HEALTHY LIFESTYLE. PREVENTION

M.V. Shubina, S.Yu. Tereshchenko, N.N. Gorbacheva, O.L. Moskalenko

CHARACTERISTICS OF SLEEP PATTERNS IN ADOLESCENTS IN SIBERIA

Background. Disruption of sleep patterns has a negative impact on mental and physical health, which is especially important in adolescence, when intensive growth and development of the whole organism is observed. The frequent problematic use of smartphones among teenagers, as well as the ever-increasing academic pressures and multitasking of modern life, contribute to this, where sleep takes a backseat.

Purpose. Assess the main indicators of sleep patterns, taking into account gender, age and ethnicity in adolescents aged 12-18 in three large cities of Central Siberia: Krasnoyarsk (the studied ethnic group is Caucasians), Abakan (the studied ethnic groups is Khakass) and Kyzyl (the studied ethnic groups is Tuvans).

Materials and methods. The study involved 5332 adolescents aged 11-18. There were 3,797 from Krasnoyarsk, 1,339 - from Abakan, and 200 – from Kyzyl. There were 4,499 Caucasians, 376 - Khakass, and 173 - Tuvans. Teenagers were asked to answer the following questions: what time did you usually go to bed? How long (minutes) did it usually take to fall asleep? What time did you usually wake up?

Results. In all the studied cities of Siberia, adolescents had a late bedtime (at 11 pm and later) and a decrease in sleep duration below established age norms (less than 9 hours in the group of children 11-14 years old, and less than 8 hours in the group 15-18 years old). This corresponds to the situation in other regions of Russia, as well as abroad. In Krasnoyarsk there was a later bedtime, longer night sleep latency and, accordingly, shorter sleep duration compared to Abakan and Kyzyl. Girls, compared to boys, and the older age group (15-18 years), compared to the younger one (11-14 years), had significantly more pronounced disturbances in all sleep parameters in all studied cities, except Kyzyl: they went to bed later, fell asleep longer, got up earlier, and had shorter sleep duration.

Conclusion. The findings show Siberia adolescents have disturbance in sleep patterns: late going to bed and a decrease in sleep duration compared to age norms, which requires preventive measures. Gender, age and ethnic differences were identified also: girls, the older age group (15-18 years) and Caucasians had more severe sleep disturbances.

Keywords: teenagers, sleep duration, time to wake up, night sleep latency, Khakass, Tuvans, Caucasians

SHUBINA Margarita Valerievna – junior researcher, Clinical Department of Somatic and Mental Health of Children, Scientific Research Institute of Medical Problems of the North Federal State Budgetary Scientific Institution Scientific Research Institute of medical problems of the North, Krasnoyarsk, Krasnoyarsk territory (krai), marg-shubina@mail.ru, SPIN-code: 2341-0834; ORCID: 0000-0002-6724-1058, Researcher ID: AAG-5586-2019; Scopus Author ID: 6603416069; **TERESHCHENKO Sergey Yurievich** – MD, prof., head of the Clinical Department of somatic and mental children health, Federal Research Center 'Krasnoyarsk Scientific Center of the Siberian Branch of the Russian Academy of Sciences' Scientific Research Institute of Medical Problems of the North, SPIN-code: 5291-5020, ORCID: 0000-0002-1605-7859, Researcher ID: C-1004-2013; Scopus Author ID: 57188640428, 57189525126; **GORBACHEVA Nina Nikolaevna** – senior researcher, Clinical Department of somatic and mental children health, 'Federal Research Center' Krasnoyarsk Scientific Center of the Siberian Branch of the Russian Academy of Sciences, Scientific Research Institute of Medical Problems of the North, SPIN-code: 7613-7371; ORCID: 0000-0003-3920-0694, Researcher ID: AAF-7758-2021; Scopus Author ID: 7004278742; **MOSKALENKO Olga Leonidovna** – senior researcher, candidate of biological sciences, Scientific Research Institute of Medical Problems of the North Federal State Budgetary Scientific Institution 'Scientific Research Institute of medical problems of the North', Krasnoyarsk, Krasnoyarsk territory (krai), Russia, 660022, 3g, Partizan Zheleznyaka str., Krasnoyarsk, Russia, olga_olgaol@mail.ru , ORCID: 0000-0003-4268-6568; Scopus Author ID: 57221448825, ResearcherID: H-4076-2017; SciProfiles: 1790780

