SLEEP DISORDERS IN PRIMARY SCHOOL CHILDREN ASSOCIATED WITH USE OF VARIOUS TYPES OF DIGITAL DEVICES

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Health of children and adolescents largely depends on the quality of their sleep. However, the effect of digital devices and screen time on thereon have not been studied thoroughly. This study aimed to investigate the influence of digital devices on the sleep quality of primary school children. We surveyed 333 parents of children aged 7–10 years. The questionnaire included questions about the types of digital devices used by children, and frequency and duration of use daily and weekly use. We studied the specifics and quality of sleep of children. It was found that using a laptop for more than an hour a day increases the risk of sleep disorders (RR = 1.87; 95% CI: 1.37–2.54; EF = 46%). Children using a computer every day run a higher risk of nightmares (RR = 4.7; 95% CI: 1.49–15.11; EF = 79%). Neither TV, nor mobile phones were shown to produce such effects. The study has revealed that the type of the device and the patterns of its use (on both daily and weekly levels) are factors in the development of sleep disorders.

Keywords: sleep disorders, digital devices, children aged 7–10, health risks

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НАРУШЕНИЯ СНА У МЛАДШИХ ШКОЛЬНИКОВ ПРИ ИСПОЛЬЗОВАНИИ РАЗЛИЧНЫХ ВИДОВ ЦИФРОВЫХ УСТРОЙСТВ

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Качество сна является важной составляющей здоровья детей и подростков. При этом окончательно не изучено влияние экранного времени на сон, в особенности влияние экранного времени, проводимого с различными видами цифровых устройств. Целью исследования было оценить влияние использования цифровых устройств на качество сна младших школьников. Проведено анкетирование 333 родителей детей 7–10 лет. Анкета состояла из вопросов о видах используемых детьми цифровых устройств, а также о частоте и продолжительности их использования в течение дня и недели. Изучены особенности и качество сна у детей. Установлено, что использование ноутбука свыше часа в день увеличивает риск нарушений сна (ОР = 1,87; 95% ДИ: 1,37–2,54; EF = 46%). Ежедневное использование компьютера увеличивает риск возникновения страшных сновидений у детей (ОР = 4,7; 95% ДИ: 1,49–15,11; EF = 79%). При оценке использования мобильных телефонов и просмотра телепередач таких результатов получено не было. Исследование показало, что на нарушение сна влияют вид устройства и режим его использования — как в течение дня, так и в течение недели.

Ключевые слова: нарушения сна, цифровые устройства, дети 7–10 лет, риски здоровью

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Соблюдение этических стандартов: исследование, выполненное в рамках государственного задания «Системные профилактические технологии формирования здоровья обучающихся в образовательных организациях» (2022–2024), одобрено этическим комитетом ФГАУ «НМИЦ здоровья детей» Минздрава России (протокол № 3 от 25 марта 2021 г.). Каждый родитель дал добровольное письменное информированное согласие на участие детей в исследовании после получения разъяснений о потенциальных рисках и преимуществах, а также о характере предстоящего исследования.

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Quality of sleep is known to have a pronounced effect on the health of children and adolescents [1–3]. Sleep disorders can trigger to various abnormalities, both somatic and neurological [4, 5]. Moreover, sleep quality also affects adaptation of children to the educational process [6].

As confirmed by a number of Russian and foreign studies, use of digital devices (DD) can negatively affect various aspects of health [7–23]. An important component of the negative impact of DD is the blue light emitted by LEDs that are an integral part of screens [24–26]

Noise is another problem associated with DD that should be paid attention to in the context of a respective analysis effort [27].

In professional Russian publications covering hygienic aspects, screen time is commonly perceived as a monolith factor and not broken down into types. Foreign authors, on the contrary, differentiate between types of screen time and investigate them separately, writing respective reports. Screen time is categorized on physiological and functional grounds, i.e., there is an active (interactive) type thereof

associated with games, social media, and learning, and a passive type of screen time, which involves watching TV and video content [28, 29]. Some papers point to the connections between various types of screen time and sleep disorders, and the degree of interactivity of the former was shown to influence the severity of the latter [30, 31]. From a practical standpoint, it is very difficult to limit a child's actual screen time, but it is much easier to control the devices they use. In this connection, this work attempts to assess the influence of various types of DD used for different tasks on sleep quality, one of the most significant factors characterizing the state of a child's nervous system.

