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IMPACT OF LIFE ACTIVITY IN CONDITIONS OF DIGITAL ENVIRONMENT ON THE STUDENTS' ORGAN OF SIGHT

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The growth of eye disease incidence in the juvenile population amidst increasing visual load, which, among other factors, results from the use of electronic devices (ED), outlines the search for effective preventive measures, geared towards preservation of health of young people. The study was aimed to assess the impact of life activity upon exposure to digital environment on the organ of sight in schoolchildren and college students. The study was carried out in 2017–2020 at Dolgoprudny gymnasium and Pirogov Russian National Research Medical University. A total of 805 schoolchildren and college students underwent ophthalmologic examination. Accommodative response was registered with Speedy-K Ver. MF-1 autorefractor keratometer (Japan). A standardized questionnaire, tailored by the authors to meet the requirements of the study, was used to assess the regime for the use of ED by students. Inclusion criteria: schoolchild, college student, ophthalmologic examination data and submitted informed consent available, correctly completed questionnaire. Statistical processing was performed using the Statistica 13.0 software. All students were the ED owners. Only 9.9% of primary school students, 2.7% of secondary school students, 1.9% of senior secondary school students, and 0.9% of college students did not use ED every day. Significant negative correlation was revealed between the students' vision acuity and the daily total time of using the ED, as well as the duration of the ED continuous use ($p \leq 0.05$). Accommodation weakness was detected in 88.76% of students with early stage of myopia; accommodative response close to normal was less common (11.24%). The increase in daily total time of using the ED by 2 hours and more results in higher prevalence of functional vision problems ($p \leq 0.05$), and the trend of increasing the number of high myopia cases. The data obtained define the need of improving the students' hygiene training starting from the preschool age.

Keywords: schoolchildren, students, electronic devices, diseases of the eye, an accommodative response.

Author contribution: Obrubov SA — academic advising, data acquisition, literature analysis; Markelova SV — data acquisition, statistical processing, literature analysis, manuscript writing.

Compliance with ethical standards: the study was approved by the Ethics Committee of Pirogov Russian National Research Medical University (protocol No. 159 dated November 21, 2016). The informed consent was obtained for all the participants. The study met the requirements of biomedical ethics and involved no risk to participants.

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ВЛИЯНИЕ ЖИЗНЕДЕЯТЕЛЬНОСТИ В УСЛОВИЯХ ЦИФРОВОЙ СРЕДЫ НА СОСТОЯНИЕ ОРГАНА ЗРЕНИЯ ОБУЧАЮЩИХСЯ

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Рост пораженности детского населения болезнями глаза на фоне увеличения зрительной нагрузки, обусловленной, в том числе использованием электронных устройств (ЭУ), определяет поиск эффективных мер профилактики, направленных на сохранение здоровья молодежи. Цель исследования — изучение влияния жизнедеятельности в условиях цифровой среды на состояние органа зрения школьников и студентов. Исследование выполнено в период 2017–2020 гг. на базе Долгопрудненской гимназии и РНИМУ им. Н. И. Пирогова. Проведен офтальмологический осмотр 805 школьников и студентов. Регистрацию аккомодационного ответа проводили с помощью автоматического аккомодографа Speedy-KverMF-1 (Япония). Для изучения режима использования ЭУ обучающимися применен стандартизованный опросник, адаптированный авторами для целей исследования. Критерии включения: школьник, студент, наличие офтальмологического осмотра и подписанного информированного согласия, корректно заполненный опросник. Статистическая обработка проведена посредством Statistica 13.0. Все учащиеся имеют ЭУ. Используют ЭУ не каждый день только 9,9% младших школьников, 2,7% учащихся средней школы, 1,9% старшеклассников, 0,9% студентов. Выявлены значимые отрицательные показатели коэффициентов корреляции между остротой зрения обучающихся и дневным суммарным временем использования ЭУ в течение дня, продолжительностью их непрерывного использования ($p \leq 0,05$). У обучающихся с начальной близорукостью слабость аккомодации отмечалась в 88,76% случаев, реже (11,24%) выявлялся аккомодационный ответ, приближающийся к нормальным показателям. Увеличение дневного суммарного времени использования ЭУ первоклассниками 2 часа и более вызывает увеличение распространенности функциональных заболеваний глаза ($p \leq 0,05$) и тенденцию к увеличению числа миопии высокой степени. Полученные данные определяют необходимость совершенствования приемов гигиенического воспитания обучающихся, начиная с дошкольного периода.

Ключевые слова: школьники, студенты, электронные устройства, болезни глаза, аккомодационный ответ.

Вклад авторов: Обрубов С. А. — научное руководство, сбор материала, анализ литературы; Маркелова С. В. — сбор материала, статистическая обработка, анализ литературы, написание статьи.

Соблюдение этических стандартов: Данное исследование было одобрено ЛЭК РНИМУ им. Н. И. Пирогова (Протокол № 159 от 21.11.2016 года). Добровольное информированное согласие было получено для каждого участника. Исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников.

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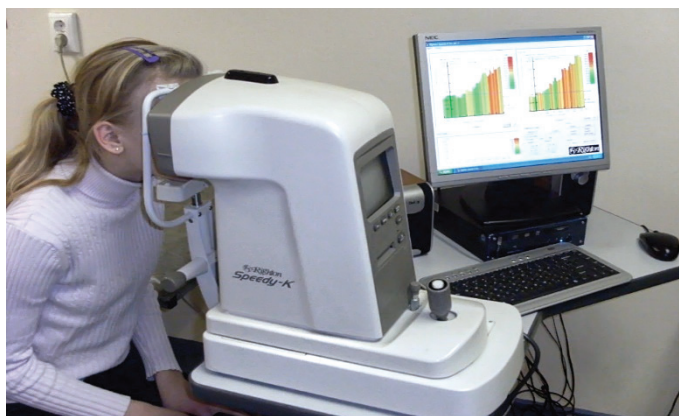


Fig. 1. Accommodative response assessment with the Speedy-K Ver. MF-1 autorefractor keratometer (Japan)

The rapidly growing usage of Internet technologies, including among children, adolescents and youth, together with younger age of users and increased duration of the Internet use by young people, were noted in the UNICEF Annual Report 2017 [1].

Digital environment substantially changes childhood and adolescence due to its contribution to many social processes (acquiring information and education, communication and maintaining social ties, entertainment and leisure activities, engagement with society and lifestyle) [2–8].

However, it is important to note the declining health of the juvenile population, especially the visual organ health. This gives relevance to development of preventive measures that would reduce adverse effects of digital environment on the health of younger generation [9, 10].

The study was aimed to assess the impact of life activity upon exposure to digital environment on the organ of sight in schoolchildren and college students.

METHODS

The study was carried out at Dolgoprudny gymnasium (Moscow Region) and Pirogov Russian National Research Medical University in 2017–2020. A total of 805 schoolchildren and college students underwent ophthalmologic examination (150 primary school students, 130 secondary school students, 200 senior secondary school students, 325 college students).

Visual acuity was assessed using the Golovin-Sivtsev table inserted in the Roth apparatus. The assessment results were presented in the following format: $Vis^{nD}_{correction}$ (OD=..., OS=...). Malinovsky test was performed [11, 12].

Accommodative response was registered with the Speedy-K Ver. MF-1 autorefractor keratometer (Japan) (Fig. 1). Monocular vision was tested. Visual stimuli were presented to patient at varying distances from the eye (from infinity to 20 cm), and refractive state was determined. Then the stimulus with this refraction value was presented (conditions for emmetropia were established). Later refraction of the stimulus was increased stepwise by 0.5 D: –0.5 D, –1.0 D, –1.5 D, –2.0 D, etc. (up to –5.0 D). Refractometer measured eye refraction amidst visual load applied many times during the study, and the data obtained went into computer to be processed and displayed in the form of diagrams. Indicators (coefficients) that characterized the ciliary muscle function were evaluated for quantification and comparative evaluation of dynamic changes in accommodography. Coefficients were calculated in the automatic mode using the specially designed software. Accommodative response coefficient reflects the degree of ciliary muscle tension. It depends on the ratio between the accommodative response

and the accommodative stimulus at each “stage” of the study. Growth (decrease) in the accommodography was evaluated using the accommodography growth coefficient. Coefficient of microfluctuations is the coefficient of high frequency ciliary muscle microfluctuations [13].

The questionnaire, developed by specialists from the Research Institute of Hygiene and Health Protection of Children and Adolescents, used in multicenter studies aimed at providing medically safe digital technologies to children, was used as a basis and tailored to meet the requirements of the study reported. All authors had the following practitioner certificates: “Hygiene of Children and Adolescents”, “Ophthalmology”. The inclusion criteria were as follows: schoolchild, college student, informed consent submitted, ophthalmologic examination data available, questionnaire, correctly completed by the respondent or his/her legal representative. Exclusion criteria: different age group, no ophthalmologic examination data available, no correctly completed questionnaire. Correlation analysis was used to define the nature of the relationship between the students’ visual acuity and their daily total time of using the ED, as well as the duration of the ED continuous use ($p \leq 0.05$).

The study involved no risk to participants and met the requirements of biomedical ethics and the Declaration of Helsinki (1983). The study was approved by the Ethics Committee of Pirogov Russian National Research Medical University (protocol No. 159 dated November 21, 2016).

Statistical processing of the data was performed using the Statistica 13.0 software package.

RESULTS

No schoolchildren and college students not using electronic devices were found. Only 9.9% of primary school students, 2.7% of secondary school students, 1.9% of senior secondary school students, and 0.9% of college students did not use electronic devices every day. The students use stationary (personal computer, laptop) and mobile (smartphone, tablet) devices on a daily basis both during school day and during holidays.

Daily total time of using all electronic devices by children, adolescents and youth during school day and during holidays is presented in Table 1.

High daily total time values of using the ED both during the school day and during holidays were obtained for all categories of respondents.

During the period of study, the daily total time of using the ED (both in educational and leisure activities) was about 2.0 hours in primary school students, 5.5 hours in secondary school

students, 8.0 hours in senior secondary school students, and 11.0 hours in college students.

During holidays, the daily total time of using the ED by primary school and secondary school students increased by an average of 0.8–1.3 hours and accounted for 2.8–3.3 hours. In senior secondary school students and college students, the daily total time of using the ED increased by an average of 1.7–3.7 hours ($p \leq 0.05$).

When studying the students' organ of sight by computed accomodography, it was found that ciliary muscle insufficiency (weakness) was the most common accommodative state, which was in line with the data reported in literature [14].

Accommodation weakness was detected in 88.76% of students with early stages of myopia (Fig. 2). Accommodative response close to normal was less common (11.24%) (Fig. 3).

The values of accommodative response obtained in schoolchildren with initial stages of myopia suggest poor blood circulation in long posterior ciliary arteries [15].

The relationship between the students' visual organ condition and the daily total time of using stationary and mobile electronic devices during the school day and during holidays is presented in Table 2.

Significant negative correlations were revealed between the students' visual acuity and the daily total time of using the ED, as well as the duration of the stationary and mobile electronic devices continuous use ($p \leq 0.05$) [16].

It is shown, that with the first graders daily total time of using the ED increased by 2 hours and more, a significant decrease in a number of individuals with functional or chronic eye problems among them is observed. The prevalence of accommodative problems is increased ($p \leq 0.05$), and the trend of increasing the number of high myopia cases is noted (Fig. 4).

DISCUSSION

Active development of the electronic industry over the past few decades has resulted in wide use of electronic devices, including by students in their life activities. Our findings illustrate the use of various ED types by the absolute majority of students, frequent and long-term use of ED by children, adolescents and youth during their studies, and increased visual load during holidays. The relationship between the increased duration of the stationary and mobile electronic devices continuous use, daily total time of using the ED and reduced visual acuity,

Table 1. Students' daily total time of using electronic devices during the school day and during holidays, M±m, min.

Students	Daily total time of using the electronic device	
	During the school day	During holidays
Primary school students	109.5±24.0	154.9±27.0
Secondary school students	315.9±50.0	393.3±60.0
Senior secondary school students	485.5±30.0	709.8±35.0*
College students	663.2±17.0	767.1±19.0*

Note: * — $p \leq 0.05$

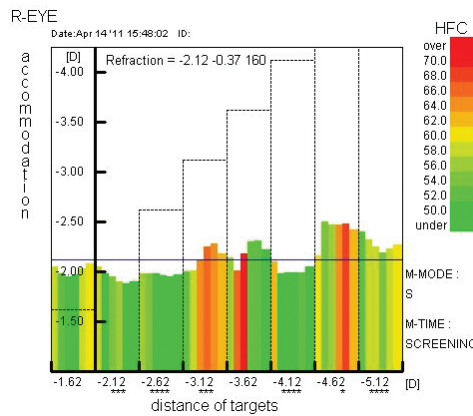


Fig. 2. Computed accomodography of the child with weak accommodation

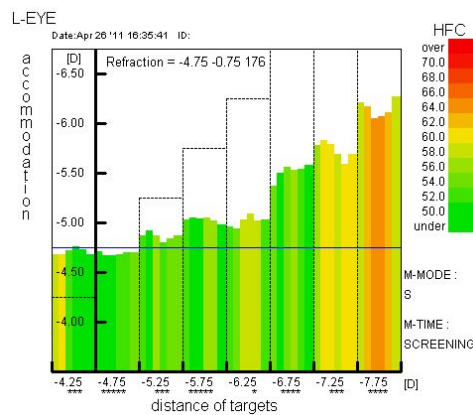
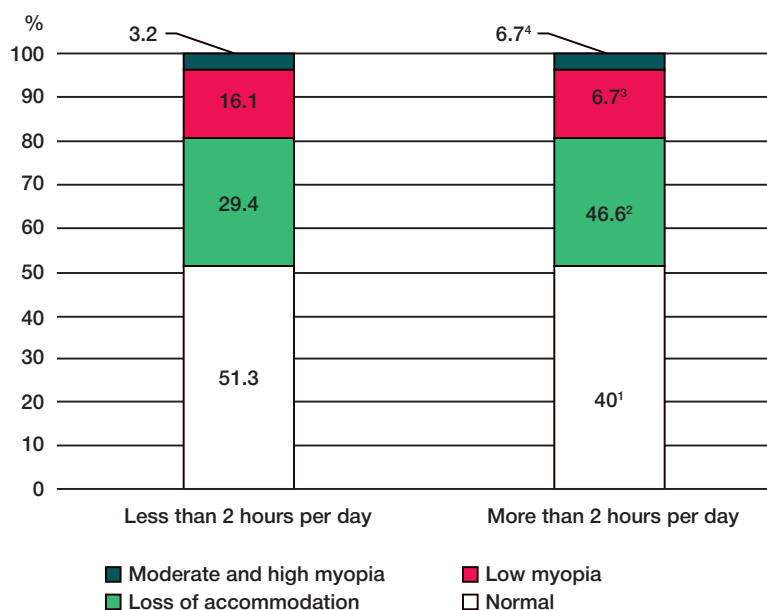


Fig. 3. Computed accomodography of the healthy child

Table 2. Relationship between the students' visual acuity and the time of using stationary and mobile electronic devices, R*

Time of using electronic devices	OD	OS
Daily total time of using		
personal computer	-0.74	-0.65
mobile electronic devices	-0.58	-0.57
Duration of the electronic device continuous use		
during the school day	-0.87	-0.81
during holidays	-0.71	-0.60

Note:* — $p \leq 0,05$ 

Note: 1 — $p \leq 0.05$ — number of first graders with normal vision;
 2 — $p \leq 0.05$ — number of first graders with the loss of accommodation;
 3 — $p \leq 0.05$ — number of first graders with low myopia;
 4 — $p \leq 0.05$ — number of first graders with moderate and high myopia.

