2): 37–41. DOI: 10.24075/rbh.2022.048.
7. Шульц К. В., Поцелуев Н. Ю., Нагорняк А. С., Жукова О. В., Казызаева А. С. Гигиеническая оценка умственной работоспособности студентов медицинского вуза в зависимости от времени занятий и питьевого режима. Российский вестник гигиены. 2023; (1): 9–12. DOI: 10.24075/rbh.2023.062.
8. Шестера А. А., Транковская Л. В., Каерова Е. В., Нагирная Л. Н. Оценка физического развития и образа жизни студентов младших курсов медицинского вуза. Российский вестник гигиены. 2024; (2): 22–8. DOI: 10.24075/rbh.2024.097.
9. Ульянов И. А., Нехаенко Н. Е., Остроушко Н. И., Меремьянин Л. В., Ульянова А. В., Петрова Т. Н. и др. Организационная модель профилактики курения в молодежной среде г. Воронежа: региональный опыт. Российский вестник гигиены. 2024; (2): 35–9. DOI: 10.24075/rbh.2024.099.
10. Аминова О. С. Факторы риска для здоровья, связанные с образом жизни молодежи. Российский вестник гигиены. 2023; (2): 15–21. DOI: 10.24075/rbh.2023.069.
11. Зацепина И. В., Кочеткова И. В., Фурсова Е. А., Петрова Т. Н. Распространенность курения среди студентов медицинского вуза. Профилактическая медицина. 2024; 27 (6): 29–35. DOI: 10.17116/profmed20242706129.
12. Скворцова Е. С., Мамченко М. М. Курение электронных сигарет как медико-социальная проблема. Профилактическая медицина. 2021; 24 (8): 89–94.
13. El Golli N, Jrad-Lamine A, Neffati H, Rahali D, Dallagi Y, Dkhili H, et al. Impact of e-cigarette refill liquid with or without nicotine on liver function in adult rats. Toxicol Mech Methods. 2016; 26 (6): 433–40. DOI: 10.3109/15376516.2016.1160963.
14. Прохоров П. Ю. Взаимосвязь поведенческих факторов, физической активности и успешности обучения в медицинском вузе. Российский вестник гигиены. 2025; (2): 20–3. DOI: 10.24075/rbh.2025.129.
15. Schwartz BD, Pellerine LP, Bray NW, Fowles JR, Furlano JA, Morava A, et al. Binge drinking and smoking are associated with worse academic performance in Canadian undergraduate students. J Am Coll Health. 2025; 73 (2): 684–90. DOI: 10.1080/07448481.2023.2232871.
16. Новикова И. И., Шевкун И. Г., Гавриш С. М., Савченко О. А., Сорокина А. В., Шепелева О. А. Тонизирующие напитки — дополнительный фактор риска здоровью детей и подростков. Медицина труда и экология человека. 2022; (4): 142–56.
17. Елиашевич С. О., Зимина П. А., Концевая А. В., Драпкина О. М. Обзор влияния потребления безалкогольных энергетических и тонизирующих напитков на здоровье детей и подростков. Профилактическая медицина. 2024; 27 (2): 111–8.
18. Веселова О. М., Фисюк Е. А., Морозов А. М. Оценка осведомленности студентов о воздействии энергетиков на организм. Формы и методы социальной работы в различных сферах жизнедеятельности: материалы XIII Международной научно-практической конференции, посвященной Году семьи в России, Улан-Удэ, 19–20 сентября 2024 года. Улан-Удэ: ФГБОУ ВПО Восточно-Сибирский государственный университет технологий и управления, 2024; 52–4.
19. Гузик А. С., Елизарова О. В., Шепелева О. А. Энергетические напитки. Обоснование необходимости проведения санитарно-просветительной работы среди молодежи. Экспериментальные и теоретические исследования в современной науке: сборник статей по материалам XIX Международной научно-практической конференции, Новосибирск, 29 января 2025 года. Новосибирск: Сибирская академическая книга, 2025; 15–21.
20. Феттер А. Д., Малекпур Х. А., Кавехе Вернусфадерани Мина Г. А., Будаев Г. Г., Новожилова Н. Е. Взгляды, знания и практика студентов-стоматологов в отношении употребления энергетических напитков. Стоматология: теория и практика. 2025; 3 (1): 19–24. DOI: 10.24412/3034-4840-2025-0030.
21. Al-Shaar L, Vercammen K, Lu C, Richardson S, Tamez M, Mattei J. Health effects and public health concerns of energy drink consumption in the United States: a mini-review. Front Public Health. 2017; (5): 225. DOI: 10.3389/fpubh.2017.00225.
22. Щербактова В. А., Мелихова Е. П. Анализ состава энергетических напитков и их влияние на здоровье студенческой молодежи. Российский вестник гигиены. 2022; (2): 42–5. DOI: 10.24075/rbh.2022.041.
23. Горелова Ж. Ю., Гурьянова М. П., Курганский А. М. Обзор исследований по изучению влияния безалкогольных тонизирующих напитков на здоровье детей и подростков, проведенных в период с 2015 по 2023 год. Медицинский алфавит. 2023; (29): 28–32. DOI: 10.33667/2078-5631-2023-29-28-32.
24. Всемирная организация здравоохранения. Доклад ВОЗ о тенденциях потребления табака: табачной зависимостью до сих пор страдает каждый пятый взрослый [Интернет]. URL: <https://www.who.int/ru/news/item/06-10-2025-who-tobacco-trends-report-1-in-5-adults-still-addicted-to-tobacco>.

ISSUE OF BULLYING IN EDUCATIONAL INSTITUTIONS: CASE REPORT

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The issue of bullying prevention remains extremely urgent due to persistence of this social phenomenon in educational institutions. The paper reports a clinical case of the long functional neurological disorder in an adolescent female patient. The patient M.'s mental status at admission was determined by frequent manifest recurrent convulsive attacks with the prolonged loss of consciousness developed against the background of systematic bullying. The clinical features of the systematic attacks observed could indicate the disorder epileptic genesis. However, the series of laboratory and instrumental tests combined with consulting experts in psychiatry confirmed the somato-mental origin of convulsive conditions. Thus, it can be concluded that not every seizure syndrome is necessarily a manifestation of a neurological disorder. The reported example emphasizes the importance of preventing bullying in educational institutions, as well as raising awareness of individuals involved in the educational process about possible consequences of bullying in educational institutions and the importance of creating a comfortable and safe psychological environment.

Keywords: bullying, prevention of mental disorders, clinical case, non-epileptic seizures, functional neurological disorder (FND)

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Compliance with ethical standards: the minor patient's legal representative submitted the informed consent for the case report publication.

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ПРОБЛЕМА ТРАВЛИ В ОБРАЗОВАТЕЛЬНЫХ ОРГАНИЗАЦИЯХ: КЛИНИЧЕСКИЙ СЛУЧАЙ

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Проблема профилактики травли (буллинга) остается чрезвычайно актуальной ввиду устойчивого существования этого социального явления в стенах образовательных учреждений. В статье представлен клинический случай продолжительного течения конверсионного расстройства у пациентки подросткового возраста. Психический статус пациентки М. на момент обращения определялся развившимися на фоне систематической травли и проявлявшимися частыми повторяющимися судорогоподобными приступами с длительной потерей сознания. Наблюдаемая клиническая картина систематических приступов могла указывать на эпилептический генез заболевания, однако проведенная серия лабораторных и инструментальных исследований в совокупности с консультациями со специалистами в области психиатрии подтвердила соматопсихическое происхождение судорожных состояний. Таким образом, можно сделать вывод, что далеко не каждый судорожный синдром обязательно является проявлением неврологической патологии. Описанный пример акцентирует внимание на важности профилактики травли в общеобразовательных учреждениях, а также повышения осведомленности участников образовательного процесса о возможных последствиях травли (буллинга) в образовательных учреждениях и о значимости создания комфортной и безопасной психологической среды.

Ключевые слова: травля, профилактика психических расстройств, клинический случай, неэпилептические приступы, конверсионное расстройство

Вклад авторов: все авторы внесли равнозначный вклад в подготовку статьи.

Соблюдение этических стандартов: от законного представителя несовершеннолетнего пациента получено добровольное информированное согласие на публикацию клинического случая.

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The issue of bullying prevention remains extremely urgent due to the fact that this phenomenon still exists in educational institutions and evolves to give rise to new forms, such as cyberbullying [1–4].

Today, a systematic approach to bullying prevention by teachers is still not being applied frequently enough: some teachers either do not pay enough attention to preventing this phenomenon or prefer to ignore manifestations of violence

among children and adolescents. As a result, victims, as well as observers or initiators of bullying, are often left without timely help and support [5].

According to the research data, about a third of school students worldwide experience various forms of aggression from their peers [6–8].

At the same time, every third student in industrialized countries admits that they have repeatedly participated in bullying

other children. Ninety percent of children surveyed identified bullying as a serious problem; two-thirds of respondents had been bullied themselves [9, 10]. However, only a third of them shared their situation with friends or parents, interpreting this phenomenon as an "inevitable evil".

Bullying prevention at school represents one of the priority tasks of not only educational system, but also public health system, since bullying can trigger mental disorders in individuals involved [11, 12].

Preventive work is complicated by the hidden and often systematic nature of bullying, which requires professionals to use specialized knowledge and skills to promptly identify such cases and then stop them [13].

Here we present a clinical case of functional neurological disorder in a school-age female patient developed against the background of bullying in an educational institution in order to raise awareness of individuals involved in the training process about possible consequences of bullying.

CLINICAL CASE

In April 2017, a female patient M. aged 13 was re-admitted to the Psychoneurology Department of the Speransky Children's City Clinical Hospital No. 9 with complaints of a series of seizures and episodes of prolonged loss of consciousness.

Past medical history

The child is from the first pregnancy born full term (on week 41 of pregnancy), no birth injury reported. Her growth and development were age-appropriate, neurological and mental statuses were preserved. She started attending school at the age of 7. According to the mother, the girl was always sociable and calm. No problems with academic performance were reported at school. However, the patient mentioned conflicts with one of her teachers over the past few years. The family history is unburdened. Past infections: ARVI, childhood infections. The patient denies traumatic brain injury.

Disease history

The patient considers herself ill since 2016, when convulsive conditions accompanied by prolonged loss of consciousness were first noted (after the end of the attack the patient remained in a stunned state for 1.5–2 h).

The first attack with loss of consciousness, falling and convulsions was noted in October 2016. The patient was admitted to the Psychoneurology Department of the Speransky Children's City Clinical Hospital No. 9. The hospital's neurologist prescribed non-drug therapy in the form of compliance with work and rest regime, daily routine, as well as drug therapy (glycine 200 mg three times a day, for a long time).

The second convulsive attack was reported one month after the previous hospital stay. The next attack of the presyncope type was reported two weeks after the second one. The patient continued regular treatment unabated.

It should be noted that all the patient's episodes of hospital admission were associated with the child's preceding contacts with one of the teachers. According to the child, the teacher exerted "systematic moral pressure" on her.

When staying at the Psychoneurology Department of the Speransky Children's City Clinical Hospital No. 9, the patient was consulted by a child neurologist and a child psychiatrist. Her neurological and mental statuses were determined during consultation.

Neurological status

At the time of examination, consciousness is clear. Orientation in space, time, and the patient's own personality is preserved.

Speech is preserved. The ocular apertures are symmetrical. No meningeal syndrome detected. There is no nystagmus. Corneal reflexes are symmetrical (D = S).

At the time of examination, no extrapyramidal symptoms are observed. Muscle strength remains unchanged. Muscle tone is preserved, symmetrical. Tendon reflexes of the limbs are lively.

Mental status

Consciousness is not clouded. The patient is correctly oriented in place, time, her own personality and in the situation. At the time of examination, she looks calm, her posture is relaxed. She answers questions in detail, maintains eye contact, and has lively, expressive facial expressions. She is active in communication and interested in conversation. During the conversation, the patient answers questions thoughtfully, her voice is quiet. Shows interest in the surrounding environment. Attention is stable. Memory without any apparent significant alterations. Thinking at an accelerated pace. Emotionally labile. No suicidal or aggressive tendencies are detected at the time of examination. The patient is ready for treatment.

A number of laboratory and instrumental tests were performed when conducting differential diagnosis of the patient's condition.

The analysis of the laboratory test results revealed no data confirming autoimmune or infectious etiology of the disease.

The main instrumental methods used to diagnose the patient's condition were electroencephalography (ЭЭГ) and magnetic resonance imaging (MRI).

EEG findings

Cortical rhythms of wakefulness are age-appropriate. No typical epileptiform discharges have been found. No abnormalities of cortical rhythms have been reported when performing functional tests. No epileptic seizures or their EEG patterns have been recorded during the study.

MRI findings

The MRI findings suggest the lack of bulk neoplasms or structural brain tissue alterations.