This study aimed to investigate the influence of DD on the sleep quality of primary school children.

METHODS

The survey was conducted in Zemskaya Gymnasium of Balashikha, and involved 333 parents of primary school children (ages 7–10 years). The questionnaire consisted of two blocks. The first block covered the purposes various DD were used for, and how often they were in use on the levels of a week and a day. The second block sought to investigate the quality of sleep, with questions about complaints such as frequent waking up, nightmares, and sleep disorders in general.

In the context of the study, we calculated relative risk (RR), odds ratio (OR), etiological fraction (EF). The risks were calculated at $p < 0.05$ (χ^2). We used an online calculator available at https://medstatistic.ru/ for the purpose. For data gathering and statistical processing, Yandex Tables, StatTech (StatTech; Russia) software was used.

RESULTS

The study showed that 12.9% of children use a computer, 12.7% watch TV for more than three hours, 10.5% use mobile phones, and 6.1% of children use a laptop (Table 1). Only 3.3% of primary school children use a tablet for more than three hours.

In the course of the study, we collected data on the weekly use of DD: 53.2% of children use a mobile phone daily, 47% of children watch TV shows, 25.9% of children use a laptop, 25.5% of children use a computer, and 18.8% use a tablet (Table 2).

The study yielded data on the DD use-related risks of sleep disorders, nightmares and general abnormalities.

By (EF), the strength of casualty associated with DD was medium for the complaints of sleep disorders in general (RR = 1.87; 95% CI: 1.37–2.54; EF = 46%) (Table 3).

We encountered a very strong causality between daily use of computer and nightmares by EF (RR = 4.75; 95% CI: 1.49–15.11; EF = 79%). A similar pattern was revealed for the tablet, which requires further study, since this device has a relatively large screen (more than 10 inches), but does not have the data input components like a laptop and a computer.

Other results were only showing trends: over 3 hours of daily computer use and difficulties with falling asleep; 5–6 sessions with a laptop a week (or more) and nightmare complaints; 5–6 sessions with a tablet a week (or more) and nightmare complaints; watching TV in the evening and difficulties with falling asleep; watching TV shows in the evening and nightmare complaints.

DISCUSSION

Known publications that explore the hygienic aspects of use of DD rarely differentiate between types of digital addiction. Psychological literature, on the other hand, distinguishes between gadget addiction, fabbing, social media addiction, Internet addiction [32]. Since 2022, the ICD sees gambling addiction as an individual phenomenon.

From standpoint of a child hygienist, it is quite difficult to control the content that a child consumes, but from a practical viewpoint, parents can be recommended to control what kind of DD the child uses. An analysis of the influence of DD allows identifying smartphone as the source of addictions associated with gadgets, personal computer and laptop producing mainly gaming addiction, and TV as the device for consumption of video content in lengthy sessions.

If we consider playing on a smartphone and a desktop computer with a keyboard, mouse, subwoofer, and a screen with the diagonal exceeding 20 inches, it becomes clear that video game addiction is device-dependent.

Smartphone use patterns are characterized by shorter, one-time sessions, more frequent changes of activity, i.e., switching between applications, and a more pronounced multitasking.

At desktops, the level of control over the gameplay is higher, same as that of concentration and anxiety, and a single session lasts longer, since completing one level can last several hours.

Thus, it can be assumed that higher complexity of sensorimotor connections associated with playing on a stationary device translates into a deeper immersion in virtual reality.

At the same time, the type of video game addiction plaguing the younger generation has changed. Earlier, children preferred games that require hours of immersion (which can be conditionally compared with a second job), but nowadays, they favor simpler entertainment, when you can play several different games on the phone within 15 minutes. Thus, it may be concluded that this type of addiction takes features of clip perception, which is consistent with our reasoning. It can also be said that use of different types of DD brings forward different properties of the central nervous system: process mobility, balance, anxiety, excitability, etc.; this phenomenon should be investigated further.

At the same time, it is obvious that the addiction to TV shows and video content is also qualitatively different from the two addictions described above.

Currently, a popular concept is the triple-network model of the brain [33]: it includes the salience network (SN), the central

Table 1. Duration of use of various types of DD by schoolchildren aged 7–10 years during the day (%)

Daily DD use duration	Type of DD				
	Computer $n = 101$	Laptop $n = 66$	Tablet $n = 61$	Mobile phone $n = 171$	TV $n = 157$
Less than 30 minutes	31.7	36.4	29.5	30.4	22.9
30 minutes to 1 hour	32.7	40.9	36.1	31	28.7
1 hour to 2 hours	16.8	13.6	26.2	17	24.9
2 hours to 3 hours	5.9	3	4.9	11.1	10.8
Over 3 hours	12.9	6.1	3.3	10.5	12.7

Table 2. Frequency of use of DD of various types by schoolchildren aged 7–10 years during the week (%)

Weekly frequency of Digital Device usage	Type of DD				
	Computer *n* = 102	Laptop *n* = 85	Tablet *n* = 80	Mobile phone *n* = 205	TV *n* = 202
Weekend	24.5	28.2	38.8	9.3	10.4
1–2 days	34.3	18.8	20	7.3	15.8
3–4 days	8.8	16.5	17.4	16.6	15.4
5–6 days	6.9	10.6	5	13.7	11.4
Daily	25.5	25.9	18.8	53.2	47

Table 3. Risks of sleep disorders depending on the purpose the DD is used for, children aged 7–10 years

DD use/complaints	χ^2	*p*	Risks		95% CI	EF (strength of casualty)
Laptop use for more than 1 hour per day/complaints about sleep disorders	9.03	0.01	RR	1.87	1.37–2.54	46% (medium)
			OR	14	1.07–1.71	
Daily computer use/complaints about nightmares	7.17	0.01	RR	4.75	1.49–15.11	79% (very high)
			OR	8.5	1.51–47.96	
Daily tablet use/complaints about nightmares	6.13	0.02	RR	4.66	1.31–16.69	79% (very high)
			OR	8.33	1.34–52.04	

executive network (CEN), and the default mode network (DMN). SN defines attention. It is activated when processing new information, and triggers fast, more superficial reactions, without great physiological investments. From the point of view of P.K. Anokhin's theory of functional systems, this network can hypothetically be compared with an afferent synthesis unit. For example, this system is activated when a person scrolls through the news feed and selects the content that interests him.

When the brain is thinking or playing a complex game, CEN starts working. This network is responsible for working memory and control [34], it is slower, requires more immersion in the process and imposes a greater physiological cost, which hypothetically can be described akin to the programming and control unit.

There are reciprocal relationships between these brain networks: activation of one suppresses the activity of others.

Several authors have expressed similar views on information processing [34, 35]. SN dominates when a person surfs the Internet and tends to subconsciously practice clip perception; in such situations, CEN is not active. For information processing, including that peculiar to complex games, the brain activates CEN, which requires more physiological resources, and DMN is triggered for passive content viewing. Authors of [36] distinguish between interactive and receptive screen time, and point out that receptive screen time is based on DMN basis, which deactivates for interactive screen time. Thus, it is obvious that DMN deactivation triggers SN or CEN, depending on the type of interactive activity.

The type of DD is important from the practical point of view: it can be assumed that different DD are associated with domination of different brain structures. Devices with a large screen, keyboard and mouse activate CEN (programming and control unit) to a greater degree, and in the domain of smartphones (viewing clips, playing simple games, no complex control involved), it is less active, which, apparently translates into a lower physiological cost of the process and the absence of neuroticism. SN dominates in smartphone and clip perception scenarios, and the CEN and DMN networks are hypothetically not activated in such situations. TV watching involves DMN. The SN and CEN networks are not activated for TV, thus, there is no physiological costs involved, and no subsequent neuroticism and sleep disorders.

Thus, from the standpoint of the three-network model, it is CEN that can affect sleep since its activation means a more pronounced psychophysiological effect that translates into sleep disorders. The other two systems, SN and DMN, have no negative effect on sleep.

CONCLUSIONS

It was found that 53.2% of children use a mobile phone daily, 47% of children watch TV shows, 25.9% of children use a laptop, 25.5% of primary school children use a computer daily, and 18.8% use a tablet.

The study has shown that the parameters of sleep are influenced by type of DD as much as by the respective use patterns, which is explained by various types of digital addiction.

Thus, it has been shown that daily use of a computer and tablet increases the risk of nightmares in children. Using a laptop for more than an hour a day increases the risk of complaints of sleep disorders in general. According to the results of the study, smartphone use and watching TV are not associated with complaints of sleep disorders.

To prevent sleep disorders, children and adolescents should follow hygienic recommendations covering use of DD. It is especially important to limit the use of DD two hours before bedtime and just refrain from using such devices immediately before going to sleep.

References

1. Abashidze JeA, Namazova LS, Kozhevnikova EV, Arshba SK. Narushenie sna u detej. Pediatricheskaja farmakologija. 2008; 5 (5): 69–73 (in Rus.).
2. Pshenichnikova II, Zaharova IN, Svincickaja VI, Miroshina AV. Narushenija nochnogo sna: vlijanie na sostojanie zdorov'ja podrostkov. Praktika pediatra. 2020; (3): 20–3 (in Rus.).
3. Chaput JP, Gray CE, Poitras VJ, Carson V, Gruber R, Olds T, et al. Systematic review of the relationships between sleep duration and health indicators in school-aged children and youth. Appl Physiol Nutr Metab. 2016; 41 (6 Suppl 3): S266–82. DOI: 10.1139/apnm-2015-0627.
4. Kolomejchuk SN, Teplova LI. Kachestvo i parametry sna u shkol'nikov. Zhurnal nevrologii i psihiatrii im. C. C. Korsakova. 2017; 117 (11-2): 92–6 (in Rus.). DOI: 10.17116/jnevro201711711292-96.
5. Kelmanson IA. Jekologicheskie i kliniko-biologicheskie aspekty narushenij cirkadiannyh ritmov son-bodrstvovanie u detej i podrostkov. Biosfera. 2015; 7 (1): 131–45 (in Rus.). DOI: 10.24855/biosfera.v7i1.52.
6. Beattie L, Kyle SD, Espie CA, Biello SM. Social interactions, emotion and sleep: A systematic review and research agenda. Sleep Med Rev. 2015; (24): 83–100. DOI: 10.1016/j.smrv.2014.12.005.
7. Kuchma VR, Suhareva LM, Hramcov PI. Gigienicheskaja bezopasnost' zhiznedejatel'nosti v cifrovoj srede. Zdorov'e naselenija i sreda obitanija. 2016; 8 (281): 4–7 (in Rus.).
8. Kuchma VR, Suhareva LM, Hramcov PI. Sovremennye podhody k obespecheniju gigienicheskoj bezopasnosti zhiznedejatel'nosti detej v giperinformacionnom obshhestve. Voprosy shkol'noj i universitetskoj mediciny i zdorov'ja. 2016; (3): 22–7 (in Rus.).
9. Kuchma VR, Suhareva LM, Stepanova MI, Hramcov PI, Aleksandrova IJe, Sokolova SB. Nauchnye osnovy i tehnologii obespechenija gigienicheskoj bezopasnosti detej v "cifrovoj shkole". Gigiena i sanitarija. 2019; 98 (12): 1385–91. DOI: 10.18821/0016-9900-2019-98-12-1385-1391.
10. Starodubceva GA, Frolova AP. Ob ispol'zovanii det'mi doshkol'nogo vozrasta jelektronnyh ustrojstv: stoit li bespokoit'sja? Chelovecheskij faktor: social'nyj pedagog. 2020; 2 (40): 130–5 (in Rus.).
11. Kuchma VR, Teksheva LM, Kurganskij AM, Petrenko AO. Gigienicheskaja ocenka ispol'zovanija riderov v nachal'noj shkole. Gigiena i sanitarija. 2014; 93 (3): 57–60 (in Rus.).
12. Teksheva LM, Kurganskij AM, Petrenko AO. Gigienicheskoe obosnovanie ispol'zovanija riderov v starshej shkole. Voprosy shkol'noj i universitetskoj mediciny i zdorov'ja. 2015; (1): 40–3 (in Rus.).
13. Rashid SMM, Mawah J, Banik E, Akter Y, Deen JI, Jahan A, et al. Prevalence and impact of the use of electronic gadgets on the health of children in secondary schools in Bangladesh: A cross-sectional study. Health Sci Rep. 2021; 4 (4): e388. DOI: 10.1002/hsr2.388.
14. Otsuka Y, Kaneita Y, Itani O, Matsumoto Y, Jike M, Higuchi S, et al. The association between Internet usage and sleep problems among Japanese adolescents: three repeated cross-sectional studies. Sleep. 2021; 44 (12): zsab175. DOI: 10.1093/sleep/zsab175.
15. Agh NI, ZaaZa A. The effects of digital technology usage on children's development and health. World family medicine. 2021; 19 (4): 56–60. DOI: 10.5742/MEWFM.2021.94027.
16. Alonzo R. Interplay between social media use, sleep quality, and mental health in youth: A systematic review. Sleep medicine reviews. 2021; (56): 101414. DOI: 10.1016/j.smrv.2020.101414.
17. Thomée S. Mobile phone use and mental health. a review of the research that takes a psychological perspective on exposure. Int J Environ Res Public Health. 2018; 15 (12): 2692. DOI: 10.3390/ijerph15122692.
18. Reid Chassiakos YL, Radesky J, Christakis D, Moreno MA, Cross C; COUNCIL ON COMMUNICATIONS AND MEDIA. Children and adolescents and digital media. Pediatrics. 2016; 138 (5): e20162593. DOI: 10.1542/peds.2016-2593.
19. Akowuah PK. Digital device use, computer vision syndrome, and sleep quality among an African undergraduate population. Advances in Public Health. 2021; (3): 1–7. DOI: 10.1155/2021/6611348.
20. LeBourgeois MK. Digital media and sleep in childhood and adolescence. Pediatrics. 2017; (140): 92–6. DOI: 10.1542/peds.2016-1758J.
21. Hysing M, Pallesen S, Stormark KM, Jakobsen R, Lundervold AJ, Sivertsen B. Sleep and use of electronic devices in adolescence: results from a large population-based study. BMJ Open. 2015; 5 (1): e006748. DOI: 10.1136/bmjopen-2014-006748.
22. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. Soc Sci Med. 2016; (148): 93–101. DOI: 10.1016/j.socscimed.2015.11.037.
23. Atoum M, Al-Rawashdeh S, Atoum D, Atoum H, Atoum R. Electronic devices use association with psychological distress and sleep among adolescents. Electron J Gen Med. 2021; 18 (6): em327. DOI: 10.29333/ejgm/11314.
24. Skoblina NA, Milushkina OJu, Kurganskij AM, Markelova SV, Camerjan AP, Tatarinchik AA, et al. Vlijanie svetodiodnogo osveshhenija shkol'nyh rekreacij na ostrotu zrenija i psihojemocional'noe sostojanie pervoklassnikov v dinamike uchebnogo goda. Zdorov'e naselenija i sreda obitanija — ZNiSO. 2020; (6): 25–30 (in Rus.). DOI: 10.35627/2219-5238/2020-327-6-25-30.
25. Dejnego VN, Kapcov VA. Svet jenergosberegajushhih i svetodiodnyh lamp i zdorov'e cheloveka. Gigiena i sanitarija. 2013; 92 (6): 81–4 (in Rus.).
26. Kuchma VR, Suhareva LM, Teksheva LM, Stepanova MI, Sazanjuk ZI. Gigienicheskie aspekty primenenija svetodiodnyh istochnikov sveta dlja obshhego osveshhenija v shkolah. Gigiena i sanitarija. 2013; 92 (5): 27–31 (in Rus.).
27. Milushkina OJu, Popov VI, Skoblina NA, Markelova SV, Pavlova GV, Martjusheva VI, et al. Dlitel'nost' ispol'zovanija mobil'nyh jelektronnyh ustrojstv s naushnikami uchashhimisja kak sovremennyj faktor riska sostojaniju ih organa sluha. Sovremennye problemy zdravoohranenija i medicinskoj statistiki. 2021; (3): 77–90 (in Rus.). DOI: 10.24412/2312-2935-2021-3-77-90.
28. Khan A, Moni MA, Khan SR, Burton NW. Different types of screen time are associated with low life satisfaction in adolescents across 37 European and North American countries. Scand J Public Health. 2023; 51 (6): 918–25. DOI: 10.1177/14034948221082459.
29. Sanders T, Parker PD, Del Pozo-Cruz B, Noetel M, Lonsdale C. Type of screen time moderates effects on outcomes in 4013 children: evidence from the Longitudinal Study of Australian Children. Int J Behav Nutr Phys Act. 2019; 16 (1): 117. DOI: 10.1186/s12966-019-0881-7.
30. Yland J, Guan S, Emanuele E, Hale L. Interactive vs passive screen time and nighttime sleep duration among school-aged children. Sleep Health. 2015; 1 (3): 191–6. DOI: 10.1016/j.sleh.2015.06.007.
31. Guerrero MD, Barnes JD, Chaput JP, Tremblay MS. Screen time and problem behaviors in children: exploring the mediating role of sleep duration. Int J Behav Nutr Phys Act. 2019; 16 (1): 105. DOI: 10.1186/s12966-019-0862-x.
32. Suhodolova EA. Aktual'nye tendencii issledovanija razlichnyh vidov cifrovoj zavisimosti. Voprosy studencheskoj nauki. 2022; 12 (76): 17–23 (in Rus.).
33. Chen AC, Oathes DJ, Chang C, Bradley T, Zhou ZW, Williams LM, et al. Causal interactions between fronto-parietal central executive and default-mode networks in humans. Proc Natl Acad Sci USA. 2013; 110 (49): 19944–9. DOI: 10.1073/pnas.1311772110.
34. Gong D, He H, Ma W, Liu D, Huang M, Dong L, et al. Functional integration between salience and central executive networks: a role for action video game experience. Neural Plast. 2016; 2016: 9803165. DOI: 10.1155/2016/9803165.
35. Lombina TN, Jurchenko OV. Osobennosti obuchenija detej s klipovym myshleniem. Obshhestvo: sociologija, psihologija, pedagogika. 2018; (1): 45–50 (in Rus.). DOI: 10.24158/spp.2018.1.7.
36. Anderson DR, Davidson MC. Receptive versus interactive video screens: A role for the brain's default mode network in learning from media. Computers in Human Behavior. 2019; (99): 168–80. DOI: 10.1016/j.chb.2019.05.008.

Литература

1. Абашидзе Э. А., Намазова Л. С., Кожевникова Е. В., Аршба С. К. Нарушение сна у детей. Педиатрическая фармакология. 2008; 5 (5): 69–73.
2. Пшеничникова И. И., Захарова И. Н., Свинцицкая В. И., Мирошина А. В. Нарушения ночного сна: влияние на состояние здоровья подростков. Практика педиатра. 2020; (3): 20–3.
3. Chaput JP, Gray CE, Poitras VJ, Carson V, Gruber R, Olds T, et al. Systematic review of the relationships between sleep duration and health indicators in school-aged children and youth. Appl Physiol Nutr Metab. 2016; 41 (6 Suppl 3): S266–82. DOI: 10.1139/apnm-2015-0627.
4. Коломейчук С. Н., Теплова Л. И. Качество и параметры сна у школьников. Журнал неврологии и психиатрии им. С. С. Корсакова. 2017; 117 (11-2): 92–6. DOI: 10.17116/jnevro201711711292-96.
5. Кельмансон И. А. Экологические и клинико-биологические аспекты нарушений циркадианных ритмов сон-бодрствование у детей и подростков. Биосфера. 2015; 7 (1): 131–45. DOI: 10.24855/biosfera.v7i1.52.
6. Beattie L, Kyle SD, Espie CA, Biello SM. Social interactions, emotion and sleep: A systematic review and research agenda. Sleep Med Rev. 2015; (24): 83–100. DOI: 10.1016/j.smrv.2014.12.005.
7. Кучма В. Р., Сухарева Л. М., Храмцов П. И. Гигиеническая безопасность жизнедеятельности в цифровой среде. Здоровье населения и среда обитания. 2016; 8 (281): 4–7.
8. Кучма В. Р., Сухарева Л. М., Храмцов П. И. Современные подходы к обеспечению гигиенической безопасности жизнедеятельности детей в гиперинформационном обществе. Вопросы школьной и университетской медицины и здоровья. 2016; (3): 22–7.
9. Кучма В. Р., Сухарева Л. М., Степанова М. И., Храмцов П. И., Александрова И. Э., Соколова С. Б. Научные основы и технологии обеспечения гигиенической безопасности детей в «цифровой школе». Гигиена и санитария. 2019; 98 (12): 1385–91. DOI: 10.18821/0016-9900-2019-98-12-1385-1391.
10. Стародубцева Г. А., Фролова А. П. Об использовании детьми дошкольного возраста электронных устройств: стоит ли беспокоиться? Человеческий фактор: социальный педагог. 2020; 2 (40): 130–5.
11. Кучма В. Р., Текшева Л. М., Курганский А. М., Петренко А. О. Гигиеническая оценка использования ридеров в начальной школе. Гигиена и санитария. 2014; 93 (3): 57–60.
12. Текшева Л. М., Курганский А. М., Петренко А. О. Гигиеническое обоснование использования ридеров в старшей школе. Вопросы школьной и университетской медицины и здоровья. 2015; (1): 40–3.
13. Rashid SMM, Mawah J, Banik E, Akter Y, Deen JI, Jahan A, et al. Prevalence and impact of the use of electronic gadgets on the health of children in secondary schools in Bangladesh: A cross-sectional study. Health Sci Rep. 2021; 4 (4): e388. DOI: 10.1002/hsr2.388.
14. Otsuka Y, Kaneita Y, Itani O, Matsumoto Y, Jike M, Higuchi S, et al. The association between Internet usage and sleep problems among Japanese adolescents: three repeated cross-sectional studies. Sleep. 2021; 44 (12): zsab175. DOI: 10.1093/sleep/zsab175.
15. Agh NI, ZaaZa A. The effects of digital technology usage on children's development and health. World family medicine. 2021; 19 (4): 56–60. DOI: 10.5742/MEWFM.2021.94027.
16. Alonzo R. Interplay between social media use, sleep quality, and mental health in youth: A systematic review. Sleep medicine reviews. 2021; (56): 101414. DOI: 10.1016/j.smrv.2020.101414.
17. Thomée S. Mobile phone use and mental health. a review of the research that takes a psychological perspective on exposure. Int J Environ Res Public Health. 2018; 15 (12): 2692. DOI: 10.3390/ijerph15122692.
18. Reid Chassiakos YL, Radesky J, Christakis D, Moreno MA, Cross C; COUNCIL ON COMMUNICATIONS AND MEDIA. Children and adolescents and digital media. Pediatrics. 2016; 138 (5): e20162593. DOI: 10.1542/peds.2016-2593.
19. Akowuah PK. Digital device use, computer vision syndrome, and sleep quality among an African undergraduate population. Advances in Public Health. 2021; (3): 1–7. DOI: 10.1155/2021/6611348.