Fig. 4. Diseases of the eye and adnexa in first graders depending on the daily total time of using the stationary and mobile electronic devices in educational and leisure activities, 2020, %

increased prevalence of functional problems and chronic eye diseases in students had been established.

The long-term effects of using the electronic devices remain unknown. However, various short-term effects on the organ of sight, such as dry eye, burning eye, redness, blurry vision, floaters and diplopia, resulting from the use of ED, are often reported both in domestic and foreign literature sources [17, 18].

This group of symptoms is known as computer vision syndrome, which can affect the users of both stationary and mobile electronic devices. According to some reports, this syndrome affects 40% of office workers, "spending at least half of their time in the office" [19].

The relationship between the organ of sight disorders and the electronic device use duration was noted by some other authors. Thus, the relationship between using the smartphone by adolescents for over 2 hours per day more than doubled the number of complaints of pain and dry eyes [20].

The symptoms listed above do not last and vanish on cessation of using the ED [21].

A whole range of measures has been developed for prevention of such organ of sight disorders. However, children, adolescents and youth show low level of awareness of the issue, and, therefore, does not acquire skills of safe ED use, which adversely affects their health, i.e. the organ of sight health, compromises their quality of life and reduces their effectiveness [22].

Such organ of sight disorders may result from impaired function of accommodation system. The condition of the accommodation system affects dynamic refraction, which in turn affects central vision. Underestimation of the role of accommodation in the development of a number of disorders may leave the students unaided and limit their visual performance at any age. Enhanced accommodation associated with the long-term use of electronic devices in children can promote postnatal growth of eyeballs and increased eye refraction. Weak accommodation precedes myopia, is considered the first sign of myopia, and accompanies the clinical course of myopia [15].

We believe that the accommodative dysfunction revealed may be due to dysregulation of the ciliary muscle function resulting from altered vegetative processes, which leads to hemodynamic changes in the ocular circulation due not only to mechanical stretching of the sclera, but also to unbalanced vascular tone neurogenic regulation [23].

Moreover, changes in choroidal perfusion can also be the probable cause of myopia progression in schoolchildren. It can be assumed that in case of increased choroidal perfusion choroid can become the source of excessive retinoid levels (retinoic acid, RA), which are unused in the biochemical reactions in the retina of individuals with myopia, and are accumulated in the known receptors of the sclera, being the closest structure [24–26].

RA accumulation in the sclera results in altered proliferation and differentiation of fibroblasts [27].

Further development of research in this field could contribute to eye protection in children, adolescents and youth in the context of exposure to digital environment [28–30].

CONCLUSION

Wide use of electronic devices by children, adolescents and youth against the background of increased incidence of the diseases of the eye and adnexa is of deep concern to ophthalmologists and hygienists. Studying the organ of sight disorders' pathogenesis and the revealed negative correlation between the students' visual acuity and the duration of continuous use and

total daily use of the electronic devices indicate that there are some manageable risk factors, that contribute to development of this pathology. Under these circumstances, hygiene training for students aimed at acquiring knowledge and skills of safe electronic device use in the context of digital environment, as well as evolving commitment to healthy lifestyle during studies, during holidays and throughout the lifespan, should be one of the top priorities in preventive work at the current stage. Taking into account the early experience of using the ED, and the need for their use for education, preventive work should start at pre-school age, and hygiene training should reach not only students, but also their parents, educators and teachers. The students' engagement with ED as a part of educational programme should comply strictly with the hygiene requirements.

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GENDER FEATURES OF THE PHYSICAL STATE OF MEDICAL UNIVERSITY PROFESSORS OF PRE-RETIREMENT AND RETIREMENT AGE

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In the past few years, the number of elderly people has been growing in Russia. Every fifth retired person does not resign and continues to work. The situation with employees that have already reached the retirement age is distinctly special in the country's higher education establishments. Therefore, the task of studying the peculiarities of health of higher school professors that have already passed the retirement age threshold or are approaching it is an urgent one, the purpose of such a study being prolongation of the "healthy old age". It is necessary to factor in gender specifics, since, according to the statistics, men run greater risks of developing chronic non-communicable diseases than women. The purpose of this study was to investigate the gender-related peculiarities of the physical condition and the rate of aging of medical university professors of pre-retirement and retirement age with the aim to develop measures enabling such employees to maintain a high level of working efficiency. The study involved 169 teachers aged 55–70. A set of anthropometric measurements was taken. The participants had their blood pressure measured, level of physical condition and their adaptive potential assessed. The rate of aging and biological age were calculated for all the participants with the help of AG Gorelkin and BB Pinkhasov's formulas. The study revealed significant differences in most morpho-functional status indicators signaling of the greater cardiovascular system disease risks run by male teachers compared with their female peers. However, female participants presented significantly more cases of obesity, which explains the revealed differences in the rate of aging that was higher among women.

Key words: physical state, retirement age, university teachers, gender characteristics.

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Compliance with ethical standards: All the participating professors enrolled voluntarily and signed an informed consent before being included in the study.

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ГЕНДЕРНЫЕ ОСОБЕННОСТИ ФИЗИЧЕСКОГО СОСТОЯНИЯ ПРЕПОДАВАТЕЛЕЙ МЕДИЦИНСКОГО ВУЗА ПРЕДПЕНСИОННОГО И ПЕНСИОННОГО ВОЗРАСТА

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В последние годы в России наблюдается рост числа лиц пожилого возраста. Каждый пятый пенсионер продолжает работать. Особая ситуация с работающими пенсионерами в вузах страны. В связи с этим актуальна задача изучения особенностей здоровья преподавателей предпенсионного и пенсионного возраста с целью продления «здоровой старости». Необходимо учитывать и гендерные различия, так как согласно статистике среди мужчин распространенность факторов риска развития хронических неинфекционных заболеваний выше, чем среди женщин. Цель исследования: изучить гендерные особенности физического состояния и коэффициента скорости старения преподавателей предпенсионного и пенсионного возраста медицинского вуза для разработки мероприятий по сохранению высокого уровня работоспособности данного контингента работающих. В исследовании приняли участие 169 преподавателей 55–70 лет. Осуществлен комплекс антропометрических измерений. Проведены измерение артериального давления, оценка уровня физического состояния обследуемых и адаптационного потенциала. Для всех участников рассчитаны коэффициент скорости старения и биологический возраст по формулам А. Г. Горелкина и Б. Б. Пинхасова. В результате исследования выявлены достоверные различия по большинству показателей морфо-функционального статуса, представляющих риск развития заболеваний сердечно-сосудистой системы у преподавателей мужского пола по сравнению с женщинами. Однако среди преподавателей женского пола выявлено достоверно больше случаев ожирения, что объясняет выявленные различия по коэффициенту скорости старения, который оказался выше среди женщин.

Ключевые слова: физическое состояние, пенсионный возраст, преподаватели вуза, гендерные особенности.

Key words: physical state, retirement age, university teachers, gender characteristics.

Вклад авторов: Латышевская Н. И. — анализ литературы, планирование исследования, интерпретация данных, подготовка черновика рукописи; Беляева А. В. — анализ литературы, планирование исследования, сбор данных, анализ данных, интерпретация данных, подготовка черновика рукописи; Ковалева М. Д. — планирование исследования, сбор данных; Левченко Н. В. — сбор данных, анализ данных, интерпретация данных.

Соблюдение этических стандартов: Участие преподавателей было добровольным, все обследуемые подписали информированное согласие перед включением в исследование.

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Today, the older generation is the most rapidly growing population in the world. With the life expectancy in the Russian Federation increasing, the process of demographic aging has accelerated, i.e. the share of elderly and old people in the country's population grows larger every year. There economic, social and political aspects to this problem. It is one of the global challenges of our time [1].

At the same time, according to a number of foreign and Russian authors, elderly people represent a significant labor resource [2]. Today, every fifth retired person in Russia continues to work. The situation with employees that have already reached the retirement age is distinctly special in the country's higher education establishments. There, over the past two decades, the share of young professors (up to 30 years old) has increased from 9.6 to 14.4%, the groups of professors aged 30 to 39 and 40 to 49 have shrunk from 32–33% to 18–20%, and the group of those 50 to 59 years old remained stable (18.1–20.2%). The largest group is that which includes professors aged 60 and older (27.7%). The most dynamic age group is comprised of people over 65: over a decade and a half, their share has increased 2.6 times [2]. The more extended the job description and the list of qualifications, the older (on average) the members of the social and professional group (doctors of sciences, academics). The work of higher school professors is associated with a high level of responsibility, large volumes and unevenness of incoming information, physical inactivity, often — irrational organization [3, 4].

The increase of the retirement age added urgency to the matter of development of a system of measures to preserve and strengthen the professional health of workers as a factor in ensuring their professional longevity.

According to the statistics, men run greater risks of developing chronic non-communicable diseases than women. Moreover, compared to Russian women, Russian men have a greater disease burden, and this discrepancy is the most pronounced in the world [1, 5, 6].

Therefore, the task of studying the peculiarities of health of higher school professors that have already passed the retirement age threshold or are approaching seems to be an urgent one, the purpose of such a study being prolongation of the "healthy old age".

PURPOSE OF THE STUDY

Investigate the gender-related peculiarities of the physical condition and the rate of aging of medical university professors of pre-retirement and retirement age with the aim to develop measures enabling such employees to maintain a high level of working efficiency.

MATERIALS AND METHODS

The study involved 169 professors from theoretical departments of the Volgograd State Medical University (87 women and 82 men), aged 55 to 70, all having the same teaching load. All the participants enrolled voluntarily and signed the informed consent before being included in the study.

A set of anthropometric measurements was taken. The participants' height was measured without shoes and outerwear, with the help of the height meter (accuracy of 1 cm); body weight (BW) measurements relied on the medical floor scales (accuracy of 100 g). Waist circumference (WC) was measured with a centimeter tape (accuracy of 0.5 cm) when the participants were standing, midway between the edge of

the costal arch and the edge of the iliac crest on both sides of the lateral surface of the trunk. The BW was evaluated in the categories of the Quetelet index (BMI — body weight (kg) / height (m) ²). According to the WHO classification (1997, 2003), in the context of BMI, BW can be insufficient (BMI<18.5), normal (18.5≤BMI≤24.9), excessive (25.0≤BMI≤29.9), and there are three degrees of obesity: I degree (30.0≤BMI≤34.9), II degree (35.0≤BMI≤39.9) and III degree (BMI>40). As for the abdominal obesity (AO) it was registered based on the WC values, ≥94 cm and ≥80 cm for male and female participants, respectively [7].

Blood pressure (BP) was measured twice, on the right arm, with the participant sitting, using an automatic tonometer. The average BP was calculated from the two measurements. Those with BP above 140/90 mm Hg and/or taking antihypertensive drugs (AHD) constituted the arterial hypertension (AH) group [6]. We assessed the physical condition (PC) of the participants, which reflects the degree of resistance of their bodies to adverse external factors, and their adaptive potential (AP), which shows the intensity of the adaptive reactions [8].

Assessment of the participants' physical condition (body resistance to adverse external factors) and their adaptive potential (intensity of the adaptive reactions) [8]. A. G. Gorelkin and B. B. Pinkhasov's formulas [9] enabled calculation of the rate of aging and biological age of all the participants.

Microsoft Excel and Statistica 6.0 were used to statistically process the data. Student's t-test allowed determining the significance of the differences. The differences were considered significant at p<0.05. Spearman's rank correlation coefficient was used to determine the relationship between the indicators.

RESULTS

Anthropometric measurements showed that female professors had a body weight within the normal range 2.2 times more often (63.2% versus 28.0%, p<0.001). Excess body weight was registered in 59.7% of men and 3.4% of women, moderate obesity — in 12.2% of male participants and 33.3% of their female counterparts (p <0.001). Waist circumference higher than normal according to the current WHO standards was found in 93.1–95.1% of the participants, which indicates they are developing abdominal obesity. At the time of measurements, 24.1% of women and 36.6% of men had the blood pressure above 140/90. That said, almost all male professors stated they were diagnosed with hypertension and are observing the therapeutic instructions given by their doctors earlier. However, these participants have also admitted that they had not been through a routine examination for a long time and probably the mentioned instructions require adjustments.

In 67.1% of men and 22.9% of women, the registered level of physical condition was low (p <0.001). A high level thereof (28.7%, p<0.001) was peculiar to female participants only.

The assessment of the body's adaptive potential has revealed that not a single participant of the study has sufficient functional capabilities to adapt to the changing environmental factors (satisfactory adaptation). Every third woman and every second man had their adaptation capabilities assessed as unsatisfactory (p<0.05).

The normal rate of aging was observed in 25.3% of women and 7.3% of men (p<0.05), while 16.1 and 12.1%,

respectively, were aging at an accelerated rate. However, 58.6% of female participants and 80.5% of their male counterparts are aging at a slow rate ($p < 0.01$). As for the biological and chronological age correlation, 68.9% of women and 87.8% of men were biologically younger than chronologically ($p < 0.01$). We also assessed the relations between the body weight and the aging rate coefficient values. The correlation ratio was 0.900 for men and 0.875 for women, which signals of a strong direct correlation between the body weight and the rate at which the body ages, this rate registered higher in female professors.

DISCUSSION OF THE RESULTS

Analysis of the data obtained showed that gender affects values of most indicators significantly. In this context, body mass index is the one that should be considered before all the other. Throughout the world, overweight and obesity are among the significant risk factors raising the rate of mortality associated with noncommunicable chronic diseases [3]. In our study, 72.0% of male participants and 36.8% of female participants were registered as overweight and/or obese. In their publications, Martynchik A. N. et al. [5] note that in the recent years male obesity has been diagnosed significantly more often, female obesity less so. At the same time, female professors of pre-retirement and retirement age suffer from obesity twice as often as their male colleagues, which is consistent with the general Russian population data — 30.8% versus 26.9%, $p < 0.001$ [7]. Waist circumference is a unique marker of adipose tissue distribution and an indicator of high cardiometabolic risk [10]. According to the WHO [11], waist circumference above ≥ 94 cm in men and ≥ 80 cm in women means a risk of developing arterial hypertension, coronary heart disease and other diseases of the cardiovascular system. In our study, 95.1% of men and 93.1% of women had their WC measuring more than the stated values, i.e., they suffered from abdominal obesity. We have also discovered a strong direct correlation between body weight and body aging rate, and it was found to be higher in women, which,

in our opinion, may be associated with a higher prevalence of obesity among them.

The gender-specific differences in blood pressure levels that we identified confirm the data of a number of studies on the prevalence of this factor among male individuals, even when they take AHD [6, 10]. V. Malinauskienė et al. [12] proved there is a relationship between work-related stress among professors and CVD. The results of our survey showed that more than 70% of the respondents were diagnosed with hypertension, and “coronary heart disease” was the diagnosis announced to every third man and every seventh woman ($p < 0.05$). At the same time, only 28.0% of male respondents suffering a chronic pathology take medications as prescribed by their doctors to support the cardiovascular system, while all female participants never fail to strictly follow the therapeutic instructions.