Clinical diagnosis

Thus, based on medical history data, the results of the current objective inpatient examination, clinical analysis of the results obtained, differential diagnosis of psychopathological symptoms revealed in the clinical picture, the patient M.'s mental state should be defined as a dissociative (conversion) disorder in accordance with the diagnostic criteria of the item F44 of the International Classification of Diseases, 10th Revision (ICD-10).

Therapy provided and assessment of its efficacy

Patient M. received anticonvulsant therapy (carbamazepine at an initial dose of 100 mg once a day with a gradual increase in the dose to 300 mg twice a day) regularly, as well as therapy with neuroleptic drugs (sertraline 50 mg once a day) in extenso. She was consulted by child psychiatrists and attended

psychotherapy sessions, but the treatment prescribed did not have the desired therapeutic effect. Conversion attacks were regular and resulted in frequent re-admissions to hospital.

Outcome and result of further follow-up

The above conversion attacks with re-admissions to hospital from school after contacting one of the teachers were reported throughout several years (2016–2020). However, after the girl entered another educational institution, manifestations of conversion attacks were no longer observed.

Upon re-examination, the patient's condition was satisfactory. She had no complaints at the time of examination.

After the regression of clinical symptoms, the patient continued her education at a new educational institution and demonstrated good academic performance; she was able to lead an active lifestyle and adapt to a new team.

CLINICAL CASE DISCUSSION

The patient M.'s mental status at admission was mental status at admission was determined by frequent recurrent non-epileptic (conversion) attacks with the prolonged loss of consciousness developed against the background of systematic bullying. Severity of the reported clinical symptoms throughout six months resulted in the adolescent's maladaptation and disruption of functioning, which was the cause of seeking care. In the medical history, a striking correlation between the clinical manifestations of conversion attacks and cases of bullying by one

of the teachers attracts attention: the patient was admitted to hospital exclusively from classes after contact with this teacher, which once again underlines the obvious role of bullying as a risk factor for the development of mental disorders in school students.

Thus, it can be concluded that the convulsive syndrome is in many cases not necessarily a manifestation of neurological disorder [14].

A number of papers show that the health of students in comprehensive schools directly depends on the health and psycho-emotional well-being of teachers [15].

Adverse educational environmental conditions, such as academic violence, victimization, and trauma, can have a significant impact on students' mental and physical health [16].

It is necessary to unite the efforts of specialists in various fields to develop and implement national state programs to combat bullying, mandatory for use in all country's schools [17].

CONCLUSION

Here we consider a clinical case of the development and long course of functional neurological disorder against the background of systematic bullying in a 13-year-old female patient. The reported example emphasizes the importance of preventing bullying in educational institutions, as well as raising awareness among participants in the educational process about the possible consequences of bullying in educational institutions and the importance of creating a comfortable and safe psychological environment.

References

- Pavlovskaja VJu, Dudchenko AV, Derkach AA. Pravovye sposoby zashhity ot kiberbullinga. Oчерki novejshej kameralistiki. 2023; (1): 43–52 (in Rus.). DOI: 10.31429/20785224_2023_43_52.
- Ganuzin VM, Maskova GS, Mozzhuhina LI, Shubina EV. Kiberbullying sredi podrostkov. Rossijskij pediatricheskij zhurnal. 2025; 28 (1): 79–84 (in Rus.). DOI: 10.46563/1560-9561-2025-28-1-79-84.
- Rakisheva GM, Sabitova DS, Zhantemirova MB. Kiberbullying v shkole: social'no-psihologicheskij aspekt. Vestnik Karagandinskogo universiteta. Serija: Pedagogika. 2023; 3 (111): 124–32 (in Rus.). DOI: 10.31489/2023Ped3/124-132.
- Lin JC, Shih YH. Strategies for preventing school bullying — A life education perspective. Front Psychol. 2024; (15): 1429215. DOI: 10.3389/fpsyg.2024.1429215.
- Bobrovnikova NS. Optimizacija social'no-psihologicheskogo klimata v kollektive pedagogov kak uslovie profilaktiki bullinga sredi podrostkov. International Journal of Medicine and Psychology. 2022; 5 (5): 102–8 (in Rus.).
- Barros R. The practice of bullying: an issue for school and society. Contribuciones a las Ciencias Sociales. 2024; 17 (1): 7215–34. DOI: 10.55905/revconv.17n.1-434.
- Abramenkova VV. Shkol'noe nasilie i organizacija bezopasnosti detstva v obrazovatel'nom prostranstve. Nauchnye issledovanija i razrabotki. Social'no-gumanitarnye issledovanija i tehnologii. 2017; 6 (2): 34–9 (in Rus.). DOI: 10.12737/article_595cd8e44cbef8.52321860.
- Storozhenko AV. Teoreticheskie aspekty podrostkovogo bullinga i psihologicheskie osobennosti uchastnikov bulling-struktury. Nauka i obrazovanie v kontekste global'noj transformacii: sbornik statej X Mezhdunarodnoj nauchno-prakticheskoj konferencii, Petrozavodsk, 10 ijulja 2023 goda. Petrozavodsk: Mezhdunarodnyj centr nauchnogo partnerstva "Novaja Nauka" (IP Ivanovskaja II), 2023; 89–93 (in Rus.).
- Gonzales M. Helping students to develop emotional intelligence. In book: Emotional Intelligence for Students, Parents, Teachers and School Leaders. Springer Singapore, 2022; 377–401.
- Begidova SN, Habahu ShA. Shkol'nyj bulling i ego profilaktika. Vestnik Adygejskogo gosudarstvennogo universiteta. Serija 3: Pedagogika i psihologija. 2022; 2 (298): 13–23 (in Rus.). DOI: 10.53598/2410-3004-2022-2-298-13-23.
- Gaffney H, Tfofi MM, Farrington DP. Effectiveness of school-based programs to reduce bullying perpetration and victimization: an updated systematic review and meta-analysis. Campbell Syst Rev. 2021; 17 (2): e1143. DOI: 10.1002/cl2.1143.
- Seryn A, Basjuk V, Lifinceva A. Osobennosti detskih psihosomaticheskikh rassstrojstv. Razvitie lichnosti. 2010; (3): 59–70 (in Rus.).
- Zhang L, Zhang Y, Zhou J, Zhang X, Gao L. The mediating role of school adaptation in the impact of adolescent victimization from bullying on mental health: a gender differences perspective. Psychol Res Behav Manag. 2024; (17): 3515–31. DOI: 10.2147/PRBM.S470027.
- Pourkalbassi D, Patel P, Espinosa PS. Conversion disorder: the brain's way of dealing with psychological conflicts. case report of a patient with non-epileptic seizures. Cureus. 2019; 11 (1): e3902. DOI: 10.7759/cureus.3902.
- Kuchma VR, Sokolova SB, Rapoport IK, Chubarovskij VV. Gigienicheskaja ocenka obraza zhizni, naprijazhonnosti i rezhima truda, sostojanija zdorov'ja i psihologicheskogo blagopoluchija pedagogov. Gigiena i sanitarija. 2023; 102 (4): 318–27 (in Rus.). DOI: 10.47470/0016-9900-2023-102-4-318-327.
- Ganuzin VM. Vlijanie psihotravmirujushhij faktorov obrazovatel'noj sredy na detej. Rossijskij pediatricheskij zhurnal. 2025; 28 (2): 155–9 (in Rus.). DOI: 10.46563/1560-9561-2025-28-2-155-159.
- Ganuzin VM. Psihotravmirujushhie faktory obrazovatel'noj sredy: profilaktika "shkol'nyh zemletrjasenij" s pomoshh'ju antibullingovyh programm (obzor). Voprosy psihicheskogo zdorov'ja detej i podrostkov. 2025; 25 (2): 98–108 (in Rus.).

Литература

1. Павловская В. Ю., Дудченко А. В., Деркач А. А. Правовые способы защиты от кибербуллинга. Очерки новейшей камералистики. 2023; (1): 43–52. DOI: 10.31429/20785224_2023_43_52.
2. Ганузин В. М., Маскова Г. С., Мозжухина Л. И., Шубина Е. В. Кибербуллинг среди подростков. Российский педиатрический журнал. 2025; 28 (1): 79–84. DOI: 10.46563/1560-9561-2025-28-1-79-84.
3. Ракишева Г. М., Сабитова Д. С., Жантемирова М. Б. Кибербуллинг в школьной среде: социально-психологический аспект. Вестник Карагандинского университета. Серия: Педагогика. 2023; 3 (111): 124–32. DOI: 10.31489/2023Ped3/124-132.
4. Lin JC, Shih YH. Strategies for preventing school bullying — A life education perspective. *Front Psychol*. 2024; (15): 1429215. DOI: 10.3389/fpsyg.2024.1429215.
5. Бобровникова Н. С. Оптимизация социально-психологического климата в коллективе педагогов как условие профилактики буллинга среди подростков. *International Journal of Medicine and Psychology*. 2022; 5 (5): 102–8.
6. Barros R. The practice of bullying: an issue for school and society. *Contribuciones a las Ciencias Sociales*. 2024; 17 (1): 7215–34. DOI:10.55905/revconv.17n.1-434.
7. Абраменкова В. В. Школьное насилие и организация безопасности детства в образовательном пространстве. Научные исследования и разработки. Социально-гуманитарные исследования и технологии. 2017; 6 (2): 34–9. DOI: 10.12737/article_595cd8e44cbef8.52321860.
8. Стороженко А. В. Теоретические аспекты подросткового буллинга и психологические особенности участников буллинга-структуры. Наука и образование в контексте глобальной трансформации: сборник статей X Международной научно-практической конференции, Петрозаводск, 10 июля 2023 года. Петрозаводск: Международный центр научного партнерства «Новая Наука» (ИП Ивановская И. И.), 2023; 89–93.
9. Gonzales M. Helping students to develop emotional intelligence. In book: *Emotional Intelligence for Students, Parents, Teachers and School Leaders*. Springer Singapore, 2022; 377–401.
10. Бегидова С. Н., Хабаху Ш. А. Школьный буллинг и его профилактика. Вестник Адыгейского государственного университета. Серия 3: Педагогика и психология. 2022; 2 (298): 13–23. DOI: 10.53598/2410-3004-2022-2-298-13-23.
11. Gaffney H, Ttofi MM, Farrington DP. Effectiveness of school-based programs to reduce bullying perpetration and victimization: an updated systematic review and meta-analysis. *Campbell Syst Rev*. 2021; 17 (2): e1143. DOI: 10.1002/cl2.1143.
12. Серых А., Басюк В., Лифинцева А. Особенности детских психосоматических расстройств. Развитие личности. 2010; (3): 59–70.
13. Zhang L, Zhang Y, Zhou J, Zhang X, Gao L. The mediating role of school adaptation in the impact of adolescent victimization from bullying on mental health: a gender differences perspective. *Psychol Res Behav Manag*. 2024; (17): 3515–31. DOI: 10.2147/PRBM.S470027.
14. Pourkalbassi D, Patel P, Espinosa PS. Conversion disorder: the brain's way of dealing with psychological conflicts. Case report of a patient with non-epileptic seizures. *Cureus*. 2019; 11 (1): e3902. DOI: 10.7759/cureus.3902.
15. Кучма В. Р., Соколова С. Б., Рапопорт И. К., Чубаровский В. В. Гигиеническая оценка образа жизни, напряженности и режима труда, состояния здоровья и психологического благополучия педагогов. Гигиена и санитария. 2023; 102 (4): 318–27. DOI: 10.47470/0016-9900-2023-102-4-318-327.
16. Ганузин В. М. Влияние психотравмирующих факторов образовательной среды на детей. Российский педиатрический журнал. 2025; 28 (2): 155–9. DOI: 10.46563/1560-9561-2025-28-2-155-159.
17. Ганузин В. М. Психотравмирующие факторы образовательной среды: профилактика «школьных землетрясений» с помощью антибуллинговых программ (обзор). Вопросы психического здоровья детей и подростков. 2025; 25 (2): 98–108.

THE HISTORY OF SANITARY AND HYGIENIC STANDARDS FOR PATHOLOGISTS IN RUSSIA

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There are many hazards a pathologist is exposed to professionally, including biological (pathogens), chemical (preservatives, reagents), physical (radiation, noise) factors, psycho-emotional stress, and ergonomic risks. Historically, the standardization of these factors and risks has lagged significantly behind practice. The digitalization of pathology (digital microscopy, telemedicine) mitigates some traditional hazards but generates new risks: visual stress, sedentary working conditions, exposure to electromagnetic fields, and psycho-emotional stress from using digital platforms. The history of standardization reflects progress in understanding the unique risks of the profession and the value of medical workers' health. Technological advances necessitate the continued updating of regulations. Thus far, too few studies have been conducted on the evolution of adverse factors and their sanitary and hygienic standardization in the work of pathologists. This review analyzes the development of a system of professional sanitary and hygienic standards for pathologists in Russia.

