

## EFFECT OF DIFFERENT MOBILE DEVICE SCREEN TIME DURATIONS ON NEUROPSYCHIATRIC HEALTH OF SCHOOLCHILDREN

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Uncontrolled screen time is a worldwide menace to health of the population. Today, the state of neuropsychiatric health of schoolchildren depends on various factors, including screen time, i.e., the time they spend using mobile electronic devices. This study aimed to investigate how different screen time durations affect the said neuropsychiatric health of this population group. In the 2022–2023 academic year, we surveyed 109 Moscow schoolchildren (35 boys and 74 girls) using questionnaires compiled by A.M. Vane (identification of signs of vegetative symptoms) and S.K. Kulakov (identification of internet addiction). The mean age of the participants was  $14.9 \pm 0.12$  years. The children were divided into two groups: those staying within the regulated limit of mobile screen time (group 1,  $n = 11$ ), and those exceeding that limit (group 2,  $n = 98$ ). In group 1, the average mobile screen time, as measured for one month, was  $110.50 \pm 10.00$  minutes per day, in group 2 —  $345.00 \pm 15.00$ . The average Vane questionnaire scores differed significantly between the groups ( $p \leq 0.01$ ):  $12.30 \pm 1.89$  points in group 1 and  $22.54 \pm 1.16$  points in group 2. Signs of vegetative symptoms were registered in 45.9% of group 1 participants and 63.6% of group 2 participants ( $p \leq 0.01$ ). The average Kulakov questionnaire scores differed significantly between the groups ( $p \leq 0.05$ ):  $28.7 \pm 1.88$  points in group 1 and  $37.1 \pm 1.09$  points in group 2. Schoolchildren who exceed the regulated mobile screen time limit are at risk of developing vegetative disorders and internet addiction.

**Keywords:** neuropsychiatric health, schoolchildren, mobile electronic devices

**Author contribution:** all authors contributed to the publication equally.

**Compliance with ethical standards:** the study was approved by the local Ethics Committee of the N.I. Pirogov Russian National Research Medical University (Minutes № 655 of April 23, 2019); signed voluntary informed consent forms were obtained for each participant

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**Received:** 02.10.2023 **Accepted:** 20.10.2023 **Published online:** 29.10.2023

**DOI:** 10.24075/brsmu.2023.040

## СОСТОЯНИЕ НЕРВНО-ПСИХИЧЕСКОГО ЗДОРОВЬЯ ШКОЛЬНИКОВ ПРИ РАЗЛИЧНОМ ВРЕМЕНИ ИСПОЛЬЗОВАНИЯ МОБИЛЬНЫХ ЭЛЕКТРОННЫХ УСТРОЙСТВ

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Мировая проблема для здоровья населения — неконтролируемое время использования электронных устройств. Состояние нервно-психического здоровья современных школьников связано с различными факторами, в том числе со временем использования мобильных электронных устройств. Цель исследования — анализ состояния нервно-психического здоровья школьников при различном времени использования мобильных электронных устройств. В 2022—2023 учебном году с помощью опросников А. М. Вейна для выявления признаков вегетативных изменений и С. К. Кулакова для выявления интернет-зависимости было опрошено 109 школьников (35 мальчиков и 74 девочек), обучающихся в образовательных организациях г. Москвы. Средний возраст составил  $14,9 \pm 0,12$  лет. Школьники были разделены на две группы: соблюдающие регламент использования мобильных электронных устройств (первая группа,  $n = 11$ ) и превышающих регламент (вторая группа,  $n = 98$ ). Средний показатель экранного времени использования мобильных электронных устройств за месяц составил в первой группе  $110,50 \pm 10,00$  мин/день, во второй —  $345,00 \pm 15,00$ . Средние значения баллов по опроснику А. М. Вейна в первой и второй группах имели достоверные различия ( $p \leq 0,01$ ) и составили  $12,30 \pm 1,89$  и  $22,54 \pm 1,16$  баллов. Наличие признаков вегетативных изменений в первой и второй группах составило 45,9% и 63,6% ( $p \leq 0,01$ ). Средние значения баллов по опроснику С. К. Кулакова в первой и второй группах имели достоверные различия ( $p \leq 0,05$ ) и составили  $28,7 \pm 1,88$  и  $37,1 \pm 1,09$  баллов. Школьники, превышающие регламент использования мобильных электронных устройств, находятся в группе риска по формированию вегетативных нарушений и интернет-зависимости.

**Ключевые слова:** нервно-психическое здоровье, школьники, мобильные электронные устройства

**Вклад авторов:** все авторы внесли равносильный вклад в подготовку публикации.

**Соблюдение этических стандартов:** исследование одобрено этическим комитетом РНИМУ имени Н. И. Пирогова (протокол № 655 от 23 апреля 2019 г.), для каждого участника было получено добровольное информированное согласие.