In terms of physical condition and adaptive potential, male professors demonstrated significantly lower functional capabilities compared to their female counterparts.

CONCLUSIONS

We have discovered significant gender-dependent differences in a number of values of morpho-functional status indicators (body weight, waist circumference, physical condition, etc.) that signal of the risk of development of such diseases as arterial hypertension, coronary heart disease and other diseases of the cardiovascular system. At the same time, the overwhelming majority of male professors with a chronic cardiovascular pathology do not follow instructions given by their doctors or have not had them adjusted for a long time. However, female participants presented significantly more cases of obesity, which explains the revealed differences in the rate of aging that was higher among women.

Thus, the results of our study support the need for a system of measures aimed at preservation of health and improvement of working efficiency of elderly medical university professors, such a system promoting rational nutrition, physical activity and timely prevention of development of chronic pathologies.

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P4 MEDICINE AS A TOOL FOR STIMULATING HEALTHY LIFESTYLE AND THE BASIS OF TEACHING PREVENTION TO STUDENTS OF GENERAL MEDICINE AND PEDIATRICS

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This article focuses on approaches to implementing the principles of P4 medicine, specifically, stimulating prevention-based thinking among students of faculties of general medicine and pediatrics. Below, we describe a pilot approach to teaching hygiene that was implemented at the Department of General Hygiene (Kazan State Medical University). Considering the gnoseological role of empathy, we designed an interactive workbook for students taking a course in Hygiene. The workbook allows the student to engage in empathic interactions and discourse about the studied subject with the teacher and peers. After the course, the students were surveyed; their degree of engagement in the learning process and their expectations were evaluated. The respondents rated their interest in Hygiene before starting the course as 5.6 and 5.7 points on the 10-point scale (for the traditional and innovative courses, respectively). During the course, the score increased to 5.8 and 8.6 points for the traditional and innovative courses, respectively. Our pilot project demonstrates the need for reviewing the strategy of teaching hygiene and prevention-related disciplines at clinical faculties and including the principles of P4 medicine in the medical curriculum, thus allowing the student to effectively perform their professional duties in primary healthcare.

Key words: P4 Medicine principles, hygienic thinking, preventative counseling, coaching technologies, a unified preventative medicine environment in Russian Federation, professional standards, position requirements.

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«4-П МЕДИЦИНА» КАК ИНСТРУМЕНТ ФОРМИРОВАНИЯ ЗДОРОВОГО ОБРАЗА ЖИЗНИ У НАСЕЛЕНИЯ И ОСНОВА ПРЕПОДАВАНИЯ ГИГИЕНЫ СТУДЕНТАМ ЛЕЧЕБНОГО И ПЕДИАТРИЧЕСКОГО ПРОФИЛЯ

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Разработка подходов реализации принципов «4-П медицины» в формировании профилактического мышления у студентов лечебного и педиатрического факультетов при изучении дисциплины «Гигиена». Пилотный подход к преподаванию дисциплины «Гигиена», реализованный на кафедре общей гигиены Казанского государственного медицинского университета. Руководствуясь гносеологическим значением эмпатии, мы разработали интерактивную тетрадь для изучения дисциплины «Гигиена», работая по которой, студент включается в эмпатийно-дискурсивное взаимодействие с собеседником (преподаватель и/или студенты) по изучаемой тематике. По итогам использования данного подхода мы провели социологический опрос среди студентов с целью определения степени вовлеченности в процесс обучения и оценки их ожиданий. В результате исследования было установлено, что средняя оценка (по 10-ти бальной шкале) заинтересованности студентов в изучении «Гигиены» до начала обучения на кафедре составила: у обучающихся по традиционной программе — 5,6 баллов, у обучающихся по инновационной программе — 5,7 баллов. Свою заинтересованность в изучении дисциплины в процессе обучения на кафедре оценили: обучающиеся по традиционной программе — в 5,8 баллов, обучающиеся по инновационной программе — 8,6 баллов. Реализуемый пилотный проект на базе кафедры общей гигиены Казанского ГМУ наглядно показывает необходимость пересмотра преподавания дисциплины «Гигиена» на клинических факультетах с обязательным включением в учебный процесс принципов «4-П медицины», что позволит будущему врачу более эффективно выстраивать профессиональную деятельность в условиях оказания первичной медико-санитарной помощи населению.

Ключевые слова: принципы «4-П медицины», гигиеническое мышление, профилактическое консультирование, коучинг-технологии, единая профилактическая среда Российской Федерации, профессиональные стандарты, трудовые функции.

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P4 medicine is a modern approach to healthcare that is preventive, predictive, personalized and participatory. This healthcare model focuses on the individual, is based on the preclinical detection of the disease, prioritizes prevention and active participation of the patient in changing their lifestyle [1].

The state-funded program *Healthcare Development in the Russian Federation* emphasizes the importance of prevention as one of the key strategic directions to curb the spread of diseases, reduce premature mortality and morbidity [2, 3].

At the same time, approaches to creating a consolidated healthcare environment with a focus on prevention address a few critical perspectives from the patient and the healthcare provider, including:

- lack of critical thinking skills among the population, which makes it difficult to critically analyze information about lifestyles;
- varying levels of media and information literacy (MIL);
- unconscious motives that prevent the individual from leading a healthy lifestyle (unmet needs, low income, lack of knowledge or skills, personality traits);
- the imperfect quality control mechanism for open-access medical information on the Internet;
- lack of P4 educational programs and P4 clinicians;
- unfulfilled preventive potential of the Russian healthcare system;
- lack of scientifically established reference ranges of rational lifestyles for diseased persons, including cancer patients.

These key points dictate the need for P4-oriented physicians with preventive thinking.

Federal educational standards for specialties 31.05.01 (General medicine) and 31.05.02 (Pediatrics) provide a list of universal and general professional competencies that are based on professional standards and include consultation and motivational skills to encourage the patient to change their lifestyle.

A competency-based approach is an opportunity to introduce original teaching methods to a syllabus. Educational institutions can exercise a certain degree of freedom in designing a curriculum. Thus, they comply with federal educational standards set by the state and at the same time promote ideas of developmental teaching.

It should be noted that boundaries are somewhat blurred between education and mentoring, health improving practices and personal development, social and pedagogical influences and psychotherapy [4]. This underscores the need for clear-cut pedagogical, social and psychology-related content in medical educational curricula and requires certain pedagogical skills from clinicians.

Interactive teaching helps to effectively apply theoretical knowledge and personal experience when solving diagnostic tasks [5, 6, 7, 8] and fosters clinical thinking [9, 10]. It can be broken down in 2 components: a specific component that includes medical knowledge and skills and a non-specific (logical) component that pertains to productive thinking.

According to the literature review of interactive teaching methods commonly used in teaching hygiene/prevention-related disciplines at the faculties of general medicine and pediatrics, the most popular methods are teaching in small groups, discussions, case studies and multimedia presentations [11, 12, 13, 14, 15, 16].

Vvedensky AI writes that interactive teaching facilitates cooperative learning, allowing students to assimilate new knowledge, acquire new competencies, pay heed to the opinion of their opponent and work out a decision together

[17]. Teaching in small groups, multimedia presentations and didactic teaching methods are used to teach about sanitary inspections of educational institutions; the case study method is used to analyze factual data provided by the local branches of Rospotrebnadzor [18, 19].

Another widely used teaching method is a simulation game [20], which involves improvised modeling of activities commonly performed by a specific group and simulation of problems that may arise during such activities.

Cinquain poems and on-online crossword puzzles are much rarer. A team of researchers [21] has proposed a few unique productive out-of-class activities based on the *Pedagogical workshop for knowledge building* and *Critical thinking* technologies that create a favorable learning atmosphere, help students to build research skills and be emotionally involved in the search for knowledge.

According to Yusupova IP [22], professional competencies of the clinician form a system of individual, professionally significant skills, qualities and knowledge united by the humane attitude to patients and colleagues and pursuit of personal and professional perfection.

The focus on building hygiene/prevention-related competencies among medical students is justified because students majoring in general medicine are quite indifferent to them. Unfortunately, traditional teaching methods often fail to engage students in out-of-class activities and independent practice [12].

Prevention is a professional challenge for GPs and pediatricians; its importance is emphasized in the standards for the medical profession. Notably, experts [4] underscore that current educational standards for the medical profession guide academic staff to actively introduce prevention in the curriculum. The student is expected to learn how to effectively educate their future patients and work out a prevention strategy tailored to the patient.

Studies of interactive teaching methods for hygiene/prevention-related disciplines are scarce and aim at improving the efficacy of content assimilation, increasing interest in the subject, and stimulating active knowledge acquisition in the context of traditional curricula. To our knowledge, there have been no projects with a focus on interactive teaching and innovative curricula for hygiene/prevention-related disciplines taught at clinical faculties. Such innovative curricula should be based on the educational roadmap that leads the student to their final destination: acquisition of hygiene/prevention-related competencies that satisfy the demands of next-generation preventive medicine.

The aim of the study was to develop approaches to implementing the principles of P4 medicine and to stimulate preventive thinking among students enrolled in the Hygiene course at the faculties of General Medicine and Pediatrics.

METHODS

A pilot approach to teaching Hygiene implemented at the Department of General Hygiene of Kazan State Medical University was harmoniously integrated in the curriculum and met the requirements A/04.7 and A/05.7 specified in the professional standards and universal/professional competencies of federal educational standards.

The novelty of the approach lies in its factor-based interactive nature and the use of task-oriented, developmental approach.

The factor-based approach implies systematization of health factors:

- Apart from studying environmental factors, students learn about lifestyle factors that impact human health (behavior and the associated metabolic risks);
- The course provides information about environmental and lifestyle factors, as well as about informational, electromagnetic, biological and chemical factors;
- The course offers a holistic view on the factor (e.g., noise is not only an industrial but also a communal factor; harmful effects occur when a permissible exposure limit or a maximum allowable concentration is exceeded, as well as in the absence and/or insufficient exposure to the factor, e.g. noise above the recommended exposure level may lead to neurosensory hearing loss, whereas the absence of any noise may lead to hallucinations, etc.);
- The course focuses on exposure, adaptation and combination/complex effects of the studied factors.

The problem-based approach is based on case studies; the cases are true to life and are solved using a strict preventive-thinking algorithm.

The developmental approach helps students to build a positive, stable attitude to prevention, develops systemic, logical and structured thinking and motivates students to lead a healthy lifestyle and pursue professional development.

The interactive approach relies on the use of simulation games, practice in a clinical setting, lectures by clinicians, excursions, discussion, brain storms, etc.

In order to implement the interactive approach to teaching hygiene and prevention, we designed an interactive workbook, a didactic tool that structures practical classes according to the principles of cognitive and emotional learning.

This interactive workbook is a part of the Hygiene course and is intended for independent work. The workbook contains exercises on different aspects of hygiene and prevention; the exercises are grouped in sections presented in the following order: CONCEPTION, COACHING, PRACTICUM.

The key idea behind the workbook is emphatic knowledge acquisition, which facilitates value-based perception of information and effective content assimilation.

This approach proposes that empathy is a way of cognition and acceptance of values; it was based on the results of our own study of values and empathy conducted in 523 students of Kazan State Medical University between 2016 and 2019; for the study, we used interviews and structured questionnaires based on the description of characteristics of empathic potential proposed by Rogov MG and Yusupova IM (1999).

Our study harnessed psychological, statistical and immediate observation methods. The obtained data were processed and their validity was tested by calculating relative and mean values, using Student's t-test and other statistical methods. Differences were considered significant at $p \leq 0.05$. Statistical analysis was carried out in Statistica 10.0 and MS Excel 2010.

RESULTS

In the first phase of our study, we established a correlation between the respondents' values and empathy. Twenty-four of 40 values were significantly correlated with empathy ($p < 0.05$ and $p < 0.01$ for 11 and 13 values, respectively). The correlations were the strongest for the following values: knowledge acquisition ($r_{xy} = 0.48$), being on good terms with people ($r_{xy} = 0.48$), honesty ($r_{xy} = 0.37$), communication with like-minded people ($r_{xy} = 0.36$), creativity ($r_{xy} = 0.36$), and high aspirations ($r_{xy} = 0.348$).

The established correlations show that the stronger the empathy, the more significant are the following values: being on good terms with people and knowledge acquisition. Perhaps, the impact of empathy on knowledge acquisition can be explained by its gnoseological aspect.

Based on the established correlations, we developed an interactive workbook, which involves the student in empathic interactions and discourse.

The sections of the workbook are presented in the order that implies gradually increasing engagement in the discipline. The first section — CONCEPTION — introduces the student to the subject of the practical class; the initial level of knowledge is tested by brain storming; then the teacher guides students to use information resources needed for solving a particular professional task. After students have systematized their knowledge of terms, concepts and principles of hygienic factor ranking, the teacher proceeds to the next section — COACHING. This section includes exercises on using the acquired knowledge/skills based on impressions and emotions coming from real life scenarios or literature sources/films, which aids effective knowledge assimilation. The section contains tests for knowledge assimilation, which enhances the personal responsibility of students in understanding the subject. The last section — PRACTICUM — presents cases that help the student to master prevention-oriented thinking.

This approach was implemented in the innovative Hygiene course and used for 3 academic years (2016/2017, 2017/2018 and 2018/2019) at the faculties of General Medicine and Pediatrics of Kazan State Medical University. Traditionally, the Hygiene course is taught in academic years 2 and 3. After the course, a total of 290 students were surveyed, of them 147 had taken the traditional Hygiene course and 143 had taken the innovative Hygiene course. The survey aimed to determine the level of student engagement in the learning process and to evaluate students' expectations.

Students who had taken the traditional course gave an average of 5.6 out of 10 points to their interest in Hygiene before the course; in the innovative course group the score was 5.7 points ($p > 0.05$).

During the course, the interest score increased to 5.8 points in the traditional course group and to 8.6 points in the innovative course group ($p < 0.05$). When asked to rate how well their expectations of the course had been met, the traditional course group rated it as 3.8 points on average; for the innovative course groups, the average score was 8.6 points ($p < 0.01$). The study shows that student engagement and interest in hygiene as the basis of prevention medicine are still maintained among senior students. Interest and engagement were also assessed based on the 3-year-long membership of students in the undergraduate research society at the Department of General Hygiene after completing the Hygiene course and passing the exam. Students continued to attend the society and went on with their research, integrating it with clinical disciplines taught in senior years.

The level of competencies to meet the requirements A/04.7 and A/05.7 of the federal educational standards can be evaluated as threshold, advanced and excellent, as proposed by the task force of our pilot project.

- Information literacy can be assessed using a structured interview (open-ended questions);
- Maturity of prevention-based thinking can be assessed during case studies;
- Theoretical knowledge is assessed using tests.

This approach facilitates transition from recognition and reproduction (memorizing) to understanding, persuasion, creativity, and practical application of the obtained knowledge.

CONCLUSIONS

Current reforms of public healthcare dictate the need for change in the way prevention-related disciplines are taught at medical educational institutions. Development of new federal educational standards and their implementation in practical healthcare necessitate the search for new approaches to shaping prevention-oriented thinking among students taking a course in Hygiene at the faculties of general medicine and pediatrics.