Keywords: occupational hygiene, pathologists, adverse factors, sanitary and hygienic standards, historical development, digitalization

Author contribution: Kozelsky AS — data acquisition and analysis, manuscript writing; Kaminer DD — study concept, manuscript writing; Zharov AR — manuscript writing and editing; Korolik VV — literature review, acquisition and analysis of literary sources, analysis of regulations and procedures; all authors confirm that their authorship is compliant with international ICMJE criteria (all authors contributed significantly to the development of the concept, conduct of the study and preparation of the article, read and approved the final version before publishing).

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ИСТОРИЯ САНИТАРНО-ГИГИЕНИЧЕСКОГО НОРМИРОВАНИЯ УСЛОВИЙ ТРУДА ВРАЧЕЙ-ПАТОЛОГОАНАТОМОВ В РОССИИ

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Профессия патологоанатома связана с многочисленными опасными факторами — биологическими (патогены), химическими (фиксаторы, реактивы), физическими (излучение, шум), а также с психоэмоциональными нагрузками и эргономическими рисками. Исторически нормирование этих рисков существенно отставало от практики. Цифровизация патологии (цифровая микроскопия, телемедицина) снижает воздействие некоторых традиционных вредностей, но порождает новые риски — зрительную нагрузку, гиподинамию, электромагнитные поля и повышенное психоэмоциональное напряжение от работы с цифровыми платформами. История нормирования отражает прогресс в понимании уникальных рисков профессии и ценности здоровья медработника, требуя постоянной актуализации правил в ответ на технологические изменения. В настоящее время исследований, посвященных изучению вопросов эволюции неблагоприятных факторов и их санитарно-гигиеническому нормированию в работе врачей-патологоанатомов, недостаточно. В обзоре представлен анализ становления и развития системы санитарно-гигиенического нормирования условий труда врачей-патологоанатомов на территории России.

Ключевые слова: гигиена труда, врачи-патологоанатомы, неблагоприятные факторы, санитарно-гигиеническое нормирование, историческое развитие, цифровизация

Вклад авторов: А. С. Козельский — сбор и анализ данных, написание статьи; Д. Д. Каминер — концепция исследования, написание статьи; А. Р. Жаров — написание и редактирование статьи; В. В. Королик — обзор литературы, сбор и анализ литературных источников, анализ нормативно-методических документов; 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).

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Pathologists occupy a unique, critically important place in both healthcare and justice systems [1–3]. This is a profession at the intersection of medicine, biology, and law; the work of pathologists is crucial for establishing cause of death, diagnosing diseases, controlling treatment quality, and providing evidence for investigators [3, 4]. There is a complex set of specific, potentially hazardous workplace factors to which pathologists are exposed [3, 4]. These include biological agents (e.g., highly pathogenic microorganisms), toxic chemicals (preservatives like formaldehyde and Sulema; reagents like lead salts and picric acid), physical factors (ionizing radiation from radioactive materials; noise), pronounced psycho-emotional

stress, and ergonomic risks [4]. Due to constant contact with pathological materials, pathologists belong to a high-risk group for occupational morbidity (infectious, toxic-chemical, and oncological hazards). With time, the profile of the respective occupational risks has changed significantly, from infectious threats and the toxic effects of crude chemicals in the past to the hazards associated with high-tech research methods, complex synthetic reagents, the challenges and the psychosocial stress of the digital age [3–5]. However, even with the said risks and hazards recognized, the development and implementation of adequate, scientifically proven sanitary and hygienic workplace standards (SanPIN, GOSTs, methodological guidelines) for this

profession has always lagged behind the realities of regular practice and scientific and technological progress. Historically, working conditions in pathology departments often failed to meet even basic sanitary standards. Currently, there are significant gaps in both the sanitary and hygienic and historical aspects of the work of pathologists. The evolution of the Russian system of sanitary and hygienic standards applicable to their operations has not been sufficiently studied. Generally, the way the said standards have been developed reflects the transformation of medical science and practice as well as shifts in the public attitude towards the protection of health of pathologists. Understanding how past approaches have evolved, along with their successes and failures, underpins efforts to devise effective occupational safety strategies for today and the future, especially in the context of rapid digitalization of pathology practice (telemedicine, electronic archives, etc.) and the associated new types of risks (electromagnetic, visual, psycho-emotional, and cybersecurity risks) [4–8].

This study traces the history and development of sanitary and hygienic workplace standards for pathologists in Russia. It covers key milestones from early challenges in the first anatomical theaters and morgues to modern issues in the digital transformation of pathology.

Methods

We analyzed the literature indexed in the international PubMed database and the Russian RSCI database. The sources were selected using keywords "pathologists" + "sanitary and hygienic standardization" + "historical development." The search depth was 10 years (2015–2025).

Among Russian sources, we preferred papers published in the journals included in the RSCI core.

A search for the keywords "pathologists + sanitary and hygienic standardization" returned 2345 foreign publications and 456 Russian papers. A further search for "pathologists + sanitary and hygienic standardization + historical development" brought 1212 works.

The number of publications for 2015–2025 found in the RSCI database for the keywords "pathologists + sanitary and hygienic standardization" was 374, and for the keywords "pathologists + sanitary and hygienic standardization + historical development" — 115 works. Ultimately, we selected 38 papers published over the past 10 years for the analytical review; the choice was based on the quality of the sources in terms of coverage of the history of development of sanitary and hygienic standards for pathologists and the current state of affairs in this field.

The origins of pathology and the first steps without supporting sanitary and hygienic standards: anatomical theaters and the first morgues

The practice of autopsies for scientific and educational purposes began in Europe during the Renaissance: anatomical theaters emerged as public venues for dissections and became a staple of medical education [9]. In the 15th–16th centuries, the first anatomical theaters appeared in Italy, and Mondino de Luzzi (Bologna) systematized knowledge about organs. The first famous theater was built in Padua (Italy) in 1594. Such venues symbolized the transition from medieval dogmas to the scientific study of the body. They opened throughout Europe; in 1706, Peter the Great studied in one of such theaters in Leiden, Holland, under the guidance of Professor F. Ruysch [10–12]. Morgues as body storage for forensic medical investigations appeared later, in the 18th century,

mainly in universities and hospitals. At the outset, they were unsanitary: there was no proper ventilation or refrigeration equipment (the first cold boxes with refrigerants were installed in the early twentieth century), and the microbial nature of infections had yet to be discovered. All these factors promoted the spread of diseases among doctors and students [10].

In Russia, practical pathology as the systematic examination of deceased bodies to determine causes of death and disease characteristics emerged in the 18th century. Its evolution is inextricably linked with the development of medical education and the creation of the first secular hospitals [11–13]. The history of this profession began in 1698–1707, when Peter the Great issued "General Regulations on Hospitals" that prescribed autopsies of the deceased in hospitals to determine the causes of death. These regulations can be considered the first legitimate basis for pathology in Russia; although individual autopsies were conducted earlier (e.g., under the Pharmacy Order), the practice became systemic only with their publication. The first anatomical theaters appeared at hospital schools, including the Moscow Hospital School founded in 1707 by decree of Peter the Great, as well as the first universities (Moscow University, 1755). Initially, anatomical theaters were spaces — often just basements or separate hospital wings — adapted for the purpose, with a central autopsy table and an amphitheater for the audience [11–13]. The equipment was primitive (stone or wooden tables, a minimal set of knives and saws), and ventilation either poor or non-existent. As for heating, there were irregularly lit stoves. In general, during that time, the working environment of a pathologist was basically unregulated in the sanitary and hygienic aspects, which meant extremely dangerous conditions that seem unthinkable today [11–13]. At the dawn of pathoanatomic science, unsanitary conditions were the norm. This led to widespread issues like a lack of sewerage and running water, inadequate wet cleaning and disinfection, poor waste disposal, insufficient ventilation, improper corpse storage (due to a lack of refrigeration units), lapses in personal hygiene (no showers, protective clothing, or handwashing facilities), high physical demands and injury risks, and significant psychological stress. As forensic medicine developed and the number of hospitals (especially military ones) increased, mortuaries, previously used for educational purposes only, became places where mandatory autopsies of the deceased in hospitals were conducted. Functionally, the first morgues were a continuation or copy of anatomical theaters, but even less suited for regular operation. They were located in the most inconvenient and remote parts of hospital complexes: basements, ground floors, and backyards, often next to outbuildings or barnyards, which significantly worsened the existing problems [12–15]. One small room often combined the functions of storing corpses (sometimes dozens), conducting autopsies, and preparing bodies for burial. It lacked separate contaminated and clean zones. The bodies used in anatomical theaters were mostly unclaimed corpses of "beggars, tramps, rootless and unidentified," as well as executed criminals. The high prevalence of infectious diseases (plague, cholera, typhus, smallpox) meant morgue workers had constant contact with highly pathogenic material — without understanding infection mechanisms or protective equipment — which increased their infection rates [12–15]. It should be noted that the profession of a pathologist was not clearly defined, autopsies were often performed by surgeons or hospital internists, and there were no special instructions on their occupational safety.

With the development of medical science — in particular, microbiology and histology — and technology (microscopes,

fixatives since the late 19th century), the range of negative factors has expanded and partially changed. Chemical agents became widespread, including formalin (a 40% formaldehyde solution). This dramatically improved tissue safety but introduced a new hazard: a powerful irritant that affects mucous membranes, triggers allergies, and potentially causes cancer. Advancements in the study of biological hazards and better understanding of infection mechanisms made the hemocontact pathway obvious, even though hepatitis and HIV had not yet been discovered. Gradually, there appeared the simplest exhaust ventilation systems (often ineffective), electric lighting (which improves visibility, but creates new risks of visual fatigue with poor light quality), primitive personal protective equipment (rubber gloves, aprons, sometimes glasses), and refrigerating equipment (reducing odor and decomposition rate). Despite the obvious risks, the sanitary and hygienic standards have not yet been introduced. In pre-revolution Russia, there were no regulations covering the work of pathologists. Moreover, occupational hygiene as a whole was in its infancy [11–15]. The improvements were only local, and they depended on the equipment available at a particular institution and the conscientiousness of its managers.

The origins and development of sanitary standards and the struggle against adverse factors

The first attempts to regulate the work of pathologists were made in the late 19th and early 20th centuries. In the second half of the 19th century, Pasteur, Robert Koch, and others established the infectious causes of many diseases and the value of asepsis. This laid the groundwork for advances in pathology, especially in large cities and university clinics. The emergence of more effective disinfectants (carbolic acid, sulema), use of fans, and improved lighting (kerosene lamps, gas, and electricity) contributed to a gradual improvement in conditions, but there was still no systematic approach to sanitary standards for pathologists [14–18]. The first sanitary rules for hospitals were developed in that era, and they indirectly regulated morgues. The rules required mortuaries to be located in separate buildings or isolated wings. They also prescribed arranging sewerage removal and water supply systems (in new buildings), painting walls and ceilings with oil paint for easy cleaning, installing exhaust ventilation, disinfecting the rooms on a regular basis, performing autopsies in separate rooms, and disposing of waste properly. However, these requirements were advisory or partial in nature, and were often ignored due to lack of funds, lack of oversight, and common practice. Retrofitting old buildings was difficult and expensive, and there were no special standards of work for pathologists (permissible concentrations of harmful substances, requirements for special clothing and personal protective equipment (PPE), working hours, medical examinations). Occupational safety for pathologists wasn't considered a separate issue. Recognition of the unique hazards specific to this medical specialty and the need for special sanitary and hygienic standards to protect doctors' health came much later, during the Soviet period [14–18].

After the 1917 revolution, greater attention was given to protecting workers' health and safety, including that of medical professionals. The first general regulatory documents appeared, and general sanitary rules for medical institutions concerning ventilation, lighting, and cleaning were developed. However, they rarely detailed the specifics of the pathology departments. The milestone document — first of its kind — that introduced standards to address occupational hazards faced by pathologists was Resolution No. 298 of the Council

of People's Commissars of the USSR, dated March 11, 1939, "On Measures to Improve the Work of Pathology Departments" [18]. For the first time ever, this document:

- clearly outlined the health risks pathologists and lab technicians are exposed to;
- established a shortened working day (6 hours) and an additional vacation (up to two weeks) as compensation for working in harmful conditions;
- prescribed mandatory provision of special work clothes, shoes, and rubber gloves;
- formulated the requirements for equipping morgues with exhaust ventilation and refrigeration units;
- described the procedure for the disposal of biological waste.

This document became the first real legislative act regulating the sanitary and hygienic standards for morgue staff. For decades, all subsequent standardization efforts were based thereon.