Relevance: The importance of sleep in adolescence can hardly be overestimated, as this period is a time of intensive growth and development of the whole organism both at the physical and psychosocial levels. Full-fledged sleep is necessary for recovery and rest after daytime activity and increased academic load in modern schoolchildren [27]. During sleep there is systematization of the received information, repair of tissues and hereditary material of cells, synthesis of immunoglobulins, production of neurotransmitters and hormones [5, 11]. After sleep, improvement of memory and attention is noted, and performance increases [27]. Sleep reduces the effects of stress and the level of neurotization, slows down aging processes, and improves skin quality [8, 10]. While sleep disorders lead to numerous negative consequences. The risk of cardiovascular [13] and oncologic pathology, metabolic syndrome and obesity [14], anxiety-depressive disorders [18], neurodegenerative diseases [10] increases, immunity decreases. Adolescents have poorer school performance, increased irritability and aggression, and problems in relationships with peers [24].

According to the recommendations of the US National Sleep Foundation, children should sleep 9-11 hours before the age of 14 and 8-10 hours after the age of 14 [19]. However, according to the results of population studies, the established norms are often not observed [3, 7, 21, 26]. Moreover, in the last decade, marked by the widespread introduction of the Internet into everyday life, this trend has intensified. The negative impact of Internet addiction on sleep was confirmed by our previous study [2].

In addition, the sleep schedule is greatly influenced by cultural and national traditions that determine the degree of freedom and obedience of adolescents in the family, respect for the authority of elders and established rules of behavior [20, 21]. Also of great importance is the degree of urbanization and economic development of the area of residence, the availability of various institutions of further education and entertainment, which can affect the bedtime. For example, significant racial and ethnic differences in sleep duration and quality have been found among American schoolchildren: African-Americans and Hispanics had shorter sleep duration compared to their white peers [21].

Many authors have noted the dependence of sleep disorders on gender, and

the results obtained are quite contradictory. According to some data, girls have a later bedtime, and they are more likely to suffer from insomnia and other sleep disorders [7, 13]; according to other data, late bedtime and shorter sleep duration are characteristic of the male sex [1, 4]; and third researchers find no differences between them [3].

At the same time, in Russia, there is insufficient data on the prevalence of sleep disorders in adolescents, their dependence on gender and age. Studies on ethnic differences of sleep disorders in different regions of Russia were not found in the available literature.

Thus, the aim of our study was to evaluate the main indicators of sleep patterns taking into account gender, age and ethnicity in adolescents 12-18 years old in three large cities of Central Siberia: Krasnoyarsk (predominantly Caucasians), Abakan (predominantly Khakas) and Kyzyl (predominantly Tuvinians).

Materials and Methods: The study is a cross-sectional (one-stage) observational case-control study of a school sample in three large cities of Siberia. It was approved by the ethical committee of FGBU FIC KSC SB RAS "Research Institute of MPS" of Krasnoyarsk. In advance, parents were asked to fill in informed consents for the examination of children, on the basis of which 5332 adolescents aged 11-18 years were examined: in Krasnoyarsk - 3797, in Abakan - 1339 and in Kyzyl - 200, of which 4499 were Caucasians, 376 were Khakassians and 173 were Tuvinians. The sex and age characteristics of the groups are presented in Table 1.

To assess sleep parameters, adolescents were asked to answer questions characterizing their sleep patterns over the past month, excluding weekends: What time did you usually go to bed? How long (minutes) did it usually take you to fall asleep? At what time did you usually wake up?

Statistical processing of the results was carried out in a computer program - STATISTICA-10. All quantitative data are given in the form of medians with 25-75 centile interval Me (25%-75%), and qualitative features are given in the form of percentages with indication in brackets of the ratio of the absolute number of children with this feature to the total number of children in the study group % (abs/total). The Mann-Whitney test was used to compare quantitative traits, and Pearson's chi-square was used to compare qualitative traits.

Results: The analysis of the main indicators of sleep in adolescents according to the city of residence, sex and age is presented in Table 2.

The data obtained indicate pronounced differences between boys and girls in all the studied sleep parameters: girls are characterized by a later bedtime, longer time spent on falling asleep, with an earlier rise, which leads to a total reduction in the duration of sleep, compared to boys. The greatest gender differences in sleep characteristics were observed in Krasnoyarsk, to a lesser extent in Abakan, and none at all in Kyzyl.