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**Статья получена:** 02.10.2023 **Статья принята к печати:** 20.10.2023 **Опубликована онлайн:** 29.10.2023

**DOI:** 10.24075/vrgmu.2023.040

Digitalization of all aspects of life and daily use of various electronic devices by schoolchildren, both at school and at home, up the risk of various diseases, including neuropsychiatric disorders; this problem is universal throughout the world nowadays [1–3].

Today, the range of use cases for mobile electronic devices (MED) extends beyond the learning process and includes the search for and analysis of various information, and communication. In this connection, schoolchildren tend to

spend more time with mobile devices, computers, tablets not only in the context of studying, but also during their leisure time [4–6].

This entails the increasing prevalence of health disorders among schoolchildren whose mobile screen time exceeds the limit set by the hygienic standards. The disorders include deterioration of visual acuity and impaired posture, as well as disrupted functioning of other organs and systems, nervous system in particular [7, 8].

This study aimed to investigate how different screen time durations affect the neuropsychiatric health of schoolchildren.

## METHODS

In the 2022–2023 academic year, we monitored the neuropsychiatric health of Moscow schoolchildren ( $n = 109$ , 35 boys and 74 girls) with the help of questionnaires. Their mean age was  $14.9 \pm 0.12$  years. At the time of this study, all participants were equally healthy (no significant differences in health status), and had no diagnosed neuropsychiatric diseases.

We determined the vegetative status of schoolchildren with the help of a questionnaire by A.M. Vane (1998), which is designed to identify individuals with signs of vegetative symptoms. The questionnaire was adapted and recommended by A.G. Sukharev, Academician of the Russian Academy of Sciences; authors of the study tested its applicability to the studied population group [9]. The signs of internet addiction in schoolchildren were identified with a standard S.K. Kulakov questionnaire (2004) [9].

Monitoring began only after parents/legal guardians of children filled and signed the voluntary informed consent form, and if the child was 14 years old, he/she signed the form, too. The study did not endanger the participants; it met the biomedical ethics requirements and conformed to the provisions of the Declaration of Helsinki 1983.

The average time of use of an MED in the course of a month was registered from the Screen Time application.

The inclusion criteria were: status of a schoolchild in a Moscow comprehensive school, voluntary informed consent form filled by parents/legal guardians, including the child himself/herself, questionnaire filled by the child, data on the average screen time covering a month.

The exclusion criteria were: a different age group, lack of a voluntary informed consent filled by parents/legal guardians, including the child himself/herself, lack of the questionnaire filled by the child, lack of data on the average screen time covering a month.

The results were compiled into a database "Influence of mobile electronic devices and screen time with them on the development of autonomic disorders and internet addiction in schoolchildren," registered under the certificate 2023620126 of 11.01.2023. Application #022623302 of 24.11.2022.

Statistica 10.0 (StatSoft; USA) was used for statistical processing of the data. Kolmogorov–Smirnov test was run preliminarily to find out whether distribution of the values was normal or not. The collected quantitative data distributed normally, which allowed application of the methods of parametric statistics with calculation of sample mean ( $M$ ), mean error ( $m$ ) and sample standard deviation ( $\sigma$ ). Significance of differences in the mean values were assessed with the Student's  $t$ -test; the differences were considered significant at  $p < 0.05$ . Vegetative symptoms were registered when the respective questionnaire returned 25 points and above, internet addiction — at 50 points and more.

## RESULTS

Screen time was analyzed against provisions of SanPiN (sanitary rules and standards) 1.2.3685-21 "Hygienic standards and requirements for safety and/or harmlessness of an individual's environment", which limit the maximum total time of use of an MED in an educational establishment and at home at 120 minutes a day. Therefore, the children were divided into

two groups: those staying within the regulated limit of mobile screen time (group 1,  $n = 11$ ), and those exceeding that limit (group 2,  $n = 98$ ). In group 1, the average mobile screen time, as measured in one month, was  $110.50 \pm 10.00$  minutes per day, in group 2 —  $345.00 \pm 15.00$  ( $p < 0.05$ ).

The mean Vane questionnaire score for all the schoolchildren was  $21.69 \pm 1.02$  points. The means between the groups differed significantly ( $p \leq 0.01$ ):  $12.30 \pm 1.89$  points in group 1 and  $22.54 \pm 1.16$  points in group 2.

Overall, 55.0% of the participating schoolchildren exhibited signs of vegetative symptoms, 45.9% of the first group and 63.6% of all those constituting the second group ( $p < 0.01$ ).

For signs of vegetative symptoms and mobile screen time, the Person correlation coefficient was 0.55 ( $p = 0.04$ ).

In group 2, where the schoolchildren exceeded the regulated MED screen time limit, vegetative symptoms were registered 15 — 40 times more often than in group 1, and the most common of them were numbness and cold fingers (50.0%), sleep disturbance (45.0%), decreased performance and fatigue (42.0%), paroxysmal headaches (40.0%). Almost a third of the group 2 participants (29.0%) complained of rapid breathing and a dyspnea (Fig. 1).

The mean Kulakov questionnaire scores was  $33.0 \pm 1.02$  points. The means between the groups differed significantly ( $p \leq 0.05$ ):  $12.30 \pm 1.89$  points in group 1 and  $22.54 \pm 1.16$  points in group 2. Although this study did not reveal any the participants to have internet addiction, 74.0% of the respondents regularly used social media (up to 20 times a day), viewed various videos, positioned themselves as bloggers and preferred online communication to live interactions (Fig. 2).

In group 2, where schoolchildren exceeded the regulated MED screen time limit, symptoms of internet addiction were registered 10 - 40 times more often than in group 1. As a rule, if a participant had one such symptom, he/she was likely to also exhibited other symptoms, making up a combination thereof. In group 1, internet addiction symptoms were detected at the level of statistical error, 1.0%.

## DISCUSSION

Today, children and adolescents cannot imagine a full life without internet, a state of affairs that has been especially evident in the last 10 years. Schoolchildren are not alone: their parents and teachers spend more and more time online, both for work and leisure purposes, and also using the internet to find information, answers to questions and solutions to the tasks set [10, 11].

The study involved 15-year-old schoolchildren, active internet users with well-developed respective skills and sufficient experience.

A positive point about internet in the life of contemporary schoolchildren: it is a readily available, modern knowledge acquisition medium that also offers skill practicing capacities. Schoolchildren, their parents, and teachers also perceive internet as a source of leisure activities, which allows watching movies, sightseeing online and much more. Most of all, children and teenagers use it as means of communication with both friends and relatives, and their parents and teachers also connect with their colleagues online [12, 13].

Our study confirmed the above statements: 74.0% of the respondents regularly used social media (up to 20 times a day), viewed various videos, positioned themselves as bloggers and preferred online communication to live interactions.

However, spending much time online may entail internet addiction, which is characterized by mental disorders and possible behavioral problems; this risk is relevant both for

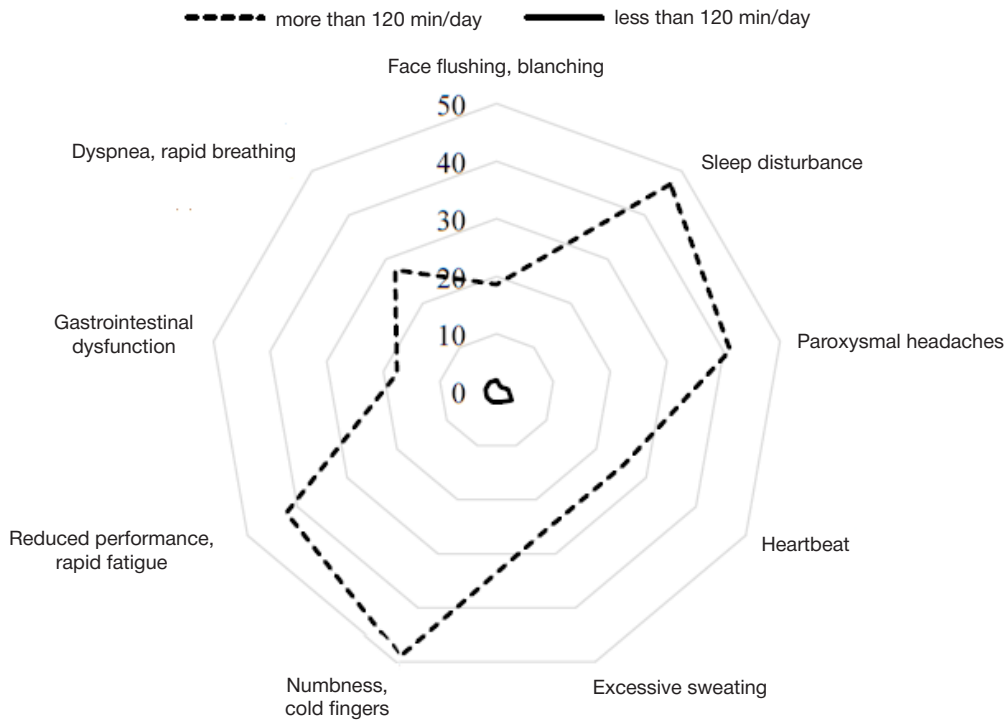


Fig. 1. Vegetative symptoms manifestations relative to mobile screen time, %

children/adolescents and adults. According to pediatricians, psychiatrists, psychologists, general practitioners, internet addiction is similar to alcohol and drug addictions. I. Goldberg, a psychiatrist, suggested this term, internet addiction, back in 1996, describing a behavioral disorder associated with use of internet or a computer [14].

Today, researchers investigate physiological processes associated with internet addiction. There are studies indicating that long a frequent online sessions cause cognitive impairment not only in schoolchildren, but also in adults [15]. Moreover, such behavior adversely affects communication skills, and, consequently, links with the society in general. The need for a personal meeting disappears if there is an opportunity to communicate online and using a mobile phone [15].

It was established that every eighth student who exceeds the regulated mobile screen time limit prefers communicating online rather than in real life. In such cases, parents and friends of the person in question feel that he/she is constantly online.

Prolonged use of internet disturbs sleep, removes outdoor time/physical activity from the daily routine or reduces its duration [15, 16].

The data collected in the context of this study indicate that every second schoolchild that exceeds the regulated mobile screen time limit has sleep problems.

Addiction to internet as a source of information, in turn, promotes endless and unrestrained online journeys. The so-called web surfing is an aimless search for information, playing.

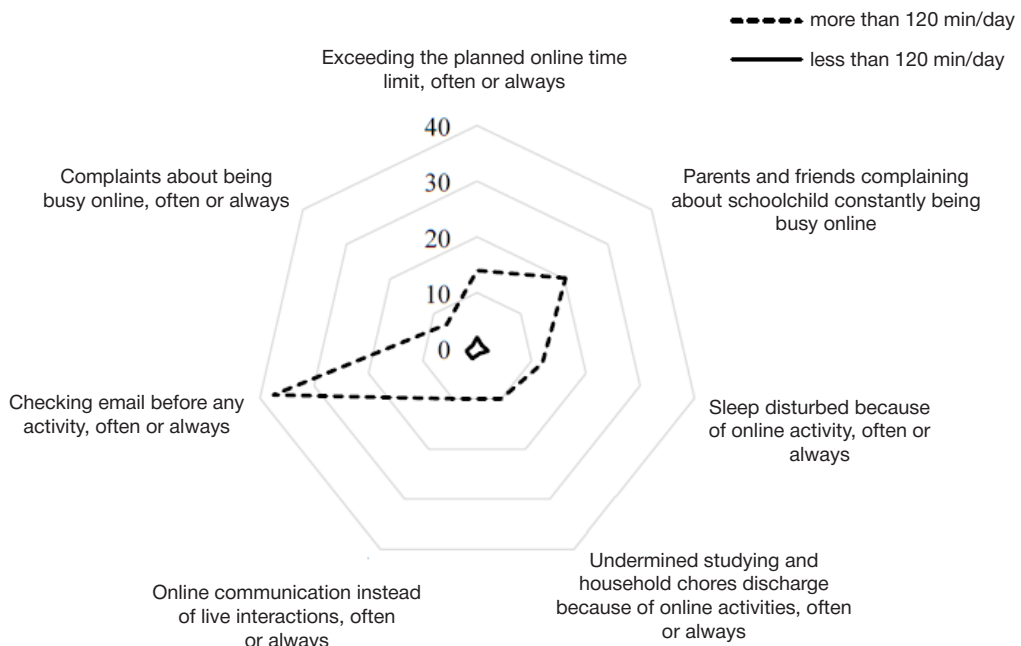


Fig. 2. Internet addiction symptoms manifestations relative to mobile screen time, %

Long online sessions and quests for information may degrade performance and translate into wasted time [15, 16].

It should be emphasized that every eighth schoolchild who exceeds the regulated mobile screen time limit stays online longer than planned, and unsuccessfully tries to reduce the said screen time, which may indicate onset of internet addiction. In this study, it was found that such schoolchildren have more complaints related to their vegetative status, with a third of them reporting three or more respective problems.

For the purposes of prevention, it is necessary to raise awareness of schoolchildren, teachers and parents about the possible health risks associated with daily prolonged use of electronic devices. The respective activities can be staged directly in the educational establishments [17–20].

## CONCLUSIONS

In conclusion, it should be noted that the age of digitalization of all aspects of life, and daily use of various electronic devices

inevitably create conditions upping the risk of various diseases, including neuropsychiatric disorders. Schoolchildren are especially vulnerable: their physiological and neuropsychiatric development is in the active phase, they face increasing loads at school, have to search for information online, and some of the educational materials are available in electronic form exclusively. Schoolchildren who exceed the regulated mobile screen time limit are at risk of developing vegetative disorders and internet addiction, which may entail chronic somatic and neuropsychiatric diseases. It should be remembered that supported development of healthy habits and compliance with the screen time rules can help mitigate the risk of vegetative and neuropsychiatric conditions in schoolchildren, and therefore, preserve their health in the future. The results of this study are a contribution to the global knowledge about the problem of uncontrolled mobile screen time associated with studying and leisure in the context of the effects on health and functional state of the neuropsychic sphere of children and adolescents.

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