In the post-war period, further detailing of the requirements was done through building codes and regulations (SNiP) for designing pathology departments and bureaus (regulation of areas, zones, ventilation, lighting, water supply, sewerage), industry instructions and methodological recommendations of the USSR Ministry of Health, as well as standards for equipping workplaces (microtomes with protective screens, efficient fume hoods for work with formalin and volatile reagents) [19–21]. Standards mainly concerned combating the effects of various (chemical, biological, physical, and psycho-emotional) factors. The maximum permissible concentration (MPC) of formalin in workplace air, along with ventilation requirements and work duration with fixatives, has been established. Further, the documents introduced regulations for handling infectious materials, instrument disinfection and sterilization, waste disposal, and requirements for lighting (general and local at histological workstations), microclimate (temperature and humidity in dissecting rooms, and especially in histological labs where low humidity is key for high-quality tissue embedding), and equipment noise. Although no standards were developed to mitigate psychoemotional stress, a shortened workday and extra vacation time provide indirect compensation [19–21].

Currently: systematization and new challenges

The collapse of the USSR and the formation of the Russian Federation necessitated updates to the regulatory framework to reflect new realities and scientific data. For example, SanPiN 2.2.4.548-96 "Hygienic Requirements for the Microclimate in Workplaces," established strict standards for temperature, humidity, and air velocity in various morgue rooms (dissecting room, histological laboratory, doctor's office). Special attention is paid to maintaining a low temperature in the dissecting room (16–18°C) for the comfort of workers in overalls, and optimal humidity in the histological laboratory [22]. SanPiN 2.1.3.2630-10 "Sanitary and epidemiological requirements for organizations engaged in medical activities" [23] (and later editions, including SP 2.1.3678-20) [24] cover pathology departments/bureaus and specifically provide and regulate:

- requirements for architectural and planning solutions (isolation of contaminated and clean zones, separate pathways for bodies, staff, visitors, materials);
- engineering equipment, forced supply and exhaust ventilation with excess exhaust in contaminated zones, local exhaust devices above autopsy and histology tables, air conditioning in histological laboratories and offices;
- requirements for workplace illumination levels (especially important for microscopy), use of non-glare fixtures;

- sanitary regime, cleaning, disinfection, sterilization using modern effective means, as well as utilization of class B and C (highly hazardous and epi-hazardous) medical waste;

- mandatory use of PPE (robes/suits, caps, masks/respirators, safety glasses/shields, gloves (several pairs of different types), special shoes), as well as their replacement and cleaning/disposal;

- work and rest conditions, medical examinations, vaccination (hepatitis B, etc.).

The hygienic standard GN 2.2.5.3532-18 "Maximum permissible concentrations (MPC) of harmful substances in the air of the working area" establishes the current MPC of formaldehyde and other chemicals used in practice (xylene, toluene, paraffins, etc.). The emergence of highly pathogenic infections (HIV, viral hepatitis transmitted parenterally) and resistant bacterial strains made countering the biological hazard an urgent task. At the same time, PPE (FFP3 respirators, aerosol shields) and disinfection methods have improved. The growing volume of macroscopic examinations of surgical material has necessitated standardizing workplace conditions (lighting, ergonomics, and ventilation for formalin-related work). In addition, standards have been set for the heights of worktables (such as sectional and histological ones), microtomes, and adjustable microscopes to avoid awkward, prolonged static postures [18–25].

The era of digitalization has created both new opportunities and new risk factors, and led to the transformation of previously existing adverse factors. Traditional occupational hazards are mitigated by modern technology [25–27]:

- digital microscopy reduces examination time, easing strain on the eyes and musculoskeletal system from static postures;

- telemedicine lowers the need for trips, which significantly reduces labor costs and mitigates the risk of professional burnout;

- dangerous steps (dewatering, degreasing, and paraffin impregnation) are fully automated and performed in a sealed module, which eliminates the need for manual operations with reagents and their evaporation into the air of the work area.

Latest research papers report the emergence of new adverse factors, both directly and indirectly related to the widespread adoption and use of digital technologies. Prolonged use of high-contrast, high-resolution monitors, the need to focus on the details of digital images necessitate regulation of work-related screen time, monitor quality (brightness, contrast, refresh rate, resolution), workplace lighting levels (glare control)

[28–30]. Currently, microclimate requirements for rooms with computers (e.g., doctors' offices and digital pathology labs) emphasize comfortable conditions for mental work: 22–24°C temperature, 40–60% humidity, and good ventilation to remove excess heat from equipment; this is different from standards for traditional "wet" morgue areas [32–35]. Prolonged computer work in a sitting position requires limiting work hours, optimizing the workspace (e.g., ergonomic chair, desk, monitor/keyboard stands), and scheduling breaks with physical warm-ups. This helps prevent musculoskeletal disorders and physical inactivity [25, 28–30]. Regular use of numerous electronic devices (monitors, servers, network equipment) leads to prolonged exposure to electromagnetic fields. Although following general rules makes immediate danger unlikely, monitoring and further study of the consequences, especially long-term effects, of such exposure are still required [28–32]. Another reported problem involves shifting psychophysiological stressors. These include the high concentration of attention required, responsibility for analyzing complex digital images, the need to master new software, information overload, and the routine review of numerous similar images — all of which lead to excessive intellectual and emotional strain [32–38].

CONCLUSION

Sanitary and hygienic standardization of the work of pathologists in Russia has gone through a thorny path from no rules in the era of the first anatomical theaters to a complex, detailed system of requirements in modern SanPiN regulations. This transformation reflects the progress of medical science, technology and, most importantly, the understanding of how valuable health of a medical professional is. While the first regulatory steps (the 1939 Resolution of the Council of People's Commissars) targeted obvious physical and chemical threats in harsh working conditions, modern standards address a wide range of factors — from traditional chemical (e.g., formaldehyde) and biological hazards to physical parameters like microclimate, lighting, noise, ergonomics, and psycho-emotional stress. The widespread introduction of digital technologies both reduces the impact of some classic hazards and sets new tasks for hygienists to standardize visual load, physical inactivity, and intellectual and emotional stress when working with digital platforms. The constant updating of sanitary rules, informed by scientific data and technological innovations, is an effective measure for safeguarding health and ensuring pathologists' productivity.

References

1. Ivanov SV, Tkach AV. Usloviya truda i professional'nye vrednye faktory, vlijajushhie na sostojanie zdorov'ja medicinskih rabotnikov. Materialy I Nacional'nogo kongressa s mezhdunarodnym uchastiem po jekologii cheloveka, gigiene i medicине okruzhajushhej sredy "Systsinskie chtenija — 2020": Sbornik tezisov, Moskva, 19–20 nojabrja 2020 goda. M.: FGBU "Centr strategicheskogo planirovaniya i upravlenija mediko-biologicheskimi riskami zdorov'ju", 2020; 145–9 (in Rus.).
2. Ivanchina JuV. K voprosu o kachestve trudovoj zhizni medicinskih rabotnikov. Medicinskoe pravo: novye pravovye vyzovy v rabote medicinskih organizacij: Materialy IV Mezhdunarodnogo foruma po medicinskomu pravu, Ekaterinburg, 25–26 aprelya 2024 goda. Ekaterinburg: Ural'skij gosudarstvennyj juridicheskij universitet im. V. F. Jakovleva, 2024; 130–4 (in Rus.).
3. Vlasov EI. Stressoustojchivost' kak professional'no znachimoe kachestvo rabotnikov medicinskoj sudebnoj jekspertizy. Vestnik Polockogo gosudarstvennogo universiteta. Serija E. Pedagogicheskie nauki. 2018; (7): 96–101 (in Rus.).
4. Kolkutin VV, Dzhuvaljakov PG, Ivanova EB. Problemy sanitarnogigienicheskogo obespechenija dejatel'nosti gosudarstvennyh sudebno-medicinskih jekspertnyh uchrezhdenij. Dezinfekcija. Antiseptika. 2012; 3 (4): 44–9 (in Rus.).
5. Stepanov EG, Masyagutova LM, Shaykhlislamova ER, Sadrtidinova GR, Vlasova NV, Rafikova LA, et al. Occupational and general somatic pathology in healthcare workers. Russian Bulletin of Hygiene. 2025; (1): 4–9. DOI: 10.24075/rbh.2025.118.
6. Kaminer DD, Milushkina OJu, Sheina NI, Bulaceva MB, Girina MD, Paleeva MF. Cifrovizacija zdravoohranenija i sostojanie zdorov'ja medicinskih rabotnikov. Medicina truda i promyshlennaja jekologija. 2023; 63 (8): 490–502 (in Rus.). DOI: 10.31089/1026-9428-2023-63-8-490-502.
7. Milushkina OJu, Skoblina NA, Markelova SV, Kaminer DD, Tatarinchik AA, Savchuk PO, et al. Subjektivnaja ocenka medicinskimi rabotnikami faktorov riska, svjazannyh s ispol'zovaniem jelektronnyh