Reliable differences were also observed when comparing different age groups. Younger schoolchildren (11-14 years old) went to bed earlier and got up later, and their sleep duration was longer. Only in Kyzyl, there were no reliable differences in bedtime between age groups. The time taken to fall asleep did not differ between age groups.

Significant differences were found among adolescents in the main parameters of sleep depending on the city of residence. Later bedtime was noted in Krasnoyarsk. Abakan and Kyzyl did not differ in this indicator. The time taken to fall asleep was also the longest in Krasnoyarsk, followed by Abakan, and Kyzyl in third place. The earliest time to wake up was in Abakan, while in Krasnoyarsk and Kyzyl they got up at the same time. As a result, the total duration of sleep in Krasnoyarsk and Abakan practically did not differ, while in Kyzyl it was significantly longer.

When comparing the sleep patterns of boys in different cities, the following was noted. Their sleep duration did not differ reliably. They went to bed reliably earlier in Abakan, and in Krasnoyarsk and Kyzyl they went to bed at the same time. It took significantly more time to fall asleep in Krasnoyarsk. We woke up reliably earlier in Abakan.

When comparing the sleep patterns of girls in different cities, there were also differences. The longest sleep duration was observed in Kyzyl, followed by Abakan, and the least sleep was observed in Krasnoyarsk. Krasnoyarsk was the city where the girls went to bed the latest. The longest time to fall asleep was noted there, followed by Abakan and then Kyzyl. The earliest rise time was in Abakan, and Krasnoyarsk and Kyzyl did not differ by this indicator.

When comparing the age group of 11-14 years old in different cities, the following points were highlighted. The total duration of their sleep did not differ significantly. This group went to bed the earliest in Abakan, then in Kyzyl and the latest in Krasnoyarsk. It took the longest time to fall asleep in Krasnoyarsk, somewhat less time in Abakan, and the fastest to fall asleep in Kyzyl. Abakan was the first to wake up, while in Krasnoyarsk and

Table 1

Descriptive statistics of the main studied groups. % (absolute value)

	Krasnoyarsk	Abakan	Kyzyl	Всего	p
	1	2	3		
Total sample. n	**3793**	**1339**	**200**	**5332**	
Boys	46.8 (1774)	47.3 (633)	41 (82)	46.7 (2489)	p1-2=0.753 p1-3=0.109 p2-3=0.096
Girls	53.2 (2019)	52.7 (706)	59 (118)	53.3 (2843)	
11-14 years	52.9 (2006)	39.1 (524)	56.5 (113)	49.6 (2643)	**p1-2<0.001** p1-3=0.320 **p2-3<0.001**
15-18 years	47.1 (1787)	60.9 (815)	43.5 (87)	50.4 (2689)	
Boys. n	**1774**	**633**	**82**	**2489**	
11-14 years	52.5 (932)	36.5 (231)	57.3 (47)	48.6 (1210)	**p1-2<0.001** p1-3=0.395 **p2-3<0.001**
15-18 years	47.5 (842)	63.5 (402)	42.7 (35)	51.4 (1279)	
Girls. n	**2019**	**706**	**118**	**2843**	
11-14 years	53.2 (1074)	41.5 (293)	55.9 (66)	50.4 (1433)	**p1-2<0.001** p1-3=0.568 **p2-3=0.004**
15-18 years	46.8 (945)	58.5 (413)	44.1 (52)	49.6 (1410)	
Children 11-14 years. n	**2006**	**524**	**113**	**2643**	
Boys	46.5 (932)	44.1 (231)	41.6 (47)	45.8 (1210)	p1-2=0.326 p1-3=0.309 p2-3=0.627
Girls	53.5 (1074)	55.9 (293)	58.4 (66)	54.2 (1433)	
Children 15-18 years. n	**1787**	**815**	**87**	**2689**	
Boys	47.1 (842)	49.3 (402)	40.2 (35)	47.6 (1279)	p1-2=0.297 p1-3=0.208 p2-3=0.106
Girls	52.9 (945)	50.7 (413)	59.8 (52)	52.4 (1410)	

Characteristics of the main sleep indicators depending on city of residence, sex and age, Me (25%-75%)