According to the professional standards, a general practitioner and a pediatrician receive accreditation and then

begin their career in primary healthcare. Here, they are faced with the problem of motivating their patient to lead a healthy lifestyle and have to develop patient-tailored recommendations on prevention.

Our pilot project implemented at the Department of Hygiene of Kazan State Medical University demonstrates the need for reviewing the strategy of teaching hygiene and prevention-related disciplines at clinical faculties and including the principles of P4 medicine in the medical curriculum, thus allowing the student to effectively perform their professional duties and promote prevention in primary healthcare.

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HEALTH ASPECTS OF INNOVATION IN MODERN SOCIETY

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Wide use of computers, information and communication technologies and gadgets in industry and society unlocks creativity, refines logic, stimulates analytical and research skills, makes work much easier, and allows many types of activities to be performed remotely. But despite their indisputable advantages, information technologies have a downside. The negative impact of computers and electronic gadgets on the cognitive, emotional and mental states, the gastrointestinal tract, vision and the musculoskeletal system have been proved. Children are particularly sensitive to the negative effects of IT. This study provides concise information on some IT-associated health conditions (IT-associated morbidity) and proposes some measure to minimize the negative effects of IT on children's health.

Keywords: hygiene, information and communication technology, IT-associated pediatric morbidity, prevention

Author contributions: Kolomin VV— study concept and design, data acquisition, statistical analysis, manuscript preparation; Kudryasheva IA — editing; Devrishov RD — data acquisition and processing, manuscript preparation; Khorosheva IV — data acquisition, statistical analysis; Gololobov MI — editing; Khabchiev RK — data acquisition; Filyaev VN — editing

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Key words: hygiene, information and communication technologies, IT associated morbidity in the child population, prevention.

ГИГИЕНИЧЕСКИЕ АСПЕКТЫ ИННОВАЦИОННЫХ ПРОЦЕССОВ В СОВРЕМЕННОМ ОБЩЕСТВЕ

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Широкое применение компьютерной техники, информационно-коммуникационных устройств и гаджетов во всех сферах производственной и общественной жизни способствует раскрытию творческого потенциала человека, положительно влияет на совершенствование логического мышления, выработку аналитических и исследовательских навыков, а в профессиональной деятельности значительно облегчает трудовой процесс, позволяет осуществлять многие операции удаленно. Вместе с тем, при наличии несомненных положительных аспектов использования информационных технологий, их применение имеет и отрицательную сторону. Доказательно установлено негативное влияние компьютерной техники и электронных гаджетов на когнитивную, психо-эмоциональную и физиологическую сферы человека, а также их участие в развитии патологий органов зрения и желудочно-кишечного тракта, опорно-двигательного аппарата. Наиболее восприимчив к негативному воздействию объектов применения информационных технологий (IT объектов) организм ребенка. В работе представлена краткая информация о патологических изменениях в организме детей и подростков, ассоциированных воздействием информационных технологий и IT объектов (IT ассоциированная заболеваемость). Предложены возможные мероприятия по минимизации негативного влияния IT объектов на здоровье ребенка.

Ключевые слова: гигиена, информационно-коммуникационные технологии, IT ассоциированная заболеваемость детского населения, профилактика.

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Today, society is faced with a variety of new environmental risk factors whose impact on pediatric health is yet to be explored. Those include information technologies (IT) and IT devices that are widely used by children and adolescents and have become indispensable to their socialization and the learning process.

Russia makes significant effort to prevent the negative impact of IT and IT devices on public health. The approach to creating healthy conditions for child development is systemic and reflects the principles outlined in the Information Safety Framework for Children [1] and the roadmap for its implementation under the Decade of Child Welfare (2018–2027) project [2] declared by the Order 240 of the President of Russia issued on May 29, 2017. Importantly, the sanitary aspects of using IT and IT devices by children and adolescents are regulated by the healthcare legislation of the Russian Federation [3].

At the same time, despite great effort, the problem of IT-associated morbidity among children and adolescents remains a pressing concern.

The aim of the study was to propose measures for reducing IT-associated morbidity.

METHODS

The study included data collected in public schools, gymnasiums and lyceums in 4 different districts of Astrakhan region. The data collected in 2011–2018 were provided by the Federal Research Institute for Health Organization and Informatics of Ministry of Health of the Russian Federation and the Department of Analysis, Forecasts, Public Healthcare Medical Science Development of the Ministry of Healthcare

of the Russian Federation; the data also included results of integral health assessment (medical examinations, surveys) conducted among junior to high schoolers aged 7 to 17 years.

Statistical analysis was performed using a linear regression method in Statgraphics and Microsoft Excel; Pearson's correlation coefficient (r) was calculated to measure the strength and direction of possible associations between the variables; we also used the coefficient of determination (R^2). The significance threshold was set at $p < 0.05$.

RESULTS

Children and adolescents develop ophthalmic diseases amidst increasing exposure to a variety of environmental factors, including IT devices.

Studies involving high school students of Moscow, Moscow region and Arkhangelsk have established associations between the use of IT devices and ocular morbidity. The risk varies from moderate to high, depending on the frequency of using the computer and laptop [4]. Strong correlations (Pearson's correlation coefficient 0.75, $p < 0.001$) between moderate/severe myopia and the frequency of using the computer and laptop among high school students of Moscow were established by the researchers from Pirogov Russian National Research Medical University. Functional eye disorders were detected in 67.2% of high school students and 19.0% of second year university students; 8.2% of schoolers and 53.6% of university students were found to have chronic ocular disorders (moderate and severe myopia) [5].

These results are consistent with the findings of our previous work (*Assessment of learning environment and health of public school students of Astrakhan region*), which reported a growing negative effect of IT devices on the visual system of children in the past years. Moderate myopia was diagnosed in 14.0% of 9th grade students and 21.0% of 11th grade students. The survey revealed that the proportion of children using IT devices over 2–3 h a day was increasing from 30.0% in primary school to 60.0% in middle and 70.0% in high school [6].

Multiple studies conducted in Russia and abroad demonstrate that IT devices are becoming a new etiological factor contributing to ophthalmic diseases. However, the effects of IT devices are indirect for many other conditions. IT devices are not a direct driver of musculoskeletal (MS) and gastrointestinal (GI) disorders. But the confirmed associations between the use of IT devices and MS/GI diseases in the pediatric population suggest that these conditions could be classified as IT-associated. This has been confirmed by the studies conducted in a number of Russian cities (Moscow, Arkhangelsk, Nizhny Novgorod) establishing the risk of MS and GI diseases due to the use of computers, laptops and tablets [4, 5, 7, 8, 9, 10, 11].

IT-associated MS and GI disorders are largely the result of excessive or inadequate use of IT devices by children and adolescents, which disrupts their daily routine, eating schedule, leads to the lack of movement and an unhealthy lifestyle in general. According to studies conducted in Arkhangelsk, the irrational use of IT devices was a disruption to the eating schedule for 29.2% of high school students and interfered with the normal sleep-wake schedule in 41.6% of teenagers

[7]. According to a report from Astrakhan, 20.0% of primary schoolers and 65.0% of high school students spent less than 1 h outdoors during the day [6].

Low levels of physical activity in combination with an awkward posture while working with an IT device contribute to musculoskeletal system disorders. The analysis of child morbidity revealed that the proportion of children with MS disorders rises from 12.0% in primary school to 26.4% in high school [6].

The rise in the prevalence of ocular pathology, gastrointestinal and musculoskeletal disorders can be explained not only by the increasing exposure to environmental factors but also by the low effectiveness of health-saving technologies due to the absence of systemic approach. Thus, 42.9% of schools use health-saving technologies to prevent ocular and gastrointestinal diseases, whereas 57.1% of schools use these technologies to prevent musculoskeletal disorders.

DISCUSSION

Based on the results of the study, we hypothesize that the low effectiveness of prevention measures implemented by the state might be due to:

- out-of-school factors (including information and communication technologies used in the learning process);
- the lack of systemic complex approach to the application of health-saving technologies, which are used without due consideration of their effects on the health of children.

Besides, the positive effect of prevention measures can be neutralized by irrational leisure time planning for children, teenagers and the whole family and the absence of systemic parental control over information content. Parental control unsupported by rational time planning for the whole family is not effective. Studies conducted in Arkhangelsk and Moscow demonstrate that the systemic approach to the problem results in a decrease in the proportion of children who use computer over 3 hours a day from 70.5% to 13.3% but their level of physical activity remains the same (27.6% vs 27.3%) [7].

CONCLUSIONS

Measures implemented by the state do not radically prevent the negative impact of IT on the health of children.

The solution to the problem of pediatric and teenage health and prevention of IT-associated morbidity lies in the complex approach, which includes the use of health-saving technologies. Indeed, it is important to follow the guidelines on the duration and other aspects of using the computer by the child. No less important is quality leisure time, regular physical and intellectual activity, daily routines and sleep-wake schedule.

Prevention of IT-associated conditions could be more effective if it accounted for children's hobbies. Here, health education plays a significant role and its effectiveness is largely determined by the methods used to instill the idea of healthy lifestyle. Such education should be engaging and comprehensible.

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HYGIENE PRACTICES IN CHILDREN AND ADOLESCENTS TO PREVENT COVID-19 TRANSMISSION

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Socio-economic outcome of long-term SARS-CoV-2 pandemic poses a major health risk to children. A high number of neurological disturbances and nutrition-associated problems are reported. Hygiene is one of the most important measures to avoid the novel coronavirus infection. Children and adolescents commonly constitute a special population, as disease severity in this group significantly differs from that in middle-aged and senior groups. Lockdown and transition to remote learning result in numerous reasons for emotional stress such as a dramatically altered way of life and education, and an important reduction of physical activity. The basic hygienic measures for children and adolescents included lockdown and transition to remote learning. An altered way of life caused strong emotions and poor academic achievements. As time passes, based on numerous statistical data, we can conclude that the role of children in the infection transmission and spread is insignificant. In spite of doubtful effectiveness of transition to online learning and an abundance of negative consequences for children's mental health, some authors report that closure of schools resulted in a reduced number of those affected and decreased mortality rate. Hand hygiene is a very important way to prevent the spread of infections. Hygiene promotion aimed at children and adolescents is lacking during the pandemic, as explanatory talks are mainly given by parents.

Keywords: children and adolescents, hygiene, COVID-19, coronavirus, lockdown, epidemic control measures, remote learning.

Author contribution: in this article, we provide a framework for reviewing 150 global literature sources.

Compliance with ethical standards: the article was approved by the Local Ethics Committee of the Pirogov Russian National Research Medical University (minutes of meeting of the Local Ethics Committee of the Pirogov Russian National Research Medical University No. 208 as of May 17, 2021).

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САНИТАРНО-ГИГИЕНИЧЕСКИЕ МЕРОПРИЯТИЯ ДЛЯ ДЕТЕЙ И ПОДРОСТКОВ ПО ПРОФИЛАКТИКЕ COVID-19

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Главная опасность для здоровья детей от SARS-CoV-2 связана с социально-экономическими исходом длительной пандемии, имеется информация о повышении количества нервных расстройств и проблем с питанием детей. Санитарно-гигиенические мероприятия стали одними из важнейших мер по борьбе с новой коронавирусной инфекцией. Дети и подростки, как правило, составляют особую группу пациентов, так как у них течение заболевания может ощутимо отличаться от средней и старшей возрастной группы. Карантин и переход на дистанционное обучение предполагает разнообразие причин эмоционального стресса, среди которых: сильная перемена образа жизни и обучения, а так же кардинальное уменьшение физической активности. Основными санитарно-гигиеническими мероприятиями в отношении детей и подростков стали переход на дистанционное обучение и разнообразные карантинные режимы. Перемена общепринятого образа жизни сопровождалось мощным эмоциональным стрессом и снижением плодотворности процесса обучения. По истечении определенного времени набралось много статистических данных, позволяющих сделать вывод о малосущественной роли детей в передаче и распространении инфекции. Вопреки спорной эффективности перехода к онлайн-обучению и множеству неблагоприятных последствий для психики детей, отдельные авторы сообщают, что закрытие школ содействовало уменьшению количества заболевших и снижению числа летальных исходов. Гигиена рук считается важным элементом инфекционного контроля. «Направленная» на детей и подростков популяризация гигиены во время пандемии отсутствует, и в основном разъяснительные разговоры ложатся на родителей.

Ключевые слова: дети и подростки, гигиена, коронавирусная инфекция, карантин, противоэпидемические мероприятия, дистанционное обучение.

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SARS-CoV-2, the novel virus belonging to the family of coronaviruses and causing a number of atypical respiratory diseases, was first identified in Wuhan of China's Hubei province [1]. Among the first 27 reported hospitalized cases, most were epidemiologically related to Huanan Seafood Wholesale Market. The main symptoms of viral infection were fever, cough and chest discomfort. In severe cases, dyspnea and bilateral pulmonary infiltration were developed. The acute respiratory syndrome associated with the novel viral infection

is called SARS-CoV-2 (COVID-19). COVID-19 has rapidly spread around the globe. In March 2020, the WHO declared a coronavirus pandemic. By April 2020, 1,436,198 confirmed cases of COVID-19 have been reported worldwide with an almost 6% mortality rate [2].

The COVID-19 pandemic produced a significant influence on every human business area. First and foremost, the healthcare system was altered. Integrative strategies aimed to prevent a fast growth of those infected were developed in an urgent order [3].

Particular emphasis was given to sanitation and epidemic prevention measures, as etiotropic treatment was not possible due to a lack of sufficient data about pathogenesis and course of a novel disease. During the pandemic peak, the only possible way to reduce the infection mortality rate was re-profiling of already registered and used drugs, as it took time to create and release a qualitatively novel drug and/or vaccine [4]. Various measures were introduced such as lockdown, isolation, social distance, transition to distance learning and working. State strategies were aimed to avoid unnecessary social contacts in order to slow the disease spread.

Children, adolescents and elderly normally form a special population. The course of their disease can significantly differ from that in middle aged and senior groups. According to numerous sources, children usually have mild symptoms of COVID-19 and have little to do with the spread of the coronavirus [5]. Thus, it is interesting to review sanitation and epidemic prevention measures for children and adolescents accepted during the pandemic and estimate their effectiveness.

PATIENTS AND METHODS

The study method included a literature review of 75 articles concerning the course of the novel coronavirus infection in children and adolescents, prevention of and measures preventing the spread of COVID-19. Every article describes sanitation and epidemic prevention measures, used in different countries of Europe, Asia, Africa, North and South America during COVID-19 pandemic.

STUDY RESULTS

COVID-19 is a viral disease accompanied by a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Though SARS-CoV-2 typically presents with respiratory symptoms, it is also capable of influencing the cardiovascular system, gastrointestinal tract, liver, kidneys and pancreas, and causing central and peripheral neurological impairment [6].

COVID-19 is a highly contagious disease transmitted from human-to-human by droplets or aerosols. According to statistical data, children make up 1–5% of all reported cases of COVID-19. Children normally have milder symptoms as compared to adults. In 90% of cases, no symptoms, mild symptoms or moderate symptoms are diagnosed. However, severe cases can be observed in up to 6.7% of cases. Severe cases normally occur in infants under 1 year of age and in children with underlying conditions [2]. There is no evidence for mother-to-child virus transmission. However, the neonates who have a close contact with an infected person can catch the disease as well [7].

Although medical literature shows that children are minimally susceptible to COVID-19, they mostly suffer from the psychosocial impact of the pandemic. Lockdown and home schooling can contribute to a greater emotional stress as compared to physical sufferings caused by the virus [8].

Closure of schools due to COVID-19 affected 87% of the world's students. For the majority of them, the educational regimen was qualitatively new. The sociological survey, hold in March among Shanghai pupils of primary (4) and secondary (342) schools, showed that the most common mental illnesses were anxiety (24.9%), depression (19.7%) and neurotic disorders (15.2%). However, about 21.4% of those surveyed were satisfied with the novel educational mode and school closure [9]. By the middle of April, schools were closed in 192 countries and about 90% of schoolchildren and students (about 1.6 billion people) shifted to remote learning (RL) [10].

Italy was the first COVID-19-hit country in Europe. In Italy, 16% of residents are children and adolescents. Many state schools were deprived of technological support necessary for remote learning. By the end of March, only 67% of schools shifted to learning from home covering 6.7 million children out of 8.4 million available [11]. Supporting children with limited learning disabilities was a great challenge.

In March 2020, it took 10 days to close nursery schools, day care centers, and almost all schools and colleges in the USA. The lockdown measures were unprecedented: 21 million children in kindergartens, 57 million schoolchildren and 20 million students in colleges and universities were shifted to remote learning [10].

In developing countries, children from low-income families have a limited access to online learning and depend on free school meal. The first lockdown made the South African Pediatric Association plead for coming back to schools. It recommended to implement an educational practice with minimal risk of contamination and material support for schools located in areas with poor resources [12]. Schools of Brazil also report an increased number of emotional disorders (anxiety, depression, sleep disturbance, posttraumatic stress disorder) and nutrition-related problems. Moreover, local schools were closed for more than 200 days, or much longer as compared with schools in the majority of developed countries such as Denmark, France and Germany [13].

In spite of a very low morbidity and incidence of COVID-19 among children, it was established that school closures reduced a number of those exposed per week and improved mortality rate [14]. The French Pediatric Society published clinical guidelines stating that children under 10 years old don't contribute significantly to the epidemic. In children, the risk of secondary infection is very low, whereas outbreaks are rare [15]. School opening in South Korea was postponed several times, face-to-face learning consisted of 4 stages for different classes and lasted from May 20 to June 8. School opening here wasn't accompanied by a sharp increase in the number of affected children; children with COVID-19 represented 7% of the total COVID virus detection rate in the country [16]. Israel reported a large outbreak of coronavirus, which occurred in May 2020, or 10 days after reopening of schools. 153 children and 25 staff members with COVID-19 were revealed within a short period of time [17].

Return to in-person learning will prevent disruption in the lives of children and adolescents. Another important reason was that online distance learning resulted in a poor performance. Intervals in in-person learning were linked with poor academic achievements, especially in primary school. Using a model analysis, Bao et al. predicted that reading skills in children from kindergartens would be worsened by 66% as compared to in-person learning, leading to a reduced growth of reading skills (by 31%) from January 1, 2020 to September 1, 2020 [18]. Primary school teachers insist that in-person learning is necessary, whereas high school teachers prefer a combined learning (when in-person and distant learning are used together) [19].

Measures of social distancing are introduced for a long time (more than several months). One of the most important state strategies is to minimize isolation-related economic and social disturbances [20].

Thus, the Coronavirus Act issued in England on March 23, 2020 during the first outbreak, announced a strict lockdown with a wide strategy of epidemic surveillance to monitor COVID-19 in children. Among children, the first cases were reported on February 29, 2020. A number of COVID-19 cases initiated its growth in the second week of March, reached the peak on April 11, 2020, and slowly decreased afterwards. The tendency corresponded to that one in adults [21].

According to Roche et al., isolation of all groups, which is practiced in many countries (including Russia), can be significantly less effective than targeted isolation of young and middle-aged people [20]. Experience of many countries shows that only over 1% of children were affected even during the peak of the epidemic [21]. There is also a low risk of COVID-19 spread in schools. Case studies in Guangzhou, Italy, Australia and Netherlands showed almost no virus transmission from children to adults [22]. Public health education and healthy lifestyle promotion are always considered as important components of disease prevention measures. However, their role becomes crucial during outbreaks of diseases and healthcare emergencies [23]. The WHO recommends to use respiration devices, masks and gloves due to a long-term incubation period and symptomless course of COVID-19 in some patients [24]. The drug-free modalities form a barrier restricting droplet and airborne transmission, enabling to control epidemic in its early stage and protect vulnerable groups of population [25]. There are currently no messages aimed specifically at children. The need can be replenished by video-/cartoon-based entertainment and educational activities, which are of most importance to promoting good hygiene habits on a long-term basis and preventing recurrent infections [23].

In its application, the South African Pediatric Association provides the following comments on safety measures: masking is not recommended for children under the age of 2 due to risks of suffocation. Children over 4 years old should wear masks, especially when they return to schools [12].

Hand hygiene is a very important way to prevent the spread of infections. Proper hand washing can stop the virus spread and reduce the risk of contamination among schoolchildren from 6% to 44% [26]. In their study, Chen et al. examined hand-washing behavior of schoolchildren. Handwashing survey was conducted among 8,569 children aged 6–13 years old. 80% of those surveyed had been in Wuhan with 51.95% of them being there right before the lockdown. Only 42.05% of primary school children showed excellent knowledge and conscious handwashing behavior. Researchers expected to obtain better results [25].

Smith et al. conducted a large-scale hand hygiene study among adolescents of 12–15 years old in 80 countries. It was interesting that in upper-middle-income countries they never

or seldom washed their hands before eating. There was a less probability that people with a low socio-economic status performed proper hand hygiene [27].

DISCUSSION OF RESULTS

It was the first study of global epidemic control measures during the COVID-19 pandemic. Cumulative world's experience devoted to management of sanitary and epidemiologic measures preventing the spread of COVID-19 shows that children commonly suffer from milder symptoms of COVID-19 as compared to adults. It was supposed that transmission without symptoms can contribute to the spread of infection. However, numerous sources report that the role of children and adolescents in COVID-19 spread is insignificant. SARS-CoV-2-related health threat is rather associated with socio-economic consequences of long pandemic than with COVID-19 itself. An increased number of mental disturbances (anxiety, depression, sleep disturbances, posttraumatic stress disturbance) and nutrition-related problems are reported. Hygienic measures relate to the best precautions against the novel coronavirus.

CONCLUSIONS

Hygienic measures are widely used precautions against coronavirus. During the outbreak, no data were available on the possible etiologic treatment of the novel disease and effective re-profiling of already registered drugs. The main state strategy included social distance and healthy lifestyle promotion used to slow down the infection spread and reduce COVID-19-related morbidity.

The basic hygienic measures concerning children and adolescents embraced transition to distant learning and numerous lockdown modes. An altered way of life was accompanied by a strong emotional stress and decreased effectiveness of education. As time passes, based on numerous statistical data, we can conclude that the role of children in the infection transmission and spread is insignificant. In spite of doubtful effectiveness of transition to online learning and an abundance of negative consequences for children's mental health, some authors report that closure of schools resulted in a reduced number of those affected and decreased mortality rate. Hygiene promotion aimed at children and adolescents is lacking during the pandemic, as explanatory talks are mainly given by parents.

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INFLUENCE OF THE DEGREE OF ADAPTABILITY AND LIFESTYLE ON THE QUALITY OF LIFE OF MEDICAL UNIVERSITY STUDENTS

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Adaptive capabilities of young people enrolling at higher education establishments differ from person to person. Depending on the level of these capabilities, a new student may see his/her quality of life deteriorating and a variety of diseases developing. Against this background, investigation of the dynamics of students' adaptation to studying at a higher educational establishment acquires special urgency: the results of such an investigation would enable designing an effective psychological support program for such students. This study aimed to investigate how the quality of life of students changes as studying at a higher education establishment alters their degree of adaptation and lifestyle. The report compares the studied degree of adaptability and quality of life of the same group of students in their first and third years. By design, the study was prospective continuous; it involved 120 students. M. Gavilnova's two-factor questionnaire (SA, social-ANS) enabled study of the degree of adaptability. As for the quality of life of the participating students, it was registered with the help of the SF-36 questionnaire. Lifestyle of the students was assessed relying on the questionnaire designed to uncover the person's attitude to smoking, alcohol, drugs, physical culture and sports. The results obtained enabled development of recommendations aimed at identifying students running risks of maladjustment and illnesses with the aim to render such students targeted medical and psychological assistance and adjust the sanitary and epidemiological conditions of studying.

Keywords: quality of life, adaptability, vegetative resilience, medical students, healthy lifestyle.

Author contribution Yanushanets OI carried out statistical processing of the research results, reviewed the article critically and approved its final version for publication. Petrova NA, Koroleva AA, Bezzubenkova EF processed the research results reflecting the degree of adaptation of third-year students, analyzed the changes in their condition that occurred through the 2 years of studying, interpreted the results.

Compliance with ethical standards: Each participant signed a voluntary informed consent form. The students participated voluntarily, through filling in questionnaires online. The study conformed to the biomedical ethics requirements and did not endanger the participants.

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ВЛИЯНИЕ СТЕПЕНИ АДАПТИРОВАННОСТИ И ОБРАЗА ЖИЗНИ НА КАЧЕСТВО ЖИЗНИ СТУДЕНТОВ МЕДИЦИНСКОГО УНИВЕРСИТЕТА

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К обучению в высшем учебном заведении приступают подростки с различным уровнем адаптационных возможностей организма, которые определяют возможное формирование низкого качества жизни и развитие различных заболеваний. В этой связи исследование динамики процесса адаптации студентов к обучению в высшем учебном заведении приобретает особую актуальность, поскольку предоставляет возможность на основе полученных результатов построить эффективную программу психологического сопровождения студентов. Целью исследования явилось изучение влияния изменений степени адаптированности и образа жизни в процессе обучения на качество жизни студентов. В работе представлено сравнение результатов исследования степени адаптированности и качества жизни одних и тех же студентов на первом и третьем курсе. Проспективное сплошное исследование включало опрос 120 студентов. Изучение степени адаптированности проводилось с использованием двухфакторного опросника (СВ - «социум-вегетатика»), разработанного М. Гавлиновой. Качество жизни студентов изучалось с помощью опросника SF-36. Образ жизни студентов оценивали на основе анкеты, включающей вопросы об отношении к курению, употреблению алкоголя, наркотических веществ и занятий физической культурой и спортом. Полученные результаты позволили разработать рекомендации, направленные на выявление студентов, относящихся к группе риска развития дезадаптации и болезни, с целью оказания им адресной медико- психологической помощи и корректировки санитар-эпидемиологических условий обучения.

Ключевые слова: качество жизни, адаптированность, вегетативная устойчивость, студенты-медики, здоровый образ жизни.

Вклад авторов: О И. Янушанец провела статистическую обработку результатов исследования, осуществила критический пересмотр содержания статьи и утвердила окончательный ее вариант для публикации. Н. А. Петрова, А. А. Королева, Е. Ф. Беззубенкова провели обработку результатов исследования по части адаптированности студентов третьего курса и проанализировали изменение их состояния в динамике за 2 года, интерпретировали результаты.

Соблюдение этических стандартов: добровольное информированное согласие было получено для каждого участника. Проведение онлайн-опроса проводилось на добровольной основе с использованием онлайн-сервиса. Исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников.

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The first three years at a medical university are considered difficult for the students. There are numerous factors that force students to mobilize and adapt to the new living and learning conditions, including high mental and psycho-emotional load, new interpersonal relationships outside their families, self-reliance in overcoming difficult life situations, frequent violations of the regime of work, rest and nutrition, change of the place of residence etc. Not all students cope with the difficulties of studying in a higher education establishment well; some suffer deterioration of their psychoemotional state, health and, ultimately, quality of life (QOL) [1,2]. Today, the QOL problem is a subject of interest for most researchers from various scientific domains. In the recent years, there have been published many papers investigating QOL of the student youth, which is a special social group characterized by a specific age range, lifestyle, mentality and high intensity of the mental work done in the context of studying [3]. As a rule, QOL indicators are taken as a reflection of the person's satisfaction with his/her life and the degree of realization of his/her needs [4]. In hygienic studies, QOL is considered to be an attribute showing the efficacy of preventive and therapeutic measures aimed at maintaining and strengthening health of the student youth [5,6,7,8]. In this context, it is important to consider the dynamics of QOL indicators factoring in the individual adaptive capabilities and lifestyle change rate. However, there are but a few studies published to date that investigate QOL dynamics as it depends on the changes in the degree of adaptation and lifestyle of a student attending a higher education establishment, while observing the QOL indicator dynamics can enable development of recommendations aimed at identifying students running risks of maladjustment and illnesses with the aim to render such students targeted medical and psychological assistance.

MATERIALS AND METHODS

The SF-36 questionnaire was employed to study the students' QOL. The questionnaire measures the physical component of health with 4 scales: physical functioning, role physical (role functioning depending on the physical state); bodily pain, general health and mental health, including mental health scales; role emotional (role functioning depending on the emotional state); social functioning and vitality. The results were compared with the standard values of QOL indicators [3].

Information about lifestyle of students of the medical university's medical-preventive faculty was obtained with the help of questionnaires. The questionnaire included questions about attitudes towards smoking, physical culture and sports, use of alcohol and drugs.

M. Gavlinova's two-factor questionnaire (SA, social-ANS) enabled study of the degree of adaptability [9]. The level of social adaptation and vegetative stability was assessed. Based on the results of the SA test, all the participants were divided into groups with different adaptive capabilities: students showing high levels of social adaptation and a low level of autonomic lability were assigned to the first group A (adapters); students with normal levels of social adaptation and autonomic lability were assigned to the second group N (students with average abilities); students with manifesting social communication problems and autonomic lability within the normal range were combined into the third group B (psychotics). The fourth group, C, consisted of students with increased vegetative lability and without problems of social communication C (neurotics). The fifth group, D, united students who had low social adaptability and high autonomic lability (maladaptants).

Statistical analysis of the research results was performed in MS Excel 2010 and Statistica 8 software. At the first stage,

the data were analyzed for normal distribution with the Shapiro-Wilk and Kolmogorov-Smirnov tests. With the data distribution being normal, its further processing relied on the methods of parametric statistics: Student's t-test and χ^2 test designed to compare two independent samples, McNemar's test for related samples. The critical level of reliability of the null hypothesis was taken as $p \leq 0.05$ (95% significance level). The prospective continuous study recruited 120 third-year students of the medical university's medical-preventive faculty; the students filled in the questionnaires. The data obtained were compared with the results of a study that involved the same group of students when they were in their first year.

RESULTS

Figure 1 presents the results of comparison of the degree of adaptation of students as it changed from their first to third years. As the material shows, through the 3 years covered by the study the share of students able to quickly and adequately respond to changing conditions (group A, adapters) has decreased by 4.8 times: by the third year, only 5% of the students could be assigned to group A. Such a decrease in adaptability among students who initially show high adaptive capabilities indicates that the level of load is very high and exceeds the capacities of their bodies. At the same time, 25% of the third-year participants belonged to group N, average capabilities, which marks a slight increase in this group's count compared to the first year. The almost twofold growth of group B, psychotics, is a highlight of the comparison: by the third year, 37.5% of the participating students were assigned to this group. This fact suggests lack of communication skills among modern students and/or their exposure to high levels of psycho-emotional stress in the process of adaptation to studying at a higher education establishment. Such students need additional examination by a psychologist, a program of psychological correction or training. By the third year, the share of students who consider themselves ill and present a large number of complaints of various nature, i.e., the neurotics (group C), increased by 1.5 times to 24.17%. Individual characteristics and state of health of such students make them intolerant to increased loads of any nature, they need additional examination and health improvement procedures (Figure 1).

At the same time, by the third year the share of students completely maladapted, unable to cope with the educational and life loads, feeling ill, i.e., students assigned to group D (maladapted), decreased 1.8 times and amounted to 8.3%. This means that by the third year at the higher education establishment, some of the students with low adaptive potential managed to cope with the educational load and organize their life. The presented data reveal that the structure of the degree of adaptation of students changes by the third year of study, since no significant differences were found (Figure 2).

Lifestyle of the students changed significantly through their years at the higher education establishment. The research revealed that the share of students with the bad habit of smoking increased by 2.3 times and amounted to 27.5%. The share of students who abuse alcohol (take it more often than once a week) has also grown 2.8 times and equaled 40.0%. Among the third-year students of the medical-prophylactic faculty, 6.8% have tried narcotic substances, which marks 2.2-fold growth over the first year of the same students.

Table 1 shows comparison of the QOL indicators of the medical university's medical-preventive faculty students in their first and third years. The data indicates that by the third year, no students had their physical functioning (PF) limited by

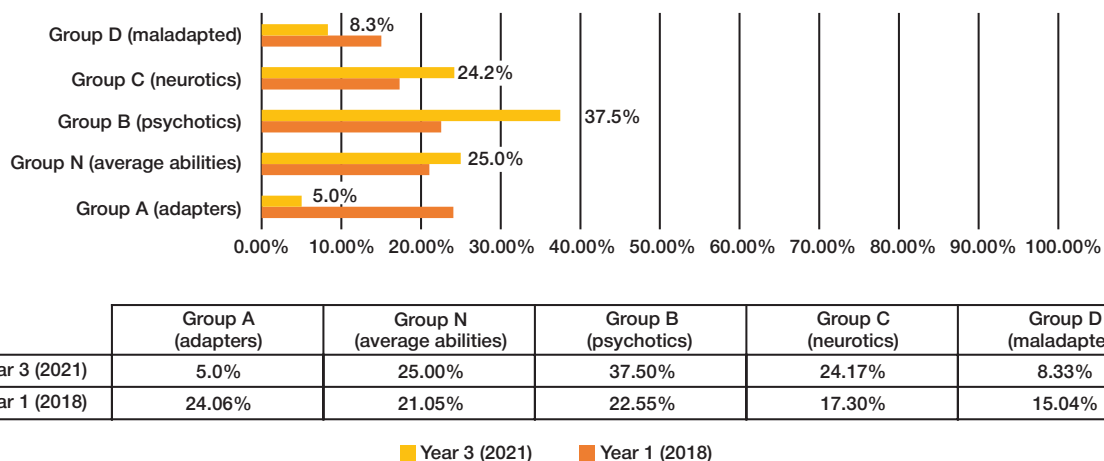


Figure 1. Structure of the degree of adaptation, 2018 through 2021, %

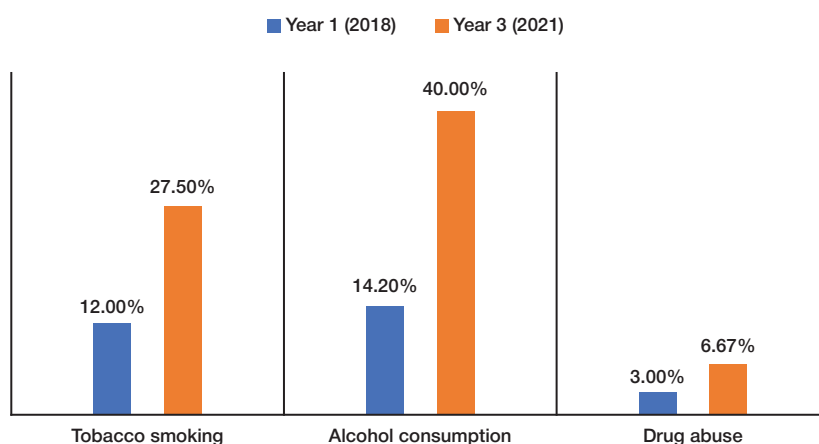


Figure 2. Changes in the share of students with bad habits, 2018 through 2021, %

Table 1. Comparison of the distribution of students by the level of QOL, first to third years at the higher education establishment, %

QOL indicator	Students' QOL level, %					
	Low		Average		High	
	Year one (2018)	Year three (2021)	Year one (2018)	Year three (2021)	Year one (2018)	Year three (2021)
Physical functioning (PF)	11.0 (n=21)	0.0 (n=0)	0.0 (n=0)	0.0 (n=0)	89.0 (n=112)	100.0 (n=120)
Role physical (RP)	28.8 (n=38)	15.0 (n=18)	0.0 (n=0)	0.0 (n=0)	71.2 (n=95)	85.0 (n=102)
Bodily pain (BP)	16.1 (n=70)	5.8 (n=7)	31.4 (n=21)	33.3 (n=40)	52.5 (n=42)	60.8 (n=73)
General health (GH)	29.7 (n=44)	6.6 (n=8)	37.3 (n=50)	48.3 (n=58)	33.0 (n=40)	45.0 (n=54)
Vitality (VT)	59.3 (n=79)	18.3 (n=22)	29.7 (n=40)	51.6 (n=62)	11.0 (n=15)	30.0 (n=36)
Social functioning (SF)	24.0 (n=68)	5.8 (n=7)	25.0 (n=33)	35.8 (n=43)	51.0 (n=32)	58.3 (n=70)
Role emotional (RE)	45.8 (n=61)	34.1 (n=41)	16.9 (n=22)	43.3 (n=52)	37.3 (n=50)	22.5 (n=27)
Mental health (MH)	41.5 (n=33)	37.5 (n=45)	33.9 (n=45)	50.0 (n=60)	24.6 (n=55)	12.5 (n=15)

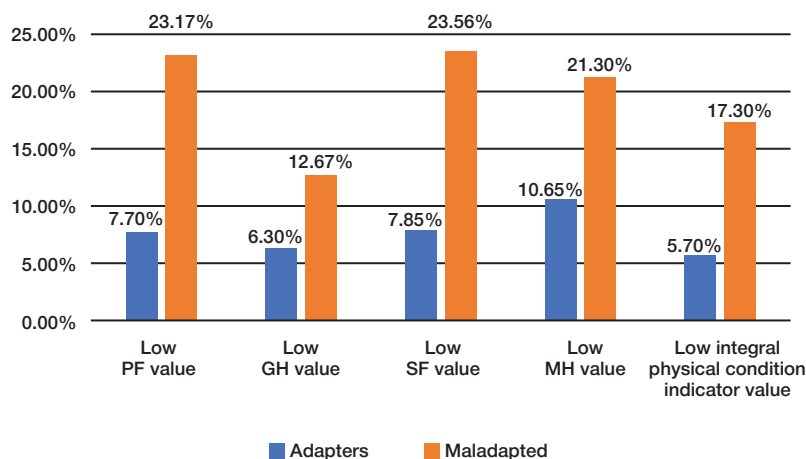


Figure 3. Influence of the degree of adaptation on the QOL indicators

the state of health, while at the first year, the share of those without such limitations was 89.0%, which marks the growth of 1.12.

The share of students whose physical condition does not limit role functioning (RP) increased slightly from 71.2% to 85.0%. (differences insignificant). At the first year, 16.0% of students reported bodily pain (BP) that significantly limited their daily activity; by the third year, their number decreased to 5.8%. ($P \leq 0.05$ $M=3.4$). The majority of third-year students do not experience pain (60%). However, it is noteworthy that a third of students (33.3%) experience various pain sensations. Compared to their first year, third-year students reported their general health as bad 4.4 times less often, the share of such assessments decreased from 29.70% to 6.67%, while 48.30% stated their general health to be at the average level and only 45.00% believed it was good ($P \leq 0.05$ $M=7.3$).

Noteworthy is the 2.7-fold increase (third year over first year) in the number of students who feel full of strength and energy (VT). In percents, the share has grown from 11.0% to 30.0%. On the other hand, the share of students reporting poor vitality decreased 3.2-fold, from 59.3% to 18.34% ($P \leq 0.05$ $M=5.2$). Such dynamics of this QOL indicator suggests that the majority of students have their learning and living conditions organized satisfactorily. The number of students whose physical or emotional state impose no limitations on their social functioning (SF) has grown by 7.3%, from 51.0% to 58.33%, by the third year at the higher education establishment. The number of students whose physical and emotional state limits their social functioning has dropped 4 times ($P \leq 0.05$ $M=6.3$).

Dynamics of the RE (role emotional, role functional depending on the emotional state) indicator also deserves a note: at the age norm level, it was registered 2.5 times more often by the third year compared to the first, the growth from 16.90% to 43.33% ($P \leq 0.05$ $M=3.3$). At the same time, the number of students that had previously reported high values of this indicator has decreased by 1.6, from 37.3% to 22.5%. Comparison of the MH (mental health) indicator values obtained at the first and third years has shown that by the third year, the number of students whose mental background is dominated by positive emotions has grown by 12.1%. However, the number of students whose mood was mostly low and emotions predominantly negative has also increased 1.4 times, from 33.9% to 50.0%. The number of students who have depressive, anxious experiences has decreased by 4%, which indicates their psychological distress.

It is fair to assume that a student with a low level of adaptability will have unsatisfactory QOL indicators. Figure 3

visualizes the analysis of influence of the degree of adaptation on the QOL indicators of the third-year students.

As the presented material shows, among the group D (maladapted) students there are 3 times more of those with low PF values than among the students that adapt well ($P=0.03$, $x_2=3.6$). The difference in the GH values is 2-fold ($P=0.03$, $x_2=4.5$), that in the SF values is 3-fold ($P=0.04$, $x_2=2.8$). The number of students with low MH values is 200% greater in group D than in the group of students with good adaptive capabilities, this difference being significant ($P=0.02$, $x_2=2.5$). The result are the determined significant differences in occurrence of low QOL indicator values by the integral criterion: physical condition of the maladapted students is 3 times worse than that of the students with good adaptive abilities ($P=0.02$, $x_2=6.3$).

The research shows that smoking increases the number of students reporting the following QOL indicator values as low: PF — 1.7-fold increase ($P=0.03$, $x_2=3.5$), RP — 2-fold increase ($P=0.03$, $x_2=3.5$), GH — 1.1-fold increase ($P=0.03$, $x_2=6.1$). The growth is significant. Smoking also contributes to deterioration of the mental health QOL indicator. The share of smoking students whose integral MH-dependent QOL criterion is low equals 42.25%, which is 1.3 times greater than that in the group of non-smokers.

Alcohol brings the whole range of QOL criteria values down. Students abusing alcohol reported poor PF values 6.4 times more often ($P=0.03$, $x_2=3.5$). A similar situation is observed for such criteria as RP, where low values were reported 1.4 times more often ($P=0.03$, $x_2=3.5$); GH, with the low values reported 1.2 times more often ($P=0.03$, $x_2=6.1$); MH and conditions showing presence of depression and anxiety, for which the participating students abusing alcohol reported low values 1.3 times more often ($P=0.004$, $x_2=1.0$).

The use of narcotic substances also has a negative effect on the QOL indicators. The share of students abusing drugs and reporting low PF values is 75%, which is 7.3 times more than among the students not using drugs ($P=0.03$, $x_2=6.4$). Drug-using students report low values of the following criteria: RP — 3.1 times more often ($P=0.02$, $x_2=3.4$); GH — 2.4 times more often ($P=0.02$, $x_2=6.2$); VT — 1.2 times more often ($P=0.02$, $x_2=3.4$), RE — 1.2 times more often ($P=0.02$, $x_2=2.84$). All comparisons here are made with the values reported by the participating students not taking drugs. It should be emphasized that the number of students with low values for the above indicators reaches 75%. Drug abuse was not found to influence the integral MH-dependent QOL indicator.

The research supports the positive effect sports have on the QOL indicators. Comparing students that go in for sports and those who do not through the lens of the QOL indicators, we established that the latter reported low values thereof considerably more often, specifically: PF — 5.2 times more often ($P=0.02$, $x_2=6.4$); RP — 1.7 times more often ($P=0.02$, $x_2=3.4$); GH — 2.2 times more often ($P=0.03$, $x_2=6.3$); VT — 1.3 times more often ($P=0.01$, $x_2=4.5$); SF — 1.2 times more often ($P=0.03$, $x_2=3.6$); RE — 1.3 times more often ($P=0.01$, $x_2=2.9$); MH, general indicator of positive emotions — 1.7 times more often ($P=0.03$, $x_2=6.6$). Thus, it should be noted here that sports has a positive effect on almost all QOL indicators.

CONCLUSIONS

1. Comparing the self-assessments of the group of students at the first and third years of studying at a higher educational institution, we registered that by the third year there are more students reporting high values for the following QOL indicators: physical functioning (PF); role physical (RP); bodily pain (BP); general health (GH); vitality (VT); social functioning (SF); role emotional (RE); mental health (MH).

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2. It was also established that by the third year the number of students with a bad habit of tobacco smoking, use of alcohol and drugs is growing. Bad habits cause significant deterioration of the QOL indicators, such as PF, RP, GH, VT, RE and MH.
3. By the third year, fewer students went in for sports as extracurricular activity. Sports significantly improve such QOL indicators as PF, RP, GH, VT, RE, MH.
4. It was found that over three years of study, the proportion of students who are able to quickly and adequately respond to the changing conditions around them has decreased by 4.8 times. The number of students who have difficulty communicating with peers and teachers has increased. However, the share of students who are completely maladapted has decreased.
5. The level of adaptability has a statistically significant effect on such QOL criteria as PF, GH, SF and MH.
6. This research enabled development of recommendations aimed at identifying students running risks of maladaptation and illnesses with the aim to render such students targeted medical and psychological assistance and adjust the sanitary and epidemiological conditions of studying.

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MEDICAL STUDENTS' PHYSICAL ACTIVITY AS AN INDICATOR OF THEIR COMMITMENT TO HEALTHY LIFESTYLE

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Physicians, who provide general medical services, should give the patients an advice on physical activity. The study was aimed to assess physical activity of medical students, as well as their awareness of this issue, and willingness to provide the public an advice on commitment to a healthy lifestyle in terms of physical activity. A total of 518 medical students were surveyed. The data obtained with the Steps and Screen Time mobile applications were used. Physical fitness was assessed using the standard anthropometric technique. Statistical processing of the data obtained was performed with the Statistica 13 PL statistical software package. The study met the requirements of biomedical ethics and posed no risk to participants. No significant differences in the number of steps between males and females was observed. It was 9033 ± 3297 steps in males and 7807 ± 3570 steps in females. The evidence supporting the relationship between physical activity and average time spent on a smartphone per day was obtained: the correlation coefficient for the relationship between the number of steps per day and the screen time was -0.36 (moderate negative correlation). Correlation coefficients for the relationships between body mass index and physical activity (-0.35) and between body mass index and screen time (0.33 , moderate positive correlation) were calculated. The data obtained allowed us to develop simple and feasible guidelines on improving physical activity in medical students, as well as to develop a tracker of positive habit of daily optimal physical activity for each student, and to discuss the results within the framework of the business game Physical Activity in Various Sectors of Population.

Keywords: students, electronic devices, motor activity

Author contribution: levleva OV — literature analysis, study design, data acquisition, statistical analysis, manuscript writing.

Compliance with ethical standards: the study was approved by the Ethics Committee of the Pirogov Russian National Research Medical University (protocol No. 203 dated December 20, 2020). The informed consent was obtained from all participants. Online survey was conducted on a voluntary basis using the online service. The study met the requirements of biomedical ethics and posed no risk to participants.

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ДВИГАТЕЛЬНАЯ АКТИВНОСТЬ СТУДЕНТОВ-МЕДИКОВ КАК ИНДИКАТОР ИХ ПРИВЕРЖЕННОСТИ ЗДОРОВОМУ ОБРАЗУ ЖИЗНИ

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Врачам, в рамках первичной медико-санитарной помощи, необходимо предоставлять пациентам консультации по физической активности. Цель работы: изучить двигательную активность студентов-медиков и их информированность по данному вопросу, а также готовность к консультированию населения по вопросам приверженности здоровому образу жизни в части двигательной активности. Опрошены 518 студентов-медиков, использованы данные приложений для смартфонов «Шаги» и «Экранное время», проведено изучение физического развития с помощью стандартной антропометрической методики. Статистическая обработка полученных данных проводилась с использованием пакета статистического анализа Statistica 13 PL. Исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников. Среднее количество шагов у юношей и девушек не имеет достоверных различий и составляет 9033 ± 3297 у юношей и 7807 ± 3570 у девушек. Получены данные, свидетельствующие о связи между двигательной активностью и средним временем использования смартфона в день — коэффициент корреляции между количеством шагов в день и «экранном временем» отрицательный средней силы $-0,36$, рассчитаны коэффициент корреляции между индексом массы тела и двигательной активностью ($-0,35$) и между индексом массы тела и «экранным» временем, который положительный, средней силы $0,33$. Полученные данные позволили сформулировать простые, выполнимые рекомендации по повышению двигательной активности студентов-медиков и сформировать для каждого трекеры привычек по формированию «полезной» привычки к ежедневной оптимальной двигательной активности и обсудить результаты в рамках деловой игры по теме «Двигательная активность для различных групп населения».

Ключевые слова: студенты, электронные устройства, двигательная активность

Вклад автора: Иевлева О. В. — анализ литературы, дизайн исследования, сбор материала, статистическая обработка, написание статьи.

Соблюдение этических стандартов: Данное исследование было одобрено ЛЭК РНИМУ им. Н. И. Пирогова (Протокол № 203 от 20.12.2020 года). Добровольное информированное согласие было получено для каждого участника. Онлайн-опрос проводился на добровольной основе с использованием онлайн-сервиса. Исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников.

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Over the past decade, the studies are being regularly published in scientific literature, which report low physical activity levels in medical students, the future doctors. This poses a direct risk to their health and can affect their future work with patients (community) in terms of obtaining a commitment to a healthy lifestyle [1, 2, 3, 4].

Moreover, physical inactivity in children, adolescents and youth is closely related to the problem of overweight and obesity [5].

Moreover, physicians, who provide general medical services, should give the patients an advice on physical activity. However, training on providing advice on physical activity is often under-

reported in the curriculum of medical schools. It is unclear whether medical students are ready to provide effective consultation in this area [6–9].

The study was aimed to assess physical activity of medical students, as well as their awareness of this issue, and willingness to provide an advice on commitment to a healthy lifestyle in terms of physical activity to the public.

METHODS

To attain the goals established, specialists of the Hygiene Department of Pediatric Faculty of the Pirogov Russian National Research Medical University, holding certificates of “Hygienic Education”, “Epidemiology”, “Hygiene of Children and Adolescents”, and “General Hygiene”, developed a questionnaire for assessment of the medical students’ lifestyle hosted on Google Forms [10].

The questionnaires proposed to respondents contained a small section with personal data and a number of evaluative questions beginning with “Please assess the risk to your health...”. These questions reflected subjective evaluation of the impact of the factors affecting health. The risk posed by exposure to each studied factor was rated on a scale of 0 to 10.

The study design consisted in evaluation of the medical students awareness of risk to health posed by lack of physical activity, investigation of the medical students’ commitment to a healthy lifestyle in terms of physical activity, search for the proof of physical inactivity effects on health, as well as defining the medical students’ willingness to change their lifestyle, and to work with the patients (community) in this area in the future (Fig. 1).

A total of 518 medical students were surveyed, of them 80% were girls. The average age of the students surveyed ($M \pm m$) was 20.1 ± 0.08 years.

We also used data of the Steps (average number of steps per day) and Screen Time (average time of using smartphone per day) mobile applications.

Physical fitness of medical students was assessed using the standard anthropometric technique [8, 11–13].

Statistical processing of the results was performed using the Statistica 13 PL software package (StatSoft, USA). Descriptive statistics was used: mean values, standard error of the mean, and standard deviation were calculated. Distribution of indicators was tested for normality using the Kolmogorov–Smirnov normality test; asymmetry and kurtosis as well as their standard errors were analyzed.

The significance of differences was estimated using the Student’s t-test. The differences were considered significant when $t \geq 2.0$ — ($p < 0.05$), $t \geq 2.6$ — ($p < 0.01$), $t \geq 3.3$ — ($p < 0.001$).

Correlation between the studied parameters was considered strong when $r = 0.7$ – 1.0 , moderate when $r = 0.3$ – 0.699 , and weak when $r = 0$ – 0.299 [5].

The Statistica 13 PL software package (StatSoft, USA) was used.

The study did not violate human rights and endanger the respondents. The study met the requirements of biomedical ethics and was approved by the Ethics Committee of the

Pirogov Russian National Research Medical University (protocol No. 203 dated December 20, 2020) in accordance with the GCP principles. The informed consent was obtained from all participants. The online survey was conducted on a voluntary basis using the online service. All the studies were conducted in accordance with ethical norms set out in the Declaration of Helsinki and the European Union directives (8/609EC).

RESULTS

The medical students subjectively considered the risk to their health posed by lack of physical activity as relatively high. They assigned it the average ($M \pm m$) score of 8.5 ± 0.3 out of 10. The group of students who underestimated the risk was only 8.0%, i.e. the future doctors were aware of the adverse effects of physical inactivity on health. A total of 50.4% surveyed medical students considered their levels of physical activity as insufficient. Among the persons surveyed, 50.0% pointed out that that they preferred active leisure activities (sports, dancing, walking), and the other 50.0% noted that they preferred passive leisure activities (social networking, watching movies, reading, playing computer games); 46.8% of surveyed medical students reported no increase in physical activity during weekends.

During the study, the number of steps per day was used as an objective measure for describing physical activity. Researchers used primarily pedometers and similar devices for measurement of this parameter in the past. During our study the number of steps per day was defined using the Steps mobile application, because 99.5% of surveyed students used different models of smartphones, and 66.6% surveyed students rarely weaned themselves off the electronic devices, never lost their electronic devices, continuously monitored notifications on their electronic devices, etc. The other 31.3% monitored notifications on their electronic devices every hour.

Distribution of the indicator in the population is an important means for describing the indicator. The Kolmogorov–Smirnov normality test confirmed the hypothesis of normal distribution for the medical students’ physical activity parameter measured in steps per day, since the significance level was $p \geq 0.20$. The average ($M \pm \sigma$) number of steps showed no significant differences between males and females ($p \geq 0.05$). It was 9033 ± 3297 in males and 7807 ± 3570 in females. Thus, the average physical activity of male students was 5736–12,330 steps per day, and in female students it was 4237–11,314 steps per day respectively (Fig. 2).

According to the Tudor-Locke physical activity classification, limited physical activity intensity (2500–4999 steps per day) was observed in 6.0% of medical students, low physical activity intensity (5000–7499 steps per day) was observed in 16.0%, and the intensity of physical activity lower than average (7500–9999 steps per day) was observed in 32.0%. Moderate intensity of physical activity (10000–12499 steps per day) was observed only in 36.0% of medical students, and high physical activity intensity (12500 and more steps per day) was observed only in 10.0%. Thus, based on objective evidence, only 46.0% of medical students demonstrated commitment to the principles of the a healthy lifestyle in reality, which showed reasonable



Fig. 1. Study design

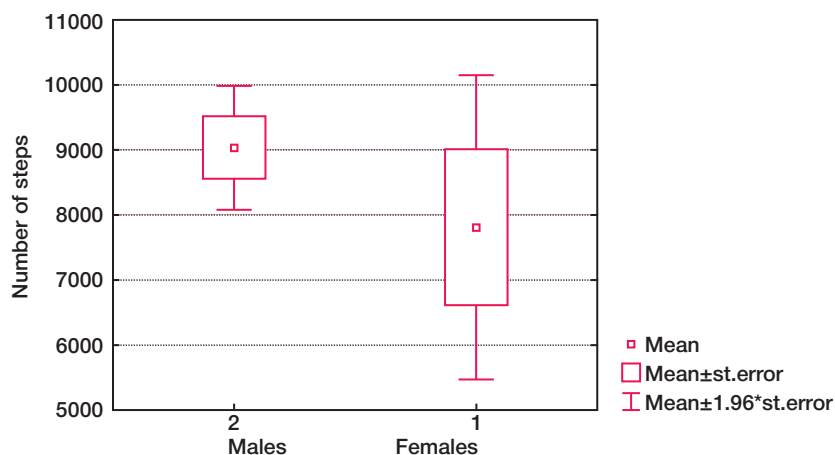


Fig. 2. Physical activity per day (steps) in male and female students

agreement with the surveyed medical students' subjective considerations.

Results of the physical activity assessment showed that the average ($M \pm m$) height of male students was 178.4 ± 0.9 cm, and in female students it was 166.8 ± 0.8 cm; the average body weight was 72.2 ± 1.3 kg and 56.9 ± 1.2 kg; the average body mass index was 22.5 ± 0.3 kg/m² and 20.4 ± 0.3 kg/m² respectively ($p \leq 0.05$). Obesity of various degree was observed in 10.1% of the examined medical students. However, only 2.9% of them believed they had health problems. Probably, the interviewed persons underestimated the significance of overweight and obesity. Then the data demonstrating the relationship between physical activity and average time spent on a smartphone per day were obtained, the correlation coefficient for the relationship between the number of steps per day and "screen time" of -0.36 (moderate negative correlation). Correlation coefficients for relationships between body mass index and physical activity (-0.35 , moderate negative correlation) and between body mass index and "screen time" (0.33 , moderate positive correlation) were calculated.

The average ($M \pm m$) values of the right and left hand muscle strength, which were dependent on physical activity levels, were low: 38.1 ± 0.2 and 37.1 ± 0.3 kg in males, 18.9 ± 0.3 and 16.7 ± 0.3 kg in females ($p \leq 0.05$). Since the vast majority of medical students rarely weaned themselves off the smartphones, the time spent on a smartphone was analyzed using the data obtained from the Screen Time application. According to the Screen Time application data, the average ($M \pm \sigma$) time spent on a smartphone was 336.4 ± 15 minutes per day, i.e. about 5.6 hours during the ordinary academic day. Correlation coefficient for the relationship between muscle strength and screen time was also calculated (-0.31 , moderate negative correlation).

Thus, modern medical students spend considerable time working with their smartphones, which has a negative impact on the levels of physical activity and physical fitness indicators in males and females.

The surveyed medical students gave their commitment to principles of healthy lifestyle an average ($M \pm m$) subjective ranking of 6.2 ± 0.2 out of 10. Furthermore, 18.8% of surveyed students did not consider themselves to commit to principles of healthy lifestyle, and 7.5% had no interest in healthy lifestyle. About 40.2% of students reported that they were careful about their levels of physical activity. The others were likely to underestimate the significance of this protective factor.

The surveyed medical students noted that they used some Health applications on their smartphones: 70.8% had installed

appropriate applications and sometimes browsed the data of monitoring heart rate, BMI, etc; 55.4% used the Screen Time application, 22.0% used the Steps application, and the others used nothing. The majority of medical students (83.3%) reported they obtained relevant information on healthy lifestyle from Internet sources. However, 88.2% of medical students reported no subscriptions to any resources on healthy lifestyle provided by medical institutions, working in prevention with the public (such as Centre of Hygienic Education of People of Rospotrebnadzor and other). Thus, there is some inconsistency; this also poses the question, which Internet resources are used by students to obtain information on healthy lifestyle.

The surveyed medical students ranked their willingness to provide an advice on commitment to a healthy lifestyle in terms of physical activity to patients (community) as relatively low: an average ($M \pm m$) of 5.6 ± 0.3 points out of 10. Moreover, 48.2% of students believed they were not prepared to this kind of activity.

The study results demonstrate that medical students rank their commitment to a healthy lifestyle and their physical activity based mainly on the subjective assessment, without supporting it with objective criteria, such as data of health applications for smartphone, data on body's functional status, no diagnoses, etc. It can be assumed that junior high school students have insufficient motivation to optimize their physical activity, being a powerful preventive factor possessing a health protection effect. They also have no essential motivation skills, as well as no access points to relevant information on this issue. Only about 50.0% of all surveyed medical students considered themselves as advocates for commitment to a healthy lifestyle for patients and community, including leading by example.

DISCUSSION

Models of physical activity and healthy lifestyle acquired during childhood and adolescence remain throughout the later life. Therefore, for the future health of the whole population it is essential to improve the levels of physical activity in young people [1, 4, 9, 13, 14].

Many factors interfere with increasing physical activity in young people:

- lack of time;
- low motivation;
- lack of support and guidance;
- feeling uneasy and incapable;
- lack of safe place for exercise;

- limited access to places and equipment for physical activity;
- lack of knowledge about the benefits of physical activity.

The studies have been published on investigation of physical activity and its relationship to improved health. These studies demonstrate positive correlation between physical activity and improved health of the subjects [4, 9, 14–17].

Therefore, there is a need for development of physical activity training programs, as well as public health programs aimed at improving the relevance of physical activity for the public [18, 19].

Shaping and development of knowledge and skills related to physical activity would be instrumental in addressing the issues both of medical students health improvement and quality preventive work with the patients. However, this challenge should be first met at the university level, where the principles of universal competence UC-7 (health protection) and general professional competence GPC-2 (healthy lifestyle) are developed in medical students [17–19].

It is essential to provide the future doctors training on principles of healthy lifestyle during studying at medical schools. This is important based on the results of the studies, which

demonstrate reduced number of students with healthy lifestyle after graduation [20–24].

CONCLUSION

In the process of medical schooling it is essential to aim for the target of at least 60.0% of medical students with optimum levels of physical activity.

The data obtained during the study allowed us to develop simple and feasible guidelines on improving physical activity in medical students:

1. Giving up the elevator in favor of the stairs.
2. Outdoor exercise (possibly combined with walking the dog) at least 30–40 minutes per day.
3. Housework, possibly combined with dancing.
4. Morning exercise, also with dance elements.
5. Walking with younger siblings, playing active games with them.

Each student should track the development of a positive habit of daily optimal physical activity. The results should be discussed within the framework of the business game Physical Activity in Various Sectors of Population.

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THE INFLUENCE OF CURRENT INFORMATION TECHNOLOGIES ON THE HEALTH STATUS OF SCHOOLCHILDREN

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The development of information technologies, their availability for every family, the transition to distance learning could not but affect health status of schoolchildren. In the past year, amid the spread of the new coronavirus infection, the time that schoolchildren spend with gadgets has significantly increased. The relevance of this study is determined by the evaluation of the ever-increasing and, as a rule, negative impact of computer technologies on the health of schoolchildren. The study aimed to investigate the features of the effect information technologies have on the well-being of high school students and to analyze the role teachers play in popularization of healthy lifestyle and reduction of the degree of influence of information technologies on health of modern schoolchildren.

Keywords: modern information technologies, school, teacher, health of schoolchildren, lifestyle.

Author contribution: Sokolova AI — literature analysis, statistical processing, article authoring; Yaskova EE — material collection, statistical processing, literature analysis.

Compliance with ethical standards: The respondents participated voluntarily, through filling out questionnaires online. The study conformed to the biomedical ethics requirements and did not endanger the participants.

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ВЛИЯНИЕ СОВРЕМЕННЫХ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ НА СОСТОЯНИЕ ЗДОРОВЬЯ ШКОЛЬНИКОВ

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Развитие информационных технологий, их доступность для каждой семьи, переход на дистанционную форму обучения не могло не сказаться на состоянии здоровья обучающихся. В последний год в условиях распространения новой коронавирусной инфекции существенно возросло время, которое школьники проводят в контакте с современными гаджетами. Оценка всё возрастающего, как правило, негативного воздействия компьютерных технологий на состояние здоровья обучающихся и определяет актуальность проведённого исследования. Цель исследования заключалась в том, чтобы изучить особенности воздействия информационных технологий на самочувствие старшеклассников, а также определить роль учителя в профилактике здорового образа жизни и снижении степени влияния информационных технологий на состояние здоровья современных школьников.

Ключевые слова: современные информационные технологии, школа, учитель, здоровье школьников, образ жизни.

Вклад авторов: Соколова А. И. — анализ литературы, статистическая обработка, написание статьи; Яськова Е. Е. — сбор материала, статистическая обработка, анализ литературы.

Соблюдение этических стандартов: Данное исследование проведено на добровольной основе с использованием онлайн-сервиса. Исследование соответствовало требованиям биомедицинской этики и не подвергало опасности участников.

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In the recent years, information technology has become an integral part of life of almost every person, especially children and adolescents leading an active lifestyle. Information technologies are all around us: at home, at school, at work, on the street, in public and private transportation, etc.; they enable the necessary communication, receipt and transmission of information, and nowadays we simply cannot refuse using them [1]. However, despite the convenience and the practical aspects, what should not be forgotten is the harm done by electronic gadgets to health, child's health in particular, when used in violation of the applicable sanitary regulations and rules.

Current computer technologies, means of transmission of information, have become an integral part of school life for both teachers and students. Interactive whiteboards, TV sets, projectors, computers, cell phones and tablets are replacing paper teaching aids; thanks to them, we can find the necessary

information much faster and perform complex calculations. But does a schoolchild know how to safely use various information technologies and electronic devices? What is the extent of their negative impact on the health of this schoolchild? Large-scale adoption of electronic devices, constant use of information technology by children at home and at school affects the state of their health. Within the last 15 years, the diseases of the eyes have been on the rise among children and adolescents, which coincides with the active introduction of information technologies into educational process [2, 3, 4, 5, 6].

Our study aimed to investigate the features of the effect information technologies have on the well-being of high school students and to analyze the role teachers play in popularization of healthy lifestyle and reduction of the degree of influence of information technologies on the health of modern schoolchildren.

MATERIALS AND METHODS

As part of this research effort we analyzed the data obtained through surveying ninth-grade students of 102 Secondary School of the city of Voronezh. The questionnaire was designed to allow the participants to express their subjective assessment of the degree of impact of information technology on the well-being of schoolchildren. There were 15 questions and multivariate formalized answers thereto.

In total, 50 people aged 14–15 took part in the survey. We decided to select this age group because when schoolchildren turn 14–15, they start spending significantly more time with electronic devices. To ensure representativeness of the answers, the participants were not given an opportunity to discuss the questionnaire and could take as much time as they needed to fill it out.

The data obtained were processed with Statistica 13.0. The values were preliminarily assessed for conformity to the law of normal distribution of the variational series. Since distribution of the quantitative data was not different from the normal, we applied the methods of parametric statistics.

The study did not infringe on human rights, did not endanger the respondents, and met the biomedical ethics requirements. At all stages, the study conformed to the ethical standards set out in the Declaration of Helsinki and the EC Directives 8/609.

RESULTS

Introduction of the new means of communication, hardware and software into the educational process gradually made the term “computer-based learning technologies” obsolete and replaced by the concept of “information learning technologies”. Information learning technologies (ILT) are a set of methods, hardware and software enabling collection, organization, storage, processing, transmission and presentation of the information that expands people’s knowledge and develops their ability to manage technical and social processes [7, 8]. Information technologies play an important part in the development of various diseases in children and adolescents, although they are not the primary cause thereof. Researchers note that fewer and fewer pupils leave school healthy and the number of children suffering from various diseases is increasing [9].

A statistical analysis of the data from our survey showed that all the respondents have computers, but not all of them have a workplace with special computer furniture: 86% of schoolchildren have a table and an armchair, 10% have only a table and 4% have only an armchair (Figure 1).

Prolonged sitting at the computer causes metabolic disorders in the musculoskeletal system. Poorly selected

furniture or lack thereof can have an adverse effect on the child’s posture, cause painful sensations in the neck, back, wrists, all of which can trigger development of musculoskeletal system disorders in the future [10].

It should be noted that only slightly more than half of the respondents control their posture when working at a computer (56%), the overwhelming majority (84%) are aware of what the correct posture should be and 56% of the schoolchildren surveyed do breaks for physical exercises (on their own, without reminders from anyone else) while working with electronic devices.

The current epidemiological situation in the country and in the world can cause the development of psychoemotional disorders in children due to the forced transition to distance learning. There is a particular problem of the younger generation entering the world of information technology, this younger generation being children with fragile psyche most susceptible to destructive influences. Included in the process of growing-up, the rapidly evolving information technology plays a significant role in the development of children’s memory and shaping the way they think. The stream of incoming information is ceaseless, which prevents the brain from storing it. There is also a problem of constant attention switching that can make the children unable to concentrate on anything.

SanPiN (sanitary regulations and standards) SP 2.4.3648–20 “Sanitary and Epidemiological Requirements for Organizations Rendering Fostering, Educational, Recreational Services for Children and Youth” limits use of electronic teaching aids in a lesson as follows: interactive whiteboard — 20 minutes for children under 10, 30 minutes for children over 10; computer — 20 minutes for 1st and 2nd grade children, 25 minutes for 3rd and 4th grade children, 30 minutes for 5th through 9th grade children, 35 minutes for 10th and 11th grade children. Extracurricular activities employing electronic devices, independent use of gadgets should also be regulated, but, unfortunately, this is rarely the case.

The results of our survey confirm that modern schoolchildren are not fully aware of the sanitary standards established for working with electronic devices. Half of the respondents believe that it is safe to spend 2–3 hours a day at a computer, 30% believe the duration of the safe period is 1–1.5 hours and 20% of schoolchildren are convinced that it is possible to spend over 3 hours a day before the computer’s display (Figure 2). The survey included a question “What is the allowed duration of a single continuous session of work at the computer?”, to which 46% of the schoolchildren replied with 30 minutes, 28% believed it was 1 hour and 26% — 2 hours.

The computer completely captures the child’s attention, who ceases to control his/her posture and loses track of

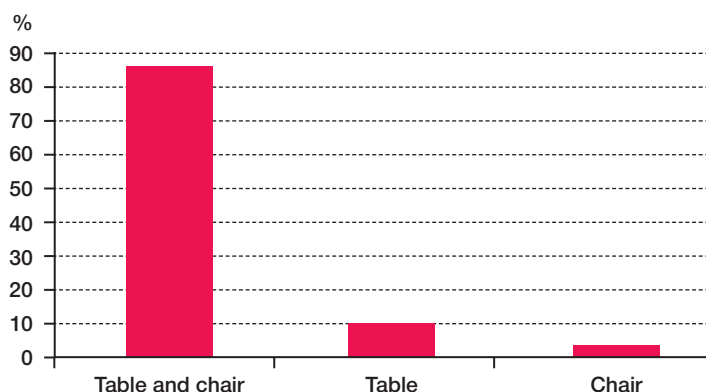


Fig. 1. Analysis of the pupils’ answers to the question “Does your workplace have special furniture?” (% of positive answers, n=50, p<0.05)

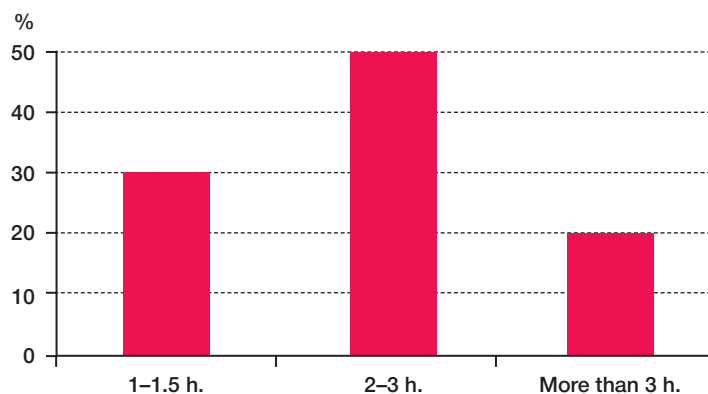


Fig. 2. Analysis of the pupils' answers to the question "How many hours a day can children of your age work at the computer?" (% of positive answers, n=50, $p \leq 0.05$)

time. Prolonged use of electronic devices and information technologies contributes to the development of rather serious pathologies in the various systems of a schoolchild's body, including the locomotor system, organs of sight, cardiovascular and nervous systems.

With the help of the questionnaire, we compared the amount of time children spent at the computer when they studied in person and after they switched to distance learning. During the in-person study period, 44% (the majority) of pupils spent 1–2 hours at the computer, 40% had 2 to 4 hours of computer time a day, 8% dedicated 5–7 hours to the computer and 8% even more than 7 hours. Switching to distance learning marked a drastic increase of the amount of time schoolchildren sit before the computer's display: 30% reported 5–7 hours, 30% — 7–9 hours, 28% stated their computer sessions lasted 2 to 4 hours and 12% confessed of 10–12 daily hours at the computer. As a result 63% of the respondents experienced neck and back pains during the distance learning period, 41% felt dryness and pain in the eyes, 27% suffered from dizziness and headaches and 16% registered pain in their arms. In addition, 24% of the schoolchildren that filled out the questionnaire mentioned poor appetite, 34% noticed the quality of their sleep deteriorated and they suffered from insomnia after long hours at the computer, 12% of the respondents noticed they have put on 1–2 kg and 4% registered an even greater, 3–4 kg increase of the body weight.

DISCUSSION

The data we have obtained indicate that, to perform well academically and otherwise, schoolchildren need rationally organized workspace and electronic device/information technology use time rationing not only at school but also at home.

There is no doubt that current information technologies and electronic devices make both the learning process and the life of a pupil much more interesting and rich. After all, these technologies and devices enable learning something new on any school subject or attending training courses outside the school curriculum, going on virtual tours through museums and exhibitions, communicating with friends and making new ones regardless of where in the world they live. We find confirmation of this in the publications by researching teachers [11, 12]. It is beyond any question that today, self-development and self-education rely on the information technologies and electronic devices. But the most important issue in this connection is the issue of assessing the impact of these technologies on the health of a person, first of all, health of a child. This issue incorporates load rationing, workplace organization and, which

is very important, self-control and self-restraint in the process of using the gadgets. A number of recent publications address the said issue. Some researchers [13, 14, 15, 16] note the state of eyes of the schoolchildren deteriorates in association with the excessive use of electronic devices, and the development of a healthy lifestyle stumbles because of the long hours of playing with gadgets.

Prolonged sitting at a computer breaks the daily routine, which adversely affects health of schoolchildren. Their nocturnal sleep time grows shorter, and, although they understand it is unhealthy, the children still stay up and before the computer late. A long stay indoors, relatively motionless, without going out into the fresh air, contributes to the development of hypodynamia, which manifests in impairments of blood circulation, respiration and other body functions; schoolchildren often complain of headaches, eye strain and feeling unwell. Improper posture, poorly selected furniture, position of the computer display, chair and table height can also harm health. Electromagnetic radiation from electronic devices also has an adverse effect on the schoolchild's health, compromising immune, endocrine and other systems. To prevent unwanted consequences in the future, parents should pay attention to the time their child spends using the phone, tablet, computer or watching TV.

Children spend a significant part of their time at school. What is the role of the teacher in reducing the risk of health problems in pupils? Undoubtedly, the teacher plays an essential part in the primary prevention of diseases, controlling, first of all, observation of the sanitary standards and school hygiene rules in the context of curricular and extracurricular activities, and secondly, actively developing and implementing various measures aimed at making the schoolchildren and their parents more knowledgeable about safe use of the information technology and electronic devices.

In our opinion, the teacher should, first of all, be the source of useful information. Schoolchildren often do not attach importance to the load they subject themselves to when using various kinds of electronic devices extensively. With their health being well, the negative consequences thereof may be a few months, or even years, delayed for them. It is the teacher who, having the knowledge, must present this information in an accessible form, with maximum efficiency, draw the schoolchildren's attention to especially important points. Such explanatory conversations can take place both in the classroom and in the course of extracurricular activities, and be regular. They will contribute to the formation of an adequate and conscious self-assessment of the pupils' behavior in the context of use of electronic devices, development of the gadget time control skill and, further on, a life routine dominated by the healthy lifestyle values.

Taking the next step, a teacher can shape the environment that has schoolchildren busy not only during the lessons but also after them: organize various events, sightseeing tours, sports competitions, etc., involving parents to a certain extent.

Developing a system of psychological and pedagogical protection of schoolchildren from various kinds of negative effects of exposure to electronic devices, the teacher not only helps to preserve their health but also contributes to the formation of their communicative behavior and personal growth.

CONCLUSIONS

Thus, summing up the results of our research, we can state that in the recent years such work has only gained in relevance because of the widespread introduction of electronic devices

and information technologies in almost all spheres of life. The impact of information technology on the health of schoolchildren can be characterized in two ways. On the one hand, it really opens up opportunities for modern pupils, enabling learning about the world around them and self-education. On the other hand, this variety of possibilities can produce positive results only if the use of electronic devices and information technology is strictly regulated factoring in age-related anatomical and physiological features of bodies of children and adolescents, as well as individual characteristics of each of them. Otherwise, the consequences for the health of pupils will be negative. What should also be underscored is the important role played by parents and teachers not only as controlling parties but also in the context of prevention of the diseases caused by the widespread penetration of information technologies into the everyday life.

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