- ustrojstv. Zdorov'e naselenija i sreda obitanija — ZNISO. 2021; (7): 86–94 (in Rus.). DOI: 10.35627/2219-5238/2021-29-7-86-94.
8. Sorokin GA, Chistjakov ND, Kirjanova MN, Bulavina ID. Vlijanie sostojanija zdorov'ja rabotnikov na ih utomljaemost' i ujazvimost' k proizvodstvennym faktoram. Zdorov'e naselenija i sreda obitanija — ZNISO. 2023; 31 (2): 38–46 (in Rus.). DOI: 10.35627/2219-5238/2023-31-2-38-46.
 9. Ghosh SK. Giovanni Battista Morgagni (1682–1771): father of pathologic anatomy and pioneer of modern medicine. *Anat Sci Int.* 2017; 92 (3): 305–12. DOI: 10.1007/s12565-016-0373-7.
 10. Dartey AF, Dzansi G, Akortiakumah JK, Asiamah EA, Raji AS, Osei S. Qualitative study on the biological hazards associated with mortuary work: the Ghanaian perspective. *J Hosp Infect.* 2022; (122): 126–32. DOI: 10.1016/j.jhin.2022.01.005.
 11. Harchenko VV, Polskoj VS, Poljanskaja ED. K voprosu pojavlenija i razvitiya anatomicheskikh teatrov. Integrativnye tendencii v medicine i obrazovanii. 2023; (4): 175–80 (in Rus.).
 12. Polskoj VS, Popova KS. Istorija razvitiya anatomicheskikh teatrov. Integrativnye tendencii v medicine i obrazovanii. 2021; (3): 64–7 (in Rus.).
 13. Jashina VS, Ermolaeva EV. Istorija anatomicheskikh teatrov. Bjulleten' medicinskij internet-konferencij. 2015; 5 (12): 1486 (in Rus.).
 14. Ushakova MJu. Istorija professii vracha-patologoanatora. Nauchnoe soobshhestvo XXI veka: sbornik nauchnyh trudov po materialam XX Mezhdunarodnoj nauchno-prakticheskoj konferencii, Anapa, 13 marta 2021 goda. Anapa: OOO "Nauchno-issledovatel'skij centr jekonomicheskij i social'nyh processov" v JuFO, 2021; 130–5 (in Rus.).
 15. Makarova AE, Svistunov VV, Makarov SV. Personificirovannyj uchet i vnutribrigadnoe raspredelenie nagruzki vrachej-patologoanatomov na osnove ispol'zovanija metodiki normirovanija ih truda. *Arhiv patologii.* 2019; 81 (2): 47–50 (in Rus.). DOI: 10.17116/patol20198102147.
 16. Problemy i perspektivy razvitiya sovremennoj mediciny: sbornik nauchnyh statej XVI Respublikanskoj nauchno-prakticheskoj konferencii s mezhdunarodnym uchastiem studentov i molodyh uchenyh v 7 tomah, Gomel', 22–23 maja 2024 goda. Gomel': Gomel'skij gosudarstvennyj medicinskij universitet, 2024; 239 p. (in Rus.).
 17. Fedotova IV, Troshin VV, Mironov LA. Povyshenie jeffektivnosti individual'noj zashhity organov dyhanija rabotnikov medicinskih organizacij. Uchebno-metodicheskoe posobie. Nizhegorodskij nauchno-issledovatel'skij institut gigijeny i professional'noj patologii federal'noj sluzhby po zashhite prav potrebitelej i blagopoluchija cheloveka. Nizhnij Novgorod: Remedium Privolzh'e, 2020; 52 p. (in Rus.). DOI: 10.21145/978-5-906125-76-7_2020.
 18. Postanovlenie Soveta Narodnyh Komissarov SSSR ot 11 marta 1939 g. № 298 "O meroprijatijah po uluchsheniju raboty patologoanatomicheskij otdelenij" (in Rus.).
 19. Ukaz Prezidiuma Verhovnogo Soveta SSSR ot 19 aprelya 1949 g. "O preobrazovanii Narodnogo komissariata zdravoohranjenja SSSR v Ministerstvo zdravoohranjenja SSSR" (in Rus.).
 20. Postanovlenie Soveta Ministrov SSSR ot 29 oktjabrja 1949 g. № 4817 "O merah po uluchsheniju sanitarnogo sostojanija v strane i usileniju bor'by s jepidemičeskimi zabojevanijami" (in Rus.).
 21. Postanovlenie Soveta Ministrov SSSR ot 21 avgusta 1951 g. № 3177 "Ob utverzhenii Polozhenija o Gosudarstvennoj sanitarnoj inspekcii" (in Rus.).
 22. SanPiN 2.2.4.548-96. "Gigienicheskie trebovanija k mikroklimatu proizvodstvennyh pomeshhenij". Sanitarnye pravila i normy. Utv. Postanovleniem Goskomsanjepidnadzora Rossii ot 01.10.1996 № 21 (in Rus.).
 23. SanPiN 2.1.3.2630-10 "Sanitarno-jepidemiologicheskie trebovanija k organizacijam, osushhestvljajushhim medicinskuju dejatel'nost'". Utv. Postanovleniem Glavnogo gosudarstvennogo sanitarnogo vracha RF ot 18.05.2010 № 58 (red. ot 10.06.2016). Utratil silu s 01.01.2021 v svjazj s svedenijem SP 2.1.3678-20 (in Rus.).
 24. SP 2.1.3678-20 "Sanitarno-jepidemiologicheskie trebovanija k sodержaniju i jekspluataciji pomeshhenij, zdaniij, sooruzhenij, oborudovanija i transporta, a takzhe k uslovijam dejatel'nosti hozjajstvujushhijh subjektov, osushhestvljajushhijh prodazhu tovarov, vypolnenie rabot ili okazanie uslug". Utv. Postanovleniem Glavnogo gosudarstvennogo sanitarnogo vracha RF ot 02.09.2020 № 24 (in Rus.).
 25. Gajdarov GM, Makarova AE. Ocenka jeffektivnosti novoj metodiki personificirovannogo ucheta i raspredelenija nagruzki vrachej-patologoanatomov. *Problemy social'noj gigijeny, zdravoohranjenja i istorii mediciny.* 2024; 32 (5): 912–7 (in Rus.). DOI: 10.32687/0869-866X-2024-32-5-912-917.
 26. Magomedov MA, Osmanova AA, Magomedov HM. Perspektivy cifrovizacii patologoanatomicheskijh issledovanij. Cifrovaja transformacija: nauka, obrazovanie, medicina. Materialy Vserossijskoj nauchno-prakticheskoj konferencii s mezhdunarodnym uchastiem, Mahachkala, 23 marta 2023 goda. Mahachkala: Izdatel'sko-poligraficheskij centr DGMU, 2023; 209–12 (in Rus.).
 27. Rumjancev JaS. Model' mehanizma upravljenja razvitiem cifrovizacii patomorfologicheskoj sluzhby. *Innovatika i tehnologicheskij suverenitet v zdravoohranении Rossii: kollektivnaja monografija.* M.: OOO "Nauchnyj konsul'tant", 2023; 86–119 (in Rus.).
 28. Hanna MG, Ardon O, Reuter VE, Sirintrapun SJ, England C, Klimstra DS, et al. Integrating digital pathology into clinical practice. *Mod Pathol.* 2022; 35 (2): 152–64. DOI: 10.1038/s41379-021-00929-0. Erratum in: *Mod Pathol.* 2022; 35 (2): 287. DOI: 10.1038/s41379-021-00948-x. Erratum in: *Mod Pathol.* 2022; 35 (2): 286. DOI: 10.1038/s41379-021-00968-7.
 29. Baxi V, Edwards R, Montalto M, Saha S. Digital pathology and artificial intelligence in translational medicine and clinical practice. *Mod Pathol.* 2022; 35 (1): 23–32. DOI: 10.1038/s41379-021-00919-2.
 30. Zhang DY, Venkat A, Khasawneh H, Sali R, Zhang V, Pei Z. Implementation of digital pathology and artificial intelligence in routine pathology practice. *Lab Invest.* 2024; 104 (9): 102111. DOI: 10.1016/j.labinv.2024.102111.
 31. Kiran N, Sapna F, Kiran F, Kumar D, Raja F, Shiwani S, et al. Digital pathology: transforming diagnosis in the digital age. *Cureus.* 2023; 15 (9): e44620. DOI: 10.7759/cureus.44620.
 32. Solovjev IA. Iskusstvennyj intellekt v patologicheskoj anatomii. *Arhiv patologii.* 2024; 86 (2): 65–71 (in Rus.). DOI: 10.17116/patol20248602165.
 33. Kapustina AS, Savin EI, Ceveleva IV. Ob ispol'zovanii dostizhenij nauchno-tehnicheskogo progressa v sudebno-jekspertnoj dejatel'nosti v Rossijskoj Federacii. Transformacija informacionno-kommunikativnoj sredy obshhestva v uslovijah vyzovov sovremennosti: materialy II Mezhdunarodnoj nauchno-prakticheskoj konferencii molodyh uchenyh, Komsomol'sk-na-Amure, 30 nojabrja — 01 dekabrja 2023 goda. Komsomol'sk-na-Amure: Komsomol'skij-na-Amure gosudarstvennyj universitet, 2023; 188–91 (in Rus.).
 34. Romanova TE. Vlijanie processov cifrovoj transformacii na sistemu vzaimootnoshenij ključevyh subjektov social'nogo instituta mediciny v Rossijskoj Federacii. Nizhnij Novgorod: Nizhegorodskij gosudarstvennyj universitet im. N. I. Lobachevskogo, 2023; 179 p. (in Rus.).
 35. Barannikova AA. Cifrovyje tehnologii v kriminalistike i sudebnoj medicine. *Pravovoe obrazovanie: sbornik nauchnyh statej.* Tom 28. Rostov-na-Donu: Rostovskij institut (filial) FGBOU VO "Vserossijskij gosudarstvennyj universitet justicii (RPA Minjusta Rossii)" v g. Rostove-na-Donu, 2022; 185–92 (in Rus.).
 36. Kaminer DD, Dubrovina EA, Sheina NI, Skoblina NA, Sanakoeva EY, Vorona VP. Hygiene as a science in modern clinical therapeutic practice: from observation to digitalization (part one). *Russian Bulletin of Hygiene.* 2023; (1): 12–6. DOI: 10.24075/rbh.2023.063.
 37. Kaminer DD, Dubrovina EA, Sheina NI, Skoblina NA, Sanakoeva EY, Vorona VP. Hygiene as a science in modern clinical therapeutic practice: from observation to digitalization (part two). *Russian Bulletin of Hygiene.* 2023; (2): 4–8. DOI: 10.24075/rbh.2023.067.
 38. Ilina OA. Gigienicheskaja ocenka faktorov riska i sostojanie zdorov'ja sotrudnikov bjuro sudebno-medicinskoj jekspertizy [dissertacija]. M., 2022 (in Rus.).

Литература

- Иванов С. В., Ткач А. В. Условия труда и профессиональные вредные факторы, влияющие на состояние здоровья медицинских работников. Материалы I Национального конгресса с международным участием по экологии человека, гигиене и медицине окружающей среды «Сысинские чтения — 2020»: Сборник тезисов, Москва, 19–20 ноября 2020 года. М.: ФГБУ «Центр стратегического планирования и управления медико-биологическими рисками здоровью», 2020; 145–9.
- Иванчина Ю. В. К вопросу о качестве трудовой жизни медицинских работников. Медицинское право: новые правовые вызовы в работе медицинских организаций: Материалы IV Международного форума по медицинскому праву, Екатеринбург, 25–26 апреля 2024 года. Екатеринбург: Уральский государственный юридический университет им. В. Ф. Яковлева, 2024; 130–4.
- Власов Е. И. Стрессоустойчивость как профессионально значимое качество работников медицинской судебной экспертизы. Вестник Полоцкого государственного университета. Серия Е. Педагогические науки. 2018; (7): 96–101.
- Колкутин В. В., Джувалыков П. Г., Иванова Е. Б. Проблемы санитарно-гигиенического обеспечения деятельности государственных судебно-медицинских экспертных учреждений. Дезинфекция. Антисептика. 2012; 3 (4): 44–9.
- Степанов Е. Г., Масыгутова Л. М., Шайхлисламова Э. Р., Садртдинова Г. Р., Власова Н. В., Рафикова Л. А. и др. Профессиональная и общесоматическая патология у работников здравоохранения. Российский вестник гигиены. 2025; (1): 4–10. DOI: 10.24075/rbh.2025.118.
- Каминер Д. Д., Милушкина О. Ю., Шеина Н. И., Булацева М. Б., Гирина М. Д., Палеева М. Ф. Цифровизация здравоохранения и состояние здоровья медицинских работников. Медицина труда и промышленная экология. 2023; 63 (8): 490–502. DOI: 10.31089/1026-9428-2023-63-8-490-502.
- Милушкина О. Ю., Скоблина Н. А., Маркелова С. В., Каминер Д. Д., Татаринчик А. А., Савчук П. О. и др. Субъективная оценка медицинскими работниками факторов риска, связанных с использованием электронных устройств. Здоровье населения и среда обитания — ЗНиСО. 2021; (7): 86–94. DOI: 10.35627/2219-5238/2021-29-7-86-94.
- Сорокин Г. А., Чистяков Н. Д., Кирьянова М. Н., Булавина И. Д. Влияние состояния здоровья работников на их утомляемость и уязвимость к производственным факторам. Здоровье населения и среда обитания — ЗНиСО. 2023; 31 (2): 38–46. DOI: 10.35627/2219-5238/2023-31-2-38-46.
- Ghosh SK, Giovanni Battista Morgagni (1682–1771): father of pathologic anatomy and pioneer of modern medicine. *Anat Sci Int.* 2017; 92 (3): 305–12. DOI: 10.1007/s12565-016-0373-7.
- Dartey AF, Dzansi G, Akortiakumah JK, Asiamah EA, Raji AS, Osei S. Qualitative study on the biological hazards associated with mortuary work: the Ghanaian perspective. *J Hosp Infect.* 2022; (122): 126–32. DOI: 10.1016/j.jhin.2022.01.005.
- Харченко В. В., Польской В. С., Полянская Е. Д. К вопросу появления и развития анатомических театров. Интегративные тенденции в медицине и образовании. 2023; (4): 175–80.
- Польской В. С., Полова К. С. История развития анатомических театров. Интегративные тенденции в медицине и образовании. 2021; (3): 64–7.
- Яшина В. С., Ермолаева Е. В. История анатомических театров. Бюллетень медицинских интернет-конференций. 2015; 5 (12): 1486.
- Ушакова М. Ю. История профессии врача-патологоанатома. Научное сообщество XXI века: сборник научных трудов по материалам XX Международной научно-практической конференции, Анапа, 13 марта 2021 года. Анапа: ООО «Научно-исследовательский центр экономических и социальных процессов» в ЮФО, 2021; 130–5.
- Макарова А. Е., Свистунов В. В., Макаров С. В. Персонализированный учет и внутрибригадное распределение нагрузки врачей-патологоанатомов на основе использования методики нормирования их труда. Архив патологии. 2019; 81 (2): 47–50. DOI: 10.17116/patol20198102147.
- Проблемы и перспективы развития современной медицины: сборник научных статей XVI Республиканской научно-практической конференции с международным участием студентов и молодых ученых в 7 томах, Гомель, 22–23 мая 2024 года. Гомель: Гомельский государственный медицинский университет, 2024; 239 с.
- Федотова И. В., Трошин В. В., Миронов Л. А. Повышение эффективности индивидуальной защиты органов дыхания работников медицинских организаций. Учебно-методическое пособие. Нижегородский научно-исследовательский институт гигиены и профессиональной патологии федеральной службы по защите прав потребителей и благополучия человека. Нижний Новгород: Ремедиум Приволжье, 2020; 52 с. DOI: 10.21145/978-5-906125-76-7_2020.
- Постановление Совета народных комиссаров СССР от 11 марта 1939 г. № 298 «О мероприятиях по улучшению работы патологоанатомических отделений».
- Указ Президиума Верховного Совета СССР от 19 апреля 1949 г. «О преобразовании Народного комиссариата здравоохранения СССР в Министерство здравоохранения СССР».
- Постановление Совета Министров СССР от 29 октября 1949 г. № 4817 «О мерах по улучшению санитарного состояния в стране и усилению борьбы с эпидемическими заболеваниями».
- Постановление Совета Министров СССР от 21 августа 1951 г. № 3177 «Об утверждении Положения о Государственной санитарной инспекции».
- СанПиН 2.2.4.548-96. «Гигиенические требования к микроклимату производственных помещений». Санитарные правила и нормы. Утв. Постановлением Госкомсанэпиднадзора России от 01.10.1996 № 21.
- СанПиН 2.1.3.2630-10 «Санитарно-эпидемиологические требования к организациям, осуществляющим медицинскую деятельность». Утв. Постановлением Главного государственного санитарного врача РФ от 18.05.2010 № 58 (ред. от 10.06.2016). Утратил силу с 01.01.2021 в связи с введением СП 2.1.3678-20.
- СП 2.1.3678-20 «Санитарно-эпидемиологические требования к содержанию и эксплуатации помещений, зданий, сооружений, оборудования и транспорта, а также к условиям деятельности хозяйствующих субъектов, осуществляющих продажу товаров, выполнение работ или оказание услуг». Утв. Постановлением Главного государственного санитарного врача РФ от 02.09.2020 № 24.
- Гайдаров Г. М., Макарова А. Е. Оценка эффективности новой методики персонализированного учета и распределения нагрузки врачей-патологоанатомов. Проблемы социальной гигиены, здравоохранения и истории медицины. 2024; 32 (5): 912–7. DOI: 10.32687/0869-866X-2024-32-5-912-917.
- Магомедов М. А., Османова А. А., Магомедов Х. М. Перспективы цифровизации патологоанатомических исследований. Цифровая трансформация: наука, образование, медицина. Материалы Всероссийской научно-практической конференции с международным участием, Махачкала, 23 марта 2023 года. Махачкала: Издательско-полиграфический центр ДГМУ, 2023; 209–12.
- Румянцев Я. С. Модель механизма управления развитием цифровизации патоморфологической службы. Инноватика и технологический суверенитет в здравоохранении России: коллективная монография. М.: ООО «Научный консультант», 2023; 86–119.
- Hanna MG, Ardon O, Reuter VE, Sirintrapun SJ, England C, Klimstra DS, et al. Integrating digital pathology into clinical practice. *Mod Pathol.* 2022; 35 (2): 152–64. DOI: 10.1038/s41379-021-00929-0. Erratum in: *Mod Pathol.* 2022; 35 (2): 287. DOI: 10.1038/s41379-021-00948-x. Erratum in: *Mod Pathol.* 2022; 35 (2): 286. DOI: 10.1038/s41379-021-00968-7.
- Baxi V, Edwards R, Montalto M, Saha S. Digital pathology and artificial intelligence in translational medicine and clinical practice. *Mod Pathol.* 2022; 35 (1): 23–32. DOI: 10.1038/s41379-021-00919-2.
- Zhang DY, Venkat A, Khasawneh H, Sali R, Zhang V, Pei Z. Implementation of digital pathology and artificial intelligence in