Groups	Number	Bedtime	Time to fall asleep	Rising time	Sleep duration in min	Sleep duration in hours
Krasnoyarsk						
total	3797	23.2 (22.5-24)	15 (10-21.5)	7 (6.7-8)	465 (405-530)	7.8 (6.8-8.8)
Boys	1776	23 (22.5-24)	10 (10-20)	7 (6.8-7.8)	473 (420-533)	7.9 (7-8.9)
Girls	2021	23.5 (22.7-24)	15 (10-25)	7 (6.5-7.7)	455 (390-520)	7.6 (6.5-8.7)
p		**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
11-14 years	2025	23 (22.5-24)	15 (10-25)	7.3 (6.8-8.8)	500 (443-560)	8.3 (7.4-9.3)
15-18 years	1795	23.5 (23-24)	12 (10-20)	7 (6.5-7.2)	435 (380-475)	7.3 (6.3-7.9)
p		**<0.001**	0.130	**<0.001**	**<0.001**	**<0.001**
Abakan						
total	1339	23 (22.3-23.8)	10 (7-20)	6.9 (6.5-7.3)	470 (420-519)	7.8 (7-8.7)
Boys	633	23 (22.2-24)	10 (5-15)	7 (6.7-7.3)	475 (430-530)	7.9 (7.2-8.8)
Girls	706	23 (22.5-23.8)	10 (8-20)	6.7 (6.5-7.1)	462 (415-508)	7.7 (6.9-8.5)
p		0.608	**<0.001**	**<0.001**	**<0.001**	**<0.001**
11-14 years	524	23 (22-23.5)	10 (7-20)	7 (6.7-8)	500 (450-555)	8.3 (7.5-9.3)
15-18 years	815	23 (22.5-24)	10 (7-20)	6.8 (6.5-7)	455 (407-491)	7.6 (6.8-8.2)
p		**<0.001**	0.122	**<0.001**	**<0.001**	**<0.001**
Kyzyl						
total	200	23 (22.5-23.7)	10 (5-15)	7 (6.5-8)	482.5 (440-532)	8 (7.3-8.9)
Boys	82	23 (22.5-24)	10 (5-15)	7 (6.5-8)	485 (440-530)	8.1 (7.3-8.8)
Girls	118	23 (22.5-23.5)	10 (7-15)	7 (6.5-8.1)	480 (432.5-533.5)	8 (7.2-8.9)
p		0.606	0.124	0.987	0.993	0.993
11-14 years	113	23 (22.5-23.8)	10 (5-15)	7.5 (7-8.8)	515 (470-545)	8.6 (7.8-9.1)
15-18 years	87	23 (22.5-23.5)	10 (7-15)	6.8 (6.5-7.2)	455 (415-504)	7.6 (6.9-8.4)
p		0.809	0.756	**<0.001**	**<0.001**	**<0.001**
Comparison of overall samples		**p1-2<0.001** **p1-3=0.012** p2-3=0.186	**p1-2<0.001** **p1-3<0.001** **p2-3=0.022**	**p1-2<0.001** p1-3=0.398 **p2-3<0.001**	p1-2=0.180 **p1-3=0.003** **p2-3=0.009**	p1-2=0.180 **p1-3=0.003** **p2-3=0.009**
A comparison of the boys		**p1-2<0.001** p1-3=0.712 p2-3=0.198	**p1-2<0.001** **p1-3<0.001** p2-3=0.235	**p1-2<0.001** p1-3=0.203 p2-3=0.241	p1-2=0.652 p1-3=0.388 p2-3=0.439	p1-2=0.652 p1-3=0.388 p2-3=0.235
Comparison of girls		**p1-2<0.001** **p1-3=0.002** p2-3=0.560	**p1-2<0.001** **p1-3<0.001** **p2-3=0.025**	**p1-2<0.001** p1-3=0.743 **p2-3<0.001**	p1-2=0.099 **p1-3<0.001** **p2-3=0.003**	p1-2=0.099 **p1-3<0.001** **p2-3=0.003**
Comparison of groups of 11-14 year olds		**p1-2<0.001** p1-3=0.568 **p2-3=0.035**	**p1-2<0.001** **p1-3<0.001** p2-3=0.077	**p1-2<0.001** p1-3=0.960 **p2-3=0.003**	p1-2=0.819 p1-3=0.183 p2-3=0.119	p1-2=0.819 p1-3=0.183 p2-3=0.119
Comparison of groups 15-18 years old		**p1-2<0.001** **p1-3=0.001** p2-3=0.844	**p1-2<0.001** **p1-3<0.001** p2-3=0.139	**p1-2<0.001** p1-3=0.123 p2-3=0.533	**p1-2<0.001** **p1-3=0.001** p2-3=0.661	**p1-2<0.001** **p1-3=0.001** p2-3=0.661

Kyzyl there were no significant differences in rising time.

When comparing the age group of 15-18 years old in different cities, reliable differences were also revealed. In Krasnoyarsk, sleep duration was 20 minutes shorter than in Abakan and Kyzyl, where this indicator did not differ. Bedtime was also the latest in Krasnoyarsk, with no differences in Abakan and Kyzyl. Also in Krasnoyarsk it was significantly more time spent on falling asleep. Getting up was the earliest in Abakan, and the latest time to get up was in Krasnoyarsk.

Discussion: The study revealed significant differences in the main sleep patterns between different urban (ethnic) populations, as well as gender and age differences.

The data obtained indicate marked differences between boys and girls in all studied sleep parameters: girls are characterized by a later bedtime, longer time spent falling asleep, and earlier rising, which leads to an overall shorter sleep duration compared to boys. This is most likely due to their greater impressionability, emotionality and tendency to experience events more deeply, which requires more time to calm down and fall asleep. Perhaps, girls are more responsible (anxious) and spend more time on preparing lessons. Also, this may be the reason for earlier rising to have more time to get ready for school, to tidy up and not to be late for lessons.

The greatest gender differences in sleep characteristics were observed in Krasnoyarsk, to a lesser extent in Abakan and completely absent in Kyzyl. That is, there is a dependence on the degree of urbanization and material status, availability of various entertainment and additional clubs, as well as, probably, on the level of education of parents, way of life and traditions that influence approaches to upbringing and the degree of obedience of adolescents.

Similar results were obtained by Korean researchers who also studied adolescents 12-18 years old: girls went to bed at 24 (±1.2) hours and boys at 23.8 (±1.1) hours, girls woke up at 6.8 (±0.6) hours and boys at 6.9 (±0.6) hours, total sleep duration in girls was 6.7 (±1.4) hours and in boys 7.1 (±9.8) hours, p=0.001 [13]. Also in a study by Organek K.D.M. et al. boys reported more sleep than girls [7]. In Japan, also during isolation for coronavirus infection, later bedtime was reported in girls [25]. However, other researchers obtained the opposite result, in which later bedtime was reported in men and boys, although girls got up earlier, as we did [1].

Also, researchers from Polar, a company that produces a program for recording various sleep parameters, report later bedtime and shorter sleep duration in men. According to their sleep monitoring data, women slept 22 minutes longer than men in 28 countries [4]. Evidence is also provided that gender differences change with age. For example, in a large-scale Brazilian study including 65,837 adolescents 12-17 years of age, the average sleep duration up to age 14 years was longer in boys than in girls, and vice versa from age 15 years. However, there are studies that found no differences at all in sleep duration between boys and girls. For example, in the Republic of Karelia in a sample of 539 people aged 10 to 18 years, no significant sex differences were found, although the results of the Pittsburgh Sleep Quality Inventory (PSQI) survey showed that girls had a higher total score, indicating worse sleep quality than boys [3].

When comparing different age groups in our study, there were also significant differences: younger schoolchildren (11-14 years old) went to bed earlier and got up later, and thus their sleep duration was longer.

The same results were obtained by many researchers. In the Republic of Karelia in the interval from 10 to 18 years of age, the difference in sleep duration time amounted to 3 hours 24 min [3]. Brazilian researchers compared the age groups of children at 12 and 17 years old, the difference in sleep duration in them amounted to about 1 hour [14]. This decrease in sleep duration in adolescence can be explained by puberty factors, in which there is a slowdown in melatonin secretion, especially in the late stages, which leads to a delay in the sleep phase, later bedtime and awakening [12]. Also increased work activity and academic workload among older adolescents, increased availability of gadgets contribute to this situation. In a recent systematic review, digital media use has been shown to be associated with shorter sleep duration and poorer sleep quality [16]. This was confirmed in our previous study: adolescents with ID had late bedtime, late awakening, shorter nighttime sleep duration, longer falling asleep and frequent night awakenings, and greater daytime sleepiness [2].

In addition, we found significant differences among adolescents in the main parameters of sleep depending on the city of residence. Sleep duration and all its regime moments suffered the most in Krasnoyarsk (especially in girls, as more susceptible to emotional problems), which is probably associated with greater opportunities and greater accessibility of various entertainment organizations,

sports sections and institutions of additional education, leading to greater workload of children. The influence of national traditions in terms of child rearing and accepted norms of behavior, in particular the degree of parental authority and control over adolescents, is also possible.

Differences in sleep duration and other sleep parameters in different nationalities have also been reported in studies by many authors. For example, according to anonymous sleep monitoring in 28 countries conducted by Polar (the manufacturer of the Polar Sleep Plus program for detailed sleep analysis), it was found that the longest sleep duration is in Estonia: 7 hours 36 minutes, and the shortest - in Japan: 6 hours 33 minutes. The earliest time to go to bed is 23:09 in Australia and 22:45 in South Africa. The latter are the earliest to rise in the morning - at 6:06. Lateest to bed in Hong Kong - 00:52 and Spain 00:45. [4]. Also in the U.S., a number of studies have been conducted to investigate racial-ethnic differences in sleep characteristics between children of national minorities (Hispanics, Asians, and African Americans) and representatives of the white race [21]. At the same time, almost all authors registered a decrease in sleep duration in these groups of children by an average of half an hour or more compared to white children [6, 7, 22]. At the same time, the decrease in sleep time was mainly due to a later bedtime [6]. The authors suggest that this is due to racial-ethnic discrimination of children, which makes them susceptible to the influence of stress [15], as well as to the influence of cultural, national characteristics and social status, including long distances to school, which requires earlier rising and, consequently, reduced sleep [21].

In addition, it should be noted that in all the cities of Siberia studied by us, in most cases the established physiological norms of sleep for adolescents are not observed. The median bedtime is 23 hours, while the desirable norm is up to 22 hours, and the sleep duration time is also insufficient. In all cities, this indicator does not meet the age-specific norms recommended by the National Sleep Foundation (9-11 hours before 14 years of age and 8-10 hours after 14 years of age) [19]. Even in Kyzyl, where the highest value of this indicator is observed, children do not get almost half an hour of sleep. Moreover, this situation is observed not only in Russia, but also around the world. For example, Norwegian schoolchildren aged 16-17 years sleep on average 7 hours and 36 minutes

during school days [23]. Sleep duration of less than 8 hours was also observed among adolescents in Poland, Latvia, Estonia, and Greece [23]. In Japan, among schoolchildren aged 12-17 years, 28.7% of boys and 32.6% of girls had less than 6 hours of sleep per night [9]. Although in some European countries and in the USA, high school students sleep at least 8 hours [23]. According to other data, one third of high school students in the USA also sleep less than 8 hours [22].

The decrease in sleep duration in our study was mainly due to late bedtime. Many authors have identified late bedtime as a factor predisposing to the development of cardiovascular pathology, depression, cognitive impairment and increased body mass index [13, 26]. The use of smartphones before bedtime is considered to be one of the causative factors, which due to exposure to short-wave (blue) light reduces melatonin production by 14-15% and thus delays the onset of sleep [17].

Conclusion:

Thus, considering the results obtained, the following conclusions can be drawn:

1. Differences between the studied cities of Siberia in the frequency of occurrence of sleep disorders in adolescents have been established: in Krasnoyarsk (Caucasians) there was a later bedtime, more time was required to fall asleep, and, accordingly, a shorter duration of sleep was registered, compared to Abakan (Khakassians) and Kyzyl (Tuvinians).

2. Gender and age differences in sleep patterns were revealed: girls, compared to boys, and the older age group (15-18 years old), compared to the younger (11-14 years old), had significantly more pronounced violations of all sleep parameters in all cities studied, except Kyzyl: they went to bed later, fell asleep longer, got up earlier, had a shorter sleep duration.

3. In all Siberian cities under study, adolescents have late bedtime (at 23 hours and later) and reduced sleep duration below the established age norms (less than 9 hours in the group of 11-14 year olds, and less than 8 hours in the group of 15-18 year olds), which corresponds to the situation in other regions of Russia and abroad.

References

1. Borisenkov M.F., Kosova A.L., Kasyanova O.N. Vliyanie perinatal'nogo fotoperioda na hronotip 11–18-letnij detej na severe Evropejskoj Rossii [The influence of perinatal photoperiod on the chronotype of 11–18 year old children in the north of European Russia// Chronobiology International. 2012; 29: 305–310 (in Russ.).]

2. Tereshchenko S.Yu., et al. Vzaimosvyaz' internet-zavisimosti i narushenij sna u podrostkov Central'noj Sibiri pri raznