

## EVALUATION OF EFFICACY OF PROVIDING HYGIENE EDUCATION TO SCHOOLCHILDREN AND STUDENTS IN THE PROCESS OF DEVELOPMENT OF THE SAFE ELECTRONIC DEVICE USE SKILLS

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The negative impact of the digital environment on the health of young people necessitates the search for new methods of hygienic education. This study aimed to test and assess the hygienic qualities of the practice designed to give students and schoolchildren the skills allowing safe use of electronic devices. The study involved 256 students, 200 senior schoolchildren, 400 teachers and 251 parent. The hygienic education practice relied on the healthy lifestyle materials published in scientific literature, as well as materials posted on the Internet resources of medical organizations professionally engaged in the area considered, as well as their groups in the social networks Odnoklassniki, VKontakte, Facebook, Instagram, etc. We observed physical development of the schoolchildren and students dynamically and polled schoolchildren, students, teachers, and parents. For statistical processing of the results, we used methods of descriptive statistics, Student's t-test, correlation, discriminant and cluster analysis, and calculated risks. As the most popular source of information about health maintenance, Internet scored as follows: among schoolchildren — 79.0%, students — 88.6%, parents — 64.9%, teachers — 50.4%. The tested hygienic education practice allowed for a reduction of the number of schoolchildren and students who did not have the skills to safely use electronic devices to 20 and 25%, respectively. The practice also taught the participants to reduce their daily smartphone use time, engage in physical activity more often, which ultimately increased the share of children whose physical development was normal ( $p \leq 0.01$ ), and helped to increase the duration of night sleep. The tested methods of education are not costly; they can be replicated in other regions and organizations.

**Keywords:** schoolchildren, students, electronic devices, rules of use, hygiene education, assessment of the effectiveness

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**Compliance with ethical standards:** the study was approved by the Ethics Committee of the Pirogov Russian National Research Medical University (Minutes #159 of November 21, 2016), conducted in compliance with the ethical standards provided by the Declaration of Helsinki and the European Community Directives (8/609 EU). Each participant signed a voluntary informed consent form. The participating adults (parents and teachers) were polled voluntarily with the help of an online service.

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## ОЦЕНКА ЭФФЕКТИВНОСТИ ГИГИЕНИЧЕСКОГО ВОСПИТАНИЯ ШКОЛЬНИКОВ И СТУДЕНТОВ ПО ФОРМИРОВАНИЮ НАВЫКОВ БЕЗОПАСНОГО ИСПОЛЬЗОВАНИЯ ЭЛЕКТРОННЫХ УСТРОЙСТВ

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Негативное влияние цифровой среды на здоровье молодежи стимулирует поиск новых приемов гигиенического воспитания. Целью работы были апробация и гигиеническая оценка эффективности практики формирования здорового образа жизни у студентов и школьников в части формирования навыков безопасного использования электронных устройств. В исследовании приняли участие 256 студентов, 200 учащихся старших классов, 400 преподавателей и 251 родитель. Гигиеническое воспитание осуществляли с использованием опубликованных в научной литературе материалов по здоровому образу жизни, а также материалов, размещенных на Интернет-ресурсах медицинских организаций, профессионально работающих в этой области и их группах в социальных сетях «Одноклассники», «ВКонтакте», «Facebook», «Инстаграм» и др. Было организовано динамическое наблюдение за физическим развитием школьников и студентов, а также анкетирование школьников, студентов, преподавателей, родителей. Для статистической обработки результатов использовали методы описательной статистики, *t*-критерий Стьюдента, корреляционный, дискриминантный и кластерный анализы, проводили расчет рисков. Наиболее популярным источником информации о сохранении здоровья респонденты отметили Интернет: среди школьников — 79,0%, студентов — 88,6%, родителей — 64,9%, преподавателей — 50,4%. Апробированная практика гигиенического воспитания позволила снизить число школьников и студентов, не имевших навыков безопасного использования электронных устройств до 20 и 25% соответственно; сократить продолжительность использования смартфона в течение дня; увеличить двигательную активность, а также долю детей с нормальным физическим развитием ( $p \leq 0,01$ ); способствовала увеличению продолжительности ночного сна. Апробированные способы воспитания финансово не затратны и могут быть тиражированы в других регионах и организациях.

**Ключевые слова:** школьники, студенты, электронные устройства, правила использования, гигиеническое воспитание, оценка эффективности

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The target of the Healthy Lifestyle Popularization (Public Health Improvement) Priority Project is to raise the share of the Russian population living a healthy lifestyle to 60% by 2025 [1]. Project execution includes a large-scale information campaign in the media, on various Internet resources, in social networks. The campaign will focus on maintaining health. The project aims to invite healthy lifestyle (HL) experts to collect, test and replicate the health maintenance best practices relevant for various groups of population.

Popularization of HL among children, adolescents and youth has always been regarded by specialists as a complex, systemic, multi-level process, covering all spheres of life of the younger generation [2–5].

All aspects of life are digitalized nowadays; this is a global trend. Digital environment affects significantly the learning process of children, adolescents and youth, their leisure time, socialization, health status and lifestyle [6–10].

Against the background of digitalization, children, adolescents and the youth have switched to the new main source of information on health preservation, the internet, and they rely on their parents, teachers and medical workers to a lesser extent in this regard [11].

Innovative methods of HL promotion become more important. Such include flash mobs, quests covered on social media, economic incentives and the like. They are more attractive to the young people compared to the traditional methods that were used several decades ago [12–14].

However, with the digitalization as it is currently, there are practically no research reports assessing effectiveness of the internet as the hygienic education enabler for the younger generation. The Yamal Center for Public Health and Medical Prevention can be taken as an example of the internet resource containing relevant information on the healthy lifestyle. Employees of the Center run an active information and communication campaign on various internet resources and social networks: they post materials on prevention of diseases and regularly hold various creative contests promoting healthy lifestyle. Similar work promoting prevention, including prevention of non-infectious diseases, is done by the specialists of the National Medical Research Center of Therapy and Preventive Medicine and the Center for Hygienic Education of the Population under Rospotrebnadzor.

The share of people living the healthy lifestyle and observing the rules of safe use of electronic devices (ED) is low [15–16]. This fact indicates that the existing preventive measures are insufficient, and there is a need to further research and intensify education efforts aimed at giving the younger generation hygiene skills, including those allowing them to use ED safely.

This study aimed to test and assess the effectiveness of the hygiene education of students and schoolchildren relying on the information available online, including education granting skills needed to use electronic devices safely.

## METHODS

In the context of this study, 2<sup>nd</sup> and 3<sup>rd</sup> year medical students received hygiene education over the course of two years. The students were studying hygiene as part of the Federal State Educational Higher Education Standard. Another track of the study had Department of Hygiene employees and postgraduate students teaching ED safe use skills for study and leisure at Dolgoprudnenskaya Grammar School (Moscow region). The hygiene skills were taught to schoolchildren, their parents and teachers.

The study inclusion criteria were: voluntarily signed informed consent form; age of schoolchildren, students;

correct completion of the questionnaire. The participating adults (parents and teachers) were polled voluntary with the help of an online service<sup>1</sup>.

Standard methods and tools enabled physical development dynamic control through the study [17].

The experimental group consisted of 128 medical students (mean age 20 years) and 100 schoolchildren (mean age 16 years); the participants attended Dolgoprudnenskaya Grammar School. The control group consisted of 128 medical students and 100 senior schoolchildren attending other schools at Dolgoprudny; they were not receiving hygiene education. The study also involved 251 parents and 400 teachers/professors working at primary, secondary and higher education organizations.

We used all educational methods (verbal, printed, visual, mixed) and such means as conversation, discussion, lecture, memos, leaflets, posters, video materials, telecommunications etc. In particular, teaching schoolchildren and students hygiene, we employed materials published to the official websites and social network pages of the Yamal Center for Public Health and Medical Prevention, National Medical Research Center of Therapy and Preventive Medicine and the Center for Hygienic Education of the Population under Rospotrebnadzor, as well as videos posted to the YouTube channel.

Factoring in the high interest the youth, their parents and teachers have in social media and websites, and considering how deeply engaged they are with the online resources, we recommended them to seek HL information online, from the specialists available for consultations in the Odnoklassniki, VKontakte, Facebook, Instagram, Telegram social networks, as well on the websites of specialized medical organizations.

In addition, the official website of the Dolgoprudny Grammar School offered HL information with practical recommendations for teachers and parents.

We tested how some HL apps by various developers work in the context of provision of hygiene education. Such apps were installed by schoolchildren and students on their personal smartphones and allowed counting/monitoring body mass index, screen time, steps, nighttime sleep.

The program of the hygiene education measures relied on the use of the following: materials covering prevention of risks associated with the technical and audiovisual properties of ED (electromagnetic radiation, air ionization, screen diagonal, screen brightness level etc.), room microclimate parameters and illumination level; workplace ergonomics, work-rest balance information; information on prevention and health-improving measures.

To assess the effectiveness of HL skills development in students and schoolchildren, we developed special questionnaires in Google Forms, which were made available to the participants [18]. The questionnaires contained questions designed to learn the peculiarities of ED use by schoolchildren and students, their level of awareness of the risks associated with uncontrolled use of ED, shape of their safe ED use skills, and subjective assessment of the respondents' health status [18].

The statistical processing of the data was enabled by Statistica 13.0 (StatSoft Inc.; USA). In our work, we used the methods of descriptive statistics, Student's t-test, correlation, discriminant and cluster analysis, risks calculation. The differences were considered significant at  $p = 0.05$ .

## RESULTS

We employed both the traditional and innovative teaching methods and means in providing hygiene education to

**Table.** Time schoolchildren spent using smartphones during the day and their body fat mass depending on the effectiveness of mastering the hygiene education program

Indicator	Group of schoolchildren that responded positively to the hygiene education program		Group of schoolchildren that did not receive hygiene education or for whom it was ineffective		<i>p</i>
	Me	[ <i>Q</i> <sub>25</sub> ; <i>Q</i> <sub>75</sub> ]	Me	[ <i>Q</i> <sub>25</sub> ; <i>Q</i> <sub>75</sub> ]	
Time spent using a smartphone a day, minutes	180	[90; 300]	720	[480; 900]	< 0.001
Body fat, kg	12	[9; 17]	14	[11; -23]	< 0.001

schoolchildren and students. The traditional methods and means were conversations, discussions using visual materials, leaflets and posters; the innovative set included business games, web quests, topical discussions with specialists online (on social media), information blogs, HL apps. The program was based both on the official materials and on the previously published information on the ED safe use rules that the authors developed in the context of their previous research efforts.

The questionnaires allowed identifying the time slot when using an ED is safe, i.e. when schoolchildren and students report no complaints about their health. We registered significant differences ( $p \leq 0.05$ ) when comparing time spent using an ED by schoolchildren and students that complained and that did not complain about the state of their health. The complaining schoolchildren and students spent considerable more time using ED (given as Me [*Q*<sub>1</sub>; *Q*<sub>3</sub>]) in minutes — (660 [420; 960]), than the schoolchildren/students reporting no complaints — (480 [360; 750]). To determine the likelihood of complaints associated with ED use, as well as to find the maximum allowable duration of such use that would not entail health complaints, we carried out discriminant analysis that yielded the following theoretical model:

$$Y_c = -1.655 + 0.02 \times X_{time},$$

where  $Y_c$  is the discriminant function characterizing the likelihood of complaints;  $X_{time}$  — time spent with an ED.

The constant of discrimination that divided the participants into two groups was determined as the value of the function equidistant from the centroids. In the no-complaints group it was — 0.216, and in the complaints group it equaled 0.080. The sensitivity of the model reached 73.3%, its specificity — 62.6%.

According to this model, schoolchildren and students may spend 78 minutes with an ED without developing health conditions entailing complaints afterwards. This figure formed the background for the hygiene education program developed. Based thereon, we established the allowed ED use time, work-rest balance, breaks involving eye and body exercises.

The data obtained indicate there is a relationship between physical activity and the average time spent with a mobile ED daily, with the correlation ratio between the number of steps per day and the screen time at  $-0.36$ . Based on these findings, we recommended replacing a portion of screen time with physical activity, decreasing the former and increasing the latter. The suggested educational effectiveness assessment criteria are the counted minutes of screen time and steps made.

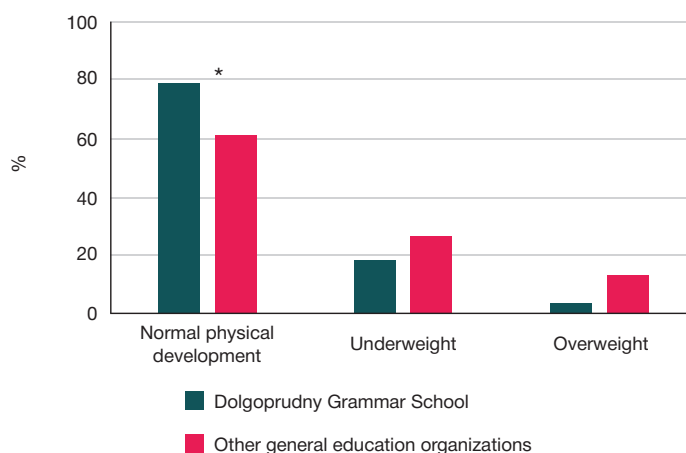
The participants trust internet as the source of information, including health maintenance and HL advice. The aggregated levels of trust reported by them are as follows: students — 88.6%; senior schoolchildren — 79.0%; parents — 64.9%; teachers — 50.4%. Considering this fact, we integrated materials published to the websites of specialized medical organizations and their social network pages, as well as online communication with specialists, into the hygiene education program.

Parents of schoolchildren and teachers who had completed the adapted training course and also seek information on the websites of specialized medical organizations participated in provision of hygiene education to the children.

The work in the context of this study allowed compiling a group of schoolchildren and students that responded well to the hygiene education.

The HL apps schoolchildren used on their personal smartphones enabled them to monitor their body mass index, steps taken, screen time, and nighttime sleep duration. Students participating in the hygiene education program had the number of steps taken increased significantly compared to their peers not included in the study ( $p \leq 0.01$ ), the figures being  $13.068 \pm 70$  vs  $9033 \pm 90$  steps for boys and  $8555 \pm 50$  vs  $7807 \pm 70$  steps for girls, respectively.

According to the app registering nighttime sleep, schoolchildren participating in the study saw the duration of their sleep growing to 8 hours ( $482 \pm 42$  minutes), which is close to hygienically justified recommendations, while schoolchildren not involved in the program did not exhibit such a trend. On average, the participating schoolchildren decreased their ED use time to 3.8 hours ( $230 \pm 30$  minutes) per a school day.

**Fig.** Senior schoolchildren from the Dolgoprudny Grammar School and other general education organizations of Dolgoprudny by level of their physical development ( $p < 0.05$ )

Cluster analysis based on the dynamics of the studied indicators allowed dividing the schoolchildren into groups. On average, schoolchildren and students who have successfully mastered the hygiene education program spent less time using their smartphones during the day and had better physical development indicators (see Table).

Thus, their average body fat mass was 12 kg and that of students that did not learn the hygienic education program effectively was 14 kg ( $p \leq 0.001$ ). The results of comparison of the groups by the excess body weight were significant ( $p \leq 0.004$ ). Schoolchildren that received no hygiene education or responded poorly to the effort were 2.44 times more likely (OR — 0.41; 95% CI: 0.23–0.73) to gain excess weight than those who mastered the program, the relative risk for the former being 2.01 (95% CI: 1.29–3.21).

Through the two years of the study, it allowed increasing the share of Dolgoprudny Grammar School's senior schoolchildren with normal physical development characteristics (to  $79.0 \pm 1.7\%$ ;  $p \leq 0.01$ ). The comparison was made with other general education organizations of the city that did not offer hygiene education to their pupils. In these schools, the number of senior schoolchildren whose physical development could be considered normal was low ( $61.0 \pm 1.5\%$ ) (see Figure).

Only 25% of the senior schoolchildren from Dolgoprudny Grammar School had dynamometry indicators below average, while the same share among their peers from other schools was 45% ( $p \leq 0.05$ ), which may indicate they suffer from a physical activity deficit.

Questionnaires filled by the schoolchildren and students when the hygiene education program was complete revealed smaller number of complaints about eye conditions from the participants, as well as the decrease of the share of schoolchildren and students not having the ED safe use skills to 20% and 25%, respectively.

In addition, as part of the hygiene curriculum practice, professors gave medical students general cultural competencies using business game elements, web quests, which motivated the said students to not only lead a healthy lifestyle but also to study the subject. Some students began to call themselves "rational nutrition bloggers", "health bloggers", "ED safe use bloggers" etc. They became more active in publishing HL-related information to their blogs and their social media pages, which is a good HL promotion experience for future doctors.

## DISCUSSION

The current education system is a "risk zone": the educational process intensifies, and this intensification entails mental loads, poor physical activity, lack of night sleep, work-rest balance violations [19–22]. The learning process is dynamic, highly labor intensive; there is a wide range of forms and methods of teaching used, the amount of information involved is growing, and educational technologies rely on ED, which makes children, adolescents and youth draw upon their adaptation reserves [23–29]. In such conditions, popularization of HL and ED safe use skills should be an effective preventive measure [12, 13, 15]. With the educational environment turning digital, raised awareness of the safe use of ED and the related HL principles, as well as mastered skills needed to implement them, should be the basis for safe behavior of the educational process participants (teachers/professors, medical workers, schoolchildren/students) [30].

This study has shown that all categories of respondents consider internet to be the most popular source of information on health maintenance. As for the "sources" of HL-related

information, two-thirds of students said such were their professors, and more than half of schoolchildren — their parents. This should be taken into account by parents of schoolchildren and teachers when they develop the general cultural competence in youth. It also necessitates raising the HL awareness among adults and fostering their HL skills practiced both in their professional activities and everyday life [15, 30]. In view of development of the digital educational environment, it is advisable to improve the training of teachers on the safe use of ED and HL principles [2, 15].

Previous studies have shown that over a third of parents (35%) and teachers (40%) lack ED safe use skills. Among medical students, the share of those belonging to the same "risk group" was 40%, and among schoolchildren — 35% [15].

The study allowed formulating the key points that need to be added to the program of hygiene education of schoolchildren and students aimed at teaching them ED safe use skills:

- keeping the correct work-rest balance, rational organization of night sleep and physical activity;
- reduction of the ED use time to 3 hours a day, with breaks every 40 minutes — 1 hour;
- training eye strain prevention exercises and exercises to relieve general fatigue;
- use of apps to monitor screen time, physical activity and other parameters;
- participation in social media groups/pages maintained by medical organizations and containing correct information on health and healthy lifestyle;
- increasing motivation to participate in hygiene education programs by using innovative elements popular among young people, stimulating interest among medical students — to blog in the field of health;
- involvement of the closest circle of schoolchildren and students (parents, teachers, professors) in promoting healthy lifestyles.

The data obtained allows recommending the tested program for the purposes of teaching hygiene to the younger generation, their parents and specialists the professional duties of which include giving youth the knowledge, skills and abilities to use ED safely and lead a healthy lifestyle.

## CONCLUSION

The study has shown the effectiveness of giving hygiene education to schoolchildren and medical students aimed at development of the electronic devices safe use skills and relying on traditional and innovative teaching methods. To increase the effectiveness of hygiene education, it is necessary to also popularize HK among teachers and parents, whom children, adolescents and youth perceive as carriers of the relevant information. HL promotion should be included in the preventive discipline curricula, for example, the hygiene course read to the medical and pediatric faculty students, since in their future professional activities they will become "sources" of information about HL for the younger generation and the patients. It is strongly recommended to teach various categories of the population the techniques of monitoring parameters related to physical activity, sleep, screen time control etc. Mobile apps installed on personal smartphones can enable such monitoring. We suggest judging the degree of mastering the hygiene education program by the participants' level of awareness about risk factors associated with uncontrolled use of ED and their ED safe use skills. The assessment may rely post-course polling of the participants. The tested methods are not costly; they can be replicated in other regions and organizations.

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