- routine pathology practice. *Lab Invest.* 2024; 104 (9): 102111. DOI: 10.1016/j.labinv.2024.102111.
31. Kiran N, Sapna F, Kiran F, Kumar D, Raja F, Shiwani S, et al. Digital pathology: transforming diagnosis in the digital age. *Cureus.* 2023; 15 (9): e44620. DOI: 10.7759/cureus.44620.
 32. Соловьев И. А. Искусственный интеллект в патологической анатомии. *Архив патологии.* 2024; 86 (2); 65–71. DOI: 10.17116/patol20248602165.
 33. Капустина А. С., Савин Е. И., Цевелева И. В. Об использовании достижений научно-технического прогресса в судебно-экспертной деятельности в Российской Федерации. Трансформация информационно-коммуникативной среды общества в условиях вызовов современности: материалы II Международной научно-практической конференции молодых ученых, Комсомольск-на-Амуре, 30 ноября — 01 декабря 2023 года. Комсомольск-на-Амуре: Комсомольский-на-Амуре государственный университет, 2023; 188–91.
 34. Романова Т. Е. Влияние процессов цифровой трансформации на систему взаимоотношений ключевых субъектов социального института медицины в Российской Федерации. Нижний Новгород: Нижегородский государственный университет им. Н. И. Лобачевского, 2023; 179 с.
 35. Баранникова А. А. Цифровые технологии в криминалистике и судебной медицине. Правовое образование: сборник научных статей. Том 28. Ростов-на-Дону: Ростовский институт (филиал) ФГБОУ ВО «Всероссийский государственный университет юстиции (РПА Минюста России)» в г. Ростове-на-Дону, 2022; 185–92.
 36. Каминер Д. Д., Дубровина Е. А., Шеина Н. И., Скоблина Н. А., Санакоева Е. Ю., Ворона В. П. Гигиеническая наука в современной клинической терапевтической практике: от наблюдения к цифровизации (часть первая). *Российский вестник гигиены.* 2023; (1): 13–7. DOI: 10.24075/rbh.2023.063.
 37. Каминер Д. Д., Дубровина Е. А., Шеина Н. И., Скоблина Н. А., Санакоева Е. Ю., Ворона В. П. Гигиеническая наука в современной клинической терапевтической практике: от наблюдения к цифровизации (часть вторая). *Российский вестник гигиены.* 2023; (2): 4–8. DOI: 10.24075/rbh.2023.067.
 38. Ильина О. А. Гигиеническая оценка факторов риска и состояние здоровья сотрудников бюро судебно-медицинской экспертизы [диссертация]. М., 2022.

MICROPLASTICS IN THE FOOD CHAIN: INVISIBLE THREAT AND SOLUTIONS

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Microplastic pollution, which exerts both direct and indirect effects on human health, has emerged as one of the most pressing global environmental threats. We performed systematic analysis of pathways for microplastics migration through food chains, assessed the impact of microplastics on body's physiological systems, estimated the existing risk reduction strategies. The review encompassed publications from the past decade, selected based on their relevance to the issue of microplastics intake with water and food products. Plastic waste, synthetic textiles, and food products have been identified as primary sources of pollution. Identification of microplastics in 93% of bottled water samples, along with the presence of hundreds of microparticles per kilogram of sea salt, confirms the magnitude of the exposure. It has been found that particles sized 0.1–150 µm can damage the intestinal epithelium, thereby inducing inflammation and oxidative stress; particles sized 2.5–10 µm reduce functional lung capacity; nanoplastics capable of crossing the blood-brain barrier exerts neurotoxicity. Membrane water purification methods exhibit efficiency of up to 99.9%. A comprehensive approach, including regulatory frameworks, technological solutions, and hygiene practices designed to disrupt the pathways through which microplastics enter the body, is necessary.

Keywords: microplastics, food safety, human health, risk reduction strategies

Author contribution: Konstantinova YuS — study concept, developing the methodology, literature data analysis, manuscript drafting, data visualization, editing and approval of the final version of the manuscript; Chuyev AS — formal data analysis, testing sources for reliability, systematization of information, project coordination, preparing bibliographic references.

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МИКРОПЛАСТИК В ПИЩЕВОЙ ЦЕПИ: НЕВИДИМАЯ УГРОЗА И ПУТИ РЕШЕНИЯ

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Микропластическое загрязнение, оказывающее прямое и опосредованное воздействие на здоровье человека, стало одной из наиболее значимых глобальных экологических угроз. Выполнены систематический анализ путей миграции микропластика по пищевым цепям, оценка влияния микропластика на физиологические системы организма, оценка существующих стратегий снижения риска. В обзор включены публикации за последние 10 лет, отобранные по критериям релевантности в отношении проблемы поступления микропластика с водой и пищевыми продуктами. В качестве основных источников загрязнения определены пластиковые отходы, синтетический текстиль и продукты питания. Обнаружение микропластика в 93% образцов бутилированной воды и сотен микрочастиц на килограмм морской соли подтверждает масштаб экспозиции. Установлено, что частицы размером 0,1–150 мкм повреждают эпителий кишечника, вызывая воспаление и окислительный стресс; частицы 2,5–10 мкм снижают жизненную емкость легких; нанопластик, способный проникать через гематоэнцефалический барьер, обладает нейротоксичностью. Мембранные методы очистки воды демонстрируют эффективность до 99,9%. Необходим комплексный подход, включающий нормативное регулирование, технологические решения и гигиенические практики, направленные на разрыв путей поступления микропластика в организм.

Ключевые слова: микропластик, пищевая безопасность, здоровье человека, стратегии снижения риска

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Sometimes, the most subtle and elusive influences may prove to be the most insidious and hazardous. In contrast to spectacular environmental disasters, such as giant oil spills or radiation accidents, the consequences of which are significant in their scale, the threat of adverse effects of plastic pollution accumulates over decades, remaining predominantly imperceptible, until it affects the fundamental underpinnings of living nature and, ultimately, our own body. Plastic pollution of the environment is duly acknowledged as one of the most significant and urgent environmental challenges of our era. The magnitude of such anthropogenic impact is indeed global. The Birmingham Plastics Network shows terrifying values:

of the 10 billion tons of plastic produced, about 80% were thrown away without prior recycling, which contributed to the formation of microplastic particles polluting the environment under the exposure to external factors (sunlight, heat, humidity) [1]. These plastic fragments, smaller than 5 mm, penetrate into all components of the biosphere, which makes them dangerous. These are found in water (from the ocean depths to drinking water available on retail shelves), air, soil, and living organisms [2, 3]. Due to their small size and hydrophobic properties, they are easily incorporated into food chains at the most basic levels (for example, they are absorbed by zooplankton), and through the mechanism of biological accumulation they are transferred

from one link to another, ultimately reaching the human body. There they affect the integrity of the gastrointestinal tract (GIT), and, having become part of the microbiota, induce oxidative and inflammatory responses [1, 2].

Our aim was to conduct systematic analysis of the currently available research data on the pathways for microplastics migration through food chains, assess direct and indirect effects of microplastics on physiological systems of organisms, including humans, as well as to comprehensively assess the existing and promising strategies to reduce plastic pollution and its consequences for ecosystems and public health.

The methodology for searching and selecting papers was as follows: we searched for scientific sources in international and domestic bibliographic databases PubMed, eLIBRARY.RU (RSCI), and Google Scholar. The analysis included papers published between 2015 and 2025. The search was performed using keywords and their combinations: “microplastics”, “nanoplastics”, “food chain”, “human health”, “drinking water”, “dietary exposure”, as well as equivalents in Russian (“микрочластик”, “наночластик”, “пищевая цепь”, “здоровье человека”, “питьевая вода”, “пищевые продукты”). The initial search identified 96 papers, from which 48 sources were selected after removing duplicates and analyzing titles and abstracts. Full-text evaluation allowed us to include in the review 30 papers that met the inclusion criteria (original experimental studies and clinical trials, systematic reviews and meta-analyses focused on pathways of microplastics entry with food and water, mechanisms underlying its biological effects, and assessment of the risk for human health). Exclusion criteria were as follows: no access to the full text, irrelevance to the research topic, paper published before 2015, conference abstracts without detailed results, as well as papers containing no data in the effects of microplastics on the human body or food chains.

Main sources of microplastics entering the food chain

The mechanisms underlying plastic distribution across the environment and its subsequent entry into humans form a complex continuous chain of transformation and migration.

The process begins with the most obvious secondary source — the dumping of large plastic items (such as drinking water bottles) into the ocean or onto land. At this stage a direct adverse effect of plastic is reported: ingestion of human waste by marine mammals, reptiles, birds, and fish can lead to their death or the development of life-threatening diseases, such as exhaustion, rupture of internal organs, and suffocation of coral reef inhabitants due to lack of oxygen and sunlight [4]. In turn, turtles, birds, and mammals are at risk of drowning when caught in nets and traps, as well as when interacting with polymeric materials.

The following should be noted: there is evidence that floating plastics can carry chemicals and pathogenic bacteria to coastal areas, which can be a factor of the subtle but significant impact on human health [5].

Then, under the exposure to ultraviolet radiation from sunlight, the plastic becomes brittle, and mechanical action of waves and sand abrasion lead to its gradual fragmentation into many microscopic particles that can directly enter the human body through the digestive organs (for example, in case of accidental swallowing of water while swimming or when drinking unpurified water due to the inability to use another source of hydration), respiratory organs, and skin in case of direct contact [6].

However, at the same time there is one more, a less noticeable but no less powerful channel for pollutant entry:

household activities. The hazard is the routine procedure, i.e. synthetic apparel laundering. Every wash releases hundreds of thousands of microscopic fibers into wastewater that treatment plants are unable to fully capture, which results in contamination of the apparently purified water [7]. This also includes wear and tear on car tires, particles of which are washed away by rain into water bodies, and urban dust, which carries microplastics through the air.

Once in the ocean or soil, particles and fibers become part of an ecological cycle. In aquatic ecosystems, these are swallowed by zooplankton representing the basis of the marine food chain; particles and fibers settle to the bottom and are absorbed by filter feeding organisms, such as mussels and oysters [3, 7]. On land, microplastics are deposited on agricultural land and taken up by soil invertebrates and plant root systems. Bioaccumulation results in buildup of pollutant concentrations in the organisms' tissues, and biomagnifications results in the concentration increase with the transition from one trophic level to another. Thus, a predatory fish that feeds on smaller species, or a herbivore that eats contaminated plants accumulates large amounts of plastic.

The final link in this chain is human, who by eating seafood, fish, agricultural products, and even breathing city air, inevitably becomes the final target of such pollution, closing the cycle that began with the bottle we, humans, threw away or the next time we washed a fleece sweater.

In addition to the above mechanisms underlying danger to humans from microplastic particles, there is another one. It is associated with using items that have become firmly established in our everyday life — plastic bottles. Scientists have proven that microplastic particles are often (in 93% of cases) found in bottled water [8]. The major contamination canals are both the packaging material itself (both the container and the lid) and the production process. Bottles made of polyethylene terephthalate (PET) undergo mechanical degradation and release microparticles during use (repeated opening and closing, compression and, most importantly, thermal exposure during storage). Considerable amounts of particles also enter the water from polypropylene lids.

Furthermore, particles yielded by decomposition of plastic are found even in familiar foods such as table salt, honey, wine, tea, coffee capsules, beer, and carbonated beverages [9–11]. The research show that the sea salt, produced by evaporating ocean water, is a particularly significant source: it can contain hundreds of microparticles per kilogram of product, directly linking ocean pollution to the food we eat [9]. The analysis of honey from different world's regions also revealed microplastic fibers and fragments, likely entering the honey through atmospheric transport and deposition on flowers or during collection and processing by beekeepers [10]. Microscopic plastic particles penetrate into various beverages through multiple points of contact with polymeric materials [11]. When poured into plastic containers, these migrate from the bottle walls, necks, and lids. Wine may contain particles from plastic corks, and hot drinks such as coffee and tea may contain particles from plastic filters, tea bags, coffee capsules, or disposable tableware. Even the process of preparing hot drinks can wash away microparticles, for example, when boiling water in a plastic electric kettle. Microplastics can also be accidentally ingested from non-food sources during oral hygiene and tooth brushing, such as toothpaste, toothbrushes, orthodontic implants, and denture materials [11]. These examples clearly demonstrate that microplastics are already circulating in a vicious circle, becoming part of the key components of our diet. This makes microplastic consumption virtually inevitable.

Thus, plastic pollution represents a closed cycle of migration and transformation: what started as full-size plastic waste, causing direct death to animals, is transformed through fragmentation processes and the household release of microparticles into an invisible but large-scale threat. It is significant that even bottled water, food products, and personal hygiene items become a source of microplastics entering the body, closing the anthropogenic pollution cycle. This systemic problem requires a comprehensive solution at all stages: from production to disposal of plastic materials.

Potential risk for human health

Microplastics invasion of human body represents a multi-layered threat, realized through several interconnected mechanisms. The main receipt pathways are GIT (with food and water), respiratory system, and to a lesser extent, skin. According to the available data, the effects of microplastics on the respiratory, gastrointestinal, cardiovascular and nervous systems are best understood. However, the impact on other body's systems, including endocrine and reproductive systems, has not been studied sufficiently. The currently available information is fragmentary, it makes it possible to only hypothesize about potential mechanisms of action and long-term consequences. Particularly challenging is the assessment of the cumulative effect in chronic low-dose exposure, typical for real-world conditions. Thus, despite growing body of scientific evidence, many aspects of the impact of microplastics on the human body require further systematic study.

Digestive system

By studying the information on the routes of plastic penetration into the human body, it can be concluded that the most likely route is oral. When consumed in this way, microplastics have a multi-component effect on the GIT. Microplastic particles can cause mechanical damage to enterocytes. Small particles sized 0.1–150 μm can translocate across the mucosal barrier and accumulate in intestinal epithelial cells, causing the tight junction integrity disruption and increased permeability of the intestinal wall playing a role of the barrier between the intestinal lumen and body's bloodstream [12]. Such intestinal barrier alteration leads to translocation of bacteria, which can cause immune responses and intestinal inflammation. Inflammatory processes can only worsen due to disturbances in lipid and energy metabolism [13]. Furthermore, disturbances in energy metabolism and immune responses are confirmed by gut microbiota alterations: the studies report alteration of the gut microbiota microbial composition often leading to reduction of the number of friendly bacteria, such as *Lactobacillus* and *Bifidobacterium*, contributing to growth of opportunistic microorganisms and thereby causing dysbiosis [2, 13, 14]. Of particular danger is the synergistic effect of sorption of pathogenic microorganisms and toxins on the surface of microplastics, which increases their bioavailability and pathogenic potential.

Respiratory system

As stated above, textiles, the fibers of which enter the atmosphere every time a synthetic item is washed, represents one of the sources of microplastics in the atmosphere. Inhalation of microplastics is characterized by selective deposition of particles depending on their size [15]. Particles with a diameter of 2.5–10 μm are deposited mainly in the upper respiratory

tract, while ultrafine fractions (< 2.5 μm) reach the alveoli. Pulmonary macrophages show limited phagocytic activity for particles larger than 10 μm , which leads to persistence of those and the development of chronic granulomatous inflammation. Experimental data suggest the dose-dependent reduction of lung capacity and increase in the airway resistance associated with chronic inhalation of polypropylene fibers. Fibrous changes in the interalveolar septa and neoplastic transformation associated with constant proliferation against the background of chronic inflammation are considered to be the long-term consequences.

Nervous system

In addition to microplastic particles, there are also smaller substances, the nanoplastic particles (< 100 nm) demonstrating the ability to penetrate the blood-brain barrier through adsorption-mediated transport [16, 17]. In the experiment involving mice, intravenous administration of fluorescence labeled polystyrene particles with a diameter of 20 nm resulted in their accumulation in the hippocampus and cerebral cortex 24 h after injection. Neurological impairment manifests itself in the form of dose-dependent cognitive decline, short-term memory impairment, and motor activity alteration. New data suggest that the exposure to pollutants in the environment disrupts the connection between the gut and the brain, leading to abnormalities in brain immunity, structure, neural connections, and behavior [17, 18]. Neurotoxicity mechanisms include mitochondrial dysfunction, microglial activation, and impaired synaptic plasticity. Electrophysiological tests record the long-term potentiation changes in hippocampal neurons when the particle concentration ≥ 1 mg/L.

Circulatory system

The cardiovascular system appears to be one of the most vulnerable targets for microplastics circulating in the bloodstream. Numerous scientific papers focused on the issue of the plastic environmental pollution adverse effects on human metabolism contain the reports of the direct relationship between the presence of microplastic particles and the development of endothelial dysfunction, as well as pro-thrombotic states [19]. The mechanisms underlying such effects are multifaceted: *in vitro* studies show that polyethylene particles with a diameter of 1 μm at a concentration of 50 $\mu\text{g}/\text{mL}$ induce apoptosis of human umbilical vein endothelial cells through caspase-3 activation [20]. This process underlies the vascular lining injury, which has been confirmed by animal experiments, in which the accelerated formation of atherosclerotic plaques in the aorta under the combined exposure to microplastics and the atherogenic diet was reported. And there are also hemostatic disorders manifested by platelet activation, increased fibrinogen levels, and shorter blood clotting time [21]. Cardiotoxic effects, including cardiac arrhythmia and reduced left ventricular ejection fraction, become the clinically significant effects of such multi-layered abnormality, which increases the risk of myocardial infarction and heart failure in the long term.

Current strategies to reduce adverse effects of microplastics

In the context of the global spread of microplastics, the hygienic strategies aimed at minimizing its entry into the human body through the main routes of exposure are particularly relevant. These strategies are based on the principle of multi-level protection,

covering both individual practices and the improvement of water treatment and food quality control systems.

As for drinking water supply, advanced water purification methods are of primary importance. Today, there are no special regulatory documents for controlling water filtration from the pollutant described above, i.e. microplastics, in the Russian Federation [22]. However, the current standard water purification methods make it possible to reduce microplastics concentration in the purified water. Thus, according to the research, combined use of sand filtration and membrane technologies (in particular, nanofiltration membranes with the pore size 0.001 μm) allows to increase the microplastic removal efficiency to 99.9% [23]. At home, one can use activated carbon and reverse osmosis water purification systems, which have proven their effectiveness in removing particles larger than 0.0001 μm [24].

Significant potential for reducing exposure is associated with optimizing dietary habits and choosing sustainable foods. Epidemiological studies suggest significant differences in microplastic levels between the aquaculture-raised and wild-caught seafood [25]. As for eating seafood, limiting the consumption of filter-feeding mollusks (mussels, oysters), which demonstrate the greatest ability to accumulate microparticles, seems to be the best solution. When choosing table salt, which has been found to contain large amounts of microplastic particles, preference should be given to rock salt, the microplastic content of which is 2–3 orders of magnitude lower than in sea salt [9].

As for household hygiene, the issue of synthetic textiles deserves special attention. It has been found that the use of microfiber filters during washing can reduce the release of plastic fibers into wastewater by 80% [26]. Switching to the use of clothing made from natural materials, as well as the use of special detergents that reduce mechanical damage to fibers represent one more protective measure.

The correct choice of packaging and storage conditions for products is an important aspect of food hygiene. Avoiding heating food in plastic packaging is a science-based recommendation, since it has been found that the exposure to temperature of 60–70 $^{\circ}\text{C}$ increases microparticle migration 5–7-fold [27]. Priority should be given to glass and ceramic containers, especially for long-term storage and heat treatment of products.

As for respiratory hygiene, the use of class FFP2 respirators, capable of retaining up to 94% of particles sized 0.3–1 μm , under the conditions of high dust content represents an effective protective measure [28]. It is recommended to use air purifiers with HEPA filters demonstrating 99.97% efficiency for particles larger than 0.3 μm to reduce microplastics concentration in indoor air of residential buildings.

Improving the regulatory framework occupies a special place in hygienic prevention. It is necessary to revise hygienic standards and determine maximum permissible concentrations of microplastics in drinking water and food products.

The development of monitoring systems enabling regular monitoring of microparticle content in key environmental objects is a promising area [29].

Thus, the current hygienic strategies to reduce negative effects of microplastics represent a complex of complementary measures based on the principles of evidence-based medicine and aimed at disrupting the pathways, through which microparticles enter the human body with water, food and air.

CONCLUSION

The analysis conducted has shown that the issue of microplastic pollution represents a global challenge characterized by the closed cycle of migration and transformation of plastic materials. A continuous chain of interconnected processes can be traced: from the initial pollution of the environment with macroplastics to the micro- and nanoparticles entering the human body. Of particular concern is the ability of microplastics to enter food chains and undergo bioaccumulation, reaching maximum concentrations at higher levels of the food chain, including humans.

Numerous studies have shown that microplastics have significant pathogenic potential, which is realized through a complex of mechanisms: from mechanical damage to cellular structures to the induction of oxidative stress, chronic inflammation, and dysfunction of major physiological systems. The effects on the gastrointestinal tract, respiratory, and cardiovascular systems is best studied while the effects on the endocrine and reproductive functions requires further research.

The existing strategies to reduce adverse effects of microplastics considered in the paper include both technological solutions (membrane filtration, sorption purification, coagulation) and hygienic practices aimed at breaking the pathways, through which microplastics enter the body. Of particular importance is the development of the regulatory framework and monitoring systems enabling objective assessment of microplastic content in environmental objects and food products.

Prospects for overcoming the challenge are associated with realization of the comprehensive approach that involves improving plastic waste recycling technologies, developing water and air purification methods, and fostering an environmentally friendly consumer culture. No less important is the development of scientific research focused on in-depth study of the long-term effects of microplastic exposure and the development of effective detoxification methods.

Thus, the issue of microplastic pollution requires the combined efforts of the scientific community, authorities, manufacturers and consumers to develop and implement effective measures to reduce the negative impact on ecosystems and human health. Only a comprehensive, interdisciplinary approach will help break the vicious circle of anthropogenic plastic pollution and minimize its consequences for present and future generations.

References

- Dove A, Elsdon-Baker F, Krause S, Thomson I, Riley J, Hall A, et al. Plastic: A Call to Action. University of Birmingham, 2023; 27 p. URL: <https://www.birmingham.ac.uk/documents/college-eps/plastics/uob-plastic-call-to-action-2023.pdf>.
- Demarquoy J. Microplastics and probiotics: mechanisms of interaction and their consequences for health. *AIMS Microbiol.* 2025; 11 (2): 388–409. DOI: 10.3934/microbiol.2025018.
- United Nations Environment Programme. From Pollution to Solution. A global assessment of marine litter and plastic pollution. Synthesis. Nairobi, 2021; 43 p.
- Maes T, van Diemen de Jel J, Vethaak AD, Desender M, Bendall VA, van Velzen M, et al. You are what you eat, microplastics in Porbeagle Sharks from the North East Atlantic: Method development and analysis in spiral valve content and tissue. *Front Mar Sci.* 2020; (7): 273. DOI: 10.3389/fmars.2020.00273.
- Peng L, Fu D, Qi H, Lan CQ, Yu H, Ge C. Micro- and nano-plastics in marine environment: Source, distribution and threats — A review. *Sci Total Environ.* 2020; (698): 134254. DOI: 10.1016/j.scitotenv.2019.134254.
- Landrigan PJ, Stegeman JJ, Fleming LE, Allemann D, Anderson DM, Backer LC, et al. Human health and ocean pollution. *Ann Glob Health.* 2020; 86 (1): 151. DOI: 10.5334/aogh.2831.
- Jahjaeva MH, Jergasheva IF. Vlijanie mikroplasticheskih chastic na organizm. *Teorija i praktika sovremennoj nauki.* 2022; 10 (88): 197–204 (in Rus.).
- Mason SA, Welch VG, Neratko J. Synthetic polymer contamination in bottled water. *Front Chem.* 2018; (6): 407. DOI: 10.3389/fchem.2018.00407.
- Kim JS, Lee HJ, Kim SK, Kim HJ. Global pattern of microplastics (MPs) in commercial food-grade salts: sea salt as an indicator of seawater MP pollution. *Environ Sci Technol.* 2018; 52 (21): 12819–28. DOI: 10.1021/acs.est.8b04180.
- Liebezeit G, Liebezeit E. Non-pollen particulates in honey and sugar. *Food Addit Contam Part A Chem Anal Control Expo Risk Assess.* 2013; 30 (12): 2136–40. DOI: 10.1080/19440049.2013.843025.
- Duda A, Petka K. The presence of micro- and nanoplastics in food and the estimation of the amount consumed depending on dietary patterns. *Molecules.* 2025; 30 (18): 3666. DOI: 10.3390/molecules30183666.
- Deng Y, Yan Z, Shen R, Wang M, Huang Y, Ren H, et al. Microplastics release phthalate esters and cause aggravated adverse effects in the mouse gut. *Environ Int.* 2020; (143): 105916. DOI: 10.1016/j.envint.2020.105916.
- Li T, Yao Z, Huang Y, Li R, Zhang L, Chen R, et al. Chronic waterborne exposure to polystyrene microplastics induces Kupffer cell polarization imbalance and hepatic lipid accumulation. *FASEB J.* 2025; 39 (17): e70980. DOI: 10.1096/fj.202500910RR.
- Jin Y, Lu L, Tu W, Luo T, Fu Z. Impacts of polystyrene microplastic on the gut barrier, microbiota and metabolism of mice. *Sci Total Environ.* 2019; (649): 308–17. DOI: 10.1016/j.scitotenv.2018.08.353.
- Prata JC. Airborne microplastics: Consequences to human health? *Environ Pollut.* 2018; (234): 115–26. DOI: 10.1016/j.envpol.2017.11.043.
- Li X, He E, Chen G, Cao X, Zhao L, Xu X, et al. Intergenerational neurotoxicity of polystyrene nanoplastics in offspring mice is mediated by dysfunctional microbe-gut-brain axis. *Environ Int.* 2024; (192): 109026. DOI: 10.1016/j.envint.2024.109026.
- Zuri G, Karanasiou A, Lacorte S. Microplastics: Human exposure assessment through air, water, and food. *Environ Int.* 2023; (179): 108150. DOI: 10.1016/j.envint.2023.108150.
- Jeong B, Baek JY, Koo J, Park S, Ryu YK, Kim KS, et al. Maternal exposure to polystyrene nanoplastics causes brain abnormalities in progeny. *J Hazard Mater.* 2022; (426): 127815. DOI: 10.1016/j.jhazmat.2021.127815.
- Deng Y, Zhang Y, Lemos B, Ren H. Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure. *Sci Rep.* 2017; (7): 46687. DOI: 10.1038/srep46687.
- Wei Z, Wang Y, Wang S, Xie J, Han Q, Chen M. Comparing the effects of polystyrene microplastics exposure on reproduction and fertility in male and female mice. *Toxicology.* 2022; (465): 153059. DOI: 10.1016/j.tox.2021.153059.
- Lett Z, Hall A, Skidmore S, Alves NJ. Environmental microplastic and nanoplastic: Exposure routes and effects on coagulation and the cardiovascular system. *Environ Pollut.* 2021; (291): 118190. DOI: 10.1016/j.envpol.2021.118190.
- Makarov AL, Beljaev AN. Promyshlennye metody ochistki vody. *StudNet.* 2020; (4): 230–4 (in Rus.).
- Pivokonsky M, Cermakova L, Novotna K, Peer P, Cajthaml T, Janda V. Occurrence of microplastics in raw and treated drinking water. *Sci Total Environ.* 2018; (643): 1644–51. DOI: 10.1016/j.scitotenv.2018.08.102.
- Novotna K, Cermakova L, Pivokonska L, Cajthaml T, Pivokonsky M. Microplastics in drinking water treatment — Current knowledge and research needs. *Sci Total Environ.* 2019; (667): 730–40. DOI: 10.1016/j.scitotenv.2019.02.431.
- Li J, Yang D, Li L, Jabeen K, Shi H. Microplastics in commercial bivalves from China. *Environ Pollut.* 2015; (207): 190–5. DOI: 10.1016/j.envpol.2015.09.018.
- Napper IE, Barrett AC, Thompson RC. The efficiency of devices intended to reduce microfibre release during clothes washing. *Sci Total Environ.* 2020; (738): 140412. DOI: 10.1016/j.scitotenv.2020.140412.
- Du H, Xie Y, Wang J. Microplastic degradation methods and corresponding degradation mechanism: Research status and future perspectives. *J Hazard Mater.* 2021; (418): 126377. DOI: 10.1016/j.jhazmat.2021.126377.
- Prata JC, Castro JL, da Costa JP, Duarte AC, Cerqueira M, Rocha-Santos T. An easy method for processing and identification of natural and synthetic microfibers and microplastics in indoor and outdoor air. *MethodsX.* 2019; (7): 1–9. DOI: 10.1016/j.mex.2019.11.032.
- Koelmans AA, Mohamed Nor NH, Hermesen E, Kooi M, Mintenig SM, De France J. Microplastics in freshwaters and drinking water: Critical review and assessment of data quality. *Water Res.* 2019; (155): 410–22. DOI: 10.1016/j.watres.2019.02.054.

Литература

- Dove A, Elsdon-Baker F, Krause S, Thomson I, Riley J, Hall A, et al. Plastic: A Call to Action. University of Birmingham, 2023; 27 p. URL: <https://www.birmingham.ac.uk/documents/college-eps/plastics/uob-plastic-call-to-action-2023.pdf>.
- Demarquoy J. Microplastics and probiotics: mechanisms of interaction and their consequences for health. *AIMS Microbiol.* 2025; 11 (2): 388–409. DOI: 10.3934/microbiol.2025018.
- United Nations Environment Programme. From Pollution to Solution. A global assessment of marine litter and plastic pollution. Synthesis. Nairobi, 2021; 43 p.
- Maes T, van Diemen de Jel J, Vethaak AD, Desender M, Bendall VA, van Velzen M, et al. You are what you eat, microplastics in Porbeagle Sharks from the North East Atlantic: Method development and analysis in spiral valve content and tissue. *Front Mar Sci.* 2020; (7): 273. DOI: 10.3389/fmars.2020.00273.
- Peng L, Fu D, Qi H, Lan CQ, Yu H, Ge C. Micro- and nano-plastics in marine environment: Source, distribution and threats — A review. *Sci Total Environ.* 2020; (698): 134254. DOI: 10.1016/j.scitotenv.2019.134254.
- Landrigan PJ, Stegeman JJ, Fleming LE, Allemann D, Anderson DM, Backer LC, et al. Human health and ocean pollution. *Ann Glob Health.* 2020; 86 (1): 151. DOI: 10.5334/aogh.2831.
- Яхьяева М. Х., Эргашева И. Ф. Влияние микропластических частиц на организм. *Теория и практика современной науки.* 2022; 10 (88): 197–204.

8. Mason SA, Welch VG, Neratko J. Synthetic polymer contamination in bottled water. *Front Chem.* 2018; (6): 407. DOI: 10.3389/fchem.2018.00407.
9. Kim JS, Lee HJ, Kim SK, Kim HJ. Global pattern of microplastics (MPs) in commercial food-grade salts: sea salt as an indicator of seawater MP pollution. *Environ Sci Technol.* 2018; 52 (21): 12819–28. DOI: 10.1021/acs.est.8b04180.
10. Liebezeit G, Liebezeit E. Non-pollen particulates in honey and sugar. *Food Addit Contam Part A Chem Anal Control Expo Risk Assess.* 2013; 30 (12): 2136–40. DOI: 10.1080/19440049.2013.843025.
11. Duda A, Petka K. The presence of micro- and nanoplastics in food and the estimation of the amount consumed depending on dietary patterns. *Molecules.* 2025; 30 (18): 3666. DOI: 10.3390/molecules30183666.
12. Deng Y, Yan Z, Shen R, Wang M, Huang Y, Ren H, et al. Microplastics release phthalate esters and cause aggravated adverse effects in the mouse gut. *Environ Int.* 2020; (143): 105916. DOI: 10.1016/j.envint.2020.105916.
13. Li T, Yao Z, Huang Y, Li R, Zhang L, Chen R, et al. Chronic waterborne exposure to polystyrene microplastics induces Kupffer cell polarization imbalance and hepatic lipid accumulation. *FASEB J.* 2025; 39 (17): e70980. DOI: 10.1096/fj.202500910RR.
14. Jin Y, Lu L, Tu W, Luo T, Fu Z. Impacts of polystyrene microplastic on the gut barrier, microbiota and metabolism of mice. *Sci Total Environ.* 2019; (649): 308–17. DOI: 10.1016/j.scitotenv.2018.08.353.
15. Prata JC. Airborne microplastics: Consequences to human health? *Environ Pollut.* 2018; (234): 115–26. DOI: 10.1016/j.envpol.2017.11.043.
16. Li X, He E, Chen G, Cao X, Zhao L, Xu X, et al. Intergenerational neurotoxicity of polystyrene nanoplastics in offspring mice is mediated by dysfunctional microbe-gut-brain axis. *Environ Int.* 2024; (192): 109026. DOI: 10.1016/j.envint.2024.109026.
17. Zuri G, Karanasiou A, Lacorte S. Microplastics: Human exposure assessment through air, water, and food. *Environ Int.* 2023; (179): 108150. DOI: 10.1016/j.envint.2023.108150.
18. Jeong B, Baek JY, Koo J, Park S, Ryu YK, Kim KS, et al. Maternal exposure to polystyrene nanoplastics causes brain abnormalities in progeny. *J Hazard Mater.* 2022; (426): 127815. DOI: 10.1016/j.jhazmat.2021.127815.
19. Deng Y, Zhang Y, Lemos B, Ren H. Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure. *Sci Rep.* 2017; (7): 46687. DOI: 10.1038/srep46687.
20. Wei Z, Wang Y, Wang S, Xie J, Han Q, Chen M. Comparing the effects of polystyrene microplastics exposure on reproduction and fertility in male and female mice. *Toxicology.* 2022; (465): 153059. DOI: 10.1016/j.tox.2021.153059.
21. Lett Z, Hall A, Skidmore S, Alves NJ. Environmental microplastic and nanoplastic: Exposure routes and effects on coagulation and the cardiovascular system. *Environ Pollut.* 2021; (291): 118190. DOI: 10.1016/j.envpol.2021.118190.
22. Макаров А. Л., Беляев А. Н. Промышленные методы очистки воды. *StudNet.* 2020; (4): 230–4.
23. Pivokonsky M, Cermakova L, Novotna K, Peer P, Cajthaml T, Janda V. Occurrence of microplastics in raw and treated drinking water. *Sci Total Environ.* 2018; (643): 1644–51. DOI: 10.1016/j.scitotenv.2018.08.102.
24. Novotna K, Cermakova L, Pivokonska L, Cajthaml T, Pivokonsky M. Microplastics in drinking water treatment — Current knowledge and research needs. *Sci Total Environ.* 2019; (667): 730–40. DOI: 10.1016/j.scitotenv.2019.02.431.
25. Li J, Yang D, Li L, Jabeen K, Shi H. Microplastics in commercial bivalves from China. *Environ Pollut.* 2015; (207): 190–5. DOI: 10.1016/j.envpol.2015.09.018.
26. Napper IE, Barrett AC, Thompson RC. The efficiency of devices intended to reduce microfibre release during clothes washing. *Sci Total Environ.* 2020; (738): 140412. DOI: 10.1016/j.scitotenv.2020.140412.
27. Du H, Xie Y, Wang J. Microplastic degradation methods and corresponding degradation mechanism: Research status and future perspectives. *J Hazard Mater.* 2021; (418): 126377. DOI: 10.1016/j.jhazmat.2021.126377.
28. Prata JC, Castro JL, da Costa JP, Duarte AC, Cerqueira M, Rocha-Santos T. An easy method for processing and identification of natural and synthetic microfibers and microplastics in indoor and outdoor air. *MethodsX.* 2019; (7): 1–9. DOI: 10.1016/j.mex.2019.11.032.
29. Koelmans AA, Mohamed Nor NH, Hermesen E, Kooi M, Mintenig SM, De France J. Microplastics in freshwaters and drinking water: Critical review and assessment of data quality. *Water Res.* 2019; (155): 410–22. DOI: 10.1016/j.watres.2019.02.054.