20. LeBourgeois MK. Digital media and sleep in childhood and adolescence. Pediatrics. 2017; (140): 92–6. DOI: 10.1542/peds.2016-1758J.
21. Hysing M, Pallesen S, Stormark KM, Jakobsen R, Lundervold AJ, Sivertsen B. Sleep and use of electronic devices in adolescence: results from a large population-based study. BMJ Open. 2015; 5 (1): e006748. DOI: 10.1136/bmjopen-2014-006748.
22. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. Soc Sci Med. 2016; (148): 93–101. DOI: 10.1016/j.socscimed.2015.11.037.
23. Atoum M, Al-Rawashdeh S, Atoum D, Atoum H, Atoum R. Electronic devices use association with psychological distress and sleep among adolescents. Electron J Gen Med. 2021; 18 (6): em327. DOI: 10.29333/ejgm/11314.
24. Скоблина Н. А., Милушкина О. Ю., Курганский А. М., Маркелова С. В., Цамерян А. П., Татаринчик А. А. и др. Влияние светодиодного освещения школьных рекреаций на остроту зрения и психоэмоциональное состояние первоклассников в динамике учебного года. Здоровье населения и среда обитания — ЗНиСО. 2020; (6): 25–30. DOI: 10.35627/2219-5238/2020-327-6-25-30.
25. Дейнего В. Н., Капцов В. А. Свет энергосберегающих и светодиодных ламп и здоровье человека. Гигиена и санитария. 2013; 92 (6): 81–4.
26. Кучма В. Р., Сухарева Л. М., Текшева Л. М., Степанова М. И., Сазанюк З. И. Гигиенические аспекты применения светодиодных источников света для общего освещения в школах. Гигиена и санитария. 2013; 92 (5): 27–31.
27. Милушкина О. Ю., Попов В. И., Скоблина Н. А., Маркелова С. В., Павлова Г. В., Мартюшева В. И. и др. Длительность использования мобильных электронных устройств с наушниками учащимися как современный фактор риска состоянию их органа слуха. Современные проблемы здравоохранения и медицинской статистики. 2021; (3): 77–90. DOI: 10.24412/2312-2935-2021-3-77-90.
28. Khan A, Moni MA, Khan SR, Burton NW. Different types of screen time are associated with low life satisfaction in adolescents across 37 European and North American countries. Scand J Public Health. 2023; 51 (6): 918–25. DOI: 10.1177/14034948221082459.
29. Sanders T, Parker PD, Del Pozo-Cruz B, Noetel M, Lonsdale C. Type of screen time moderates effects on outcomes in 4013 children: evidence from the Longitudinal Study of Australian Children. Int J Behav Nutr Phys Act. 2019; 16 (1): 117. DOI: 10.1186/s12966-019-0881-7.
30. Yland J, Guan S, Emanuele E, Hale L. Interactive vs passive screen time and nighttime sleep duration among school-aged children. Sleep Health. 2015; 1 (3): 191–6. DOI: 10.1016/j.sleh.2015.06.007.
31. Guerrero MD, Barnes JD, Chaput JP, Tremblay MS. Screen time and problem behaviors in children: exploring the mediating role of sleep duration. Int J Behav Nutr Phys Act. 2019; 16 (1): 105. DOI: 10.1186/s12966-019-0862-x.
32. Суходолова Е. А. Актуальные тенденции исследования различных видов цифровой зависимости. Вопросы студенческой науки. 2022; 12 (76): 17–23.
33. Chen AC, Oathes DJ, Chang C, Bradley T, Zhou ZW, Williams LM, et al. Causal interactions between fronto-parietal central executive and default-mode networks in humans. Proc Natl Acad Sci USA. 2013; 110 (49): 19944–9. DOI: 10.1073/pnas.1311772110.
34. Gong D, He H, Ma W, Liu D, Huang M, Dong L, et al. Functional integration between salience and central executive networks: a role for action video game experience. Neural Plast. 2016; 2016: 9803165. DOI: 10.1155/2016/9803165.
35. Ломбина Т. Н., Юрченко О. В. Особенности обучения детей с клиповым мышлением. Общество: социология, психология, педагогика. 2018; (1): 45–50. DOI: 10.24158/spp.2018.1.7.
36. Anderson DR, Davidson MC. Receptive versus interactive video screens: A role for the brain's default mode network in learning from media. Computers in Human Behavior. 2019; (99): 168–80. DOI: 10.1016/j.chb.2019.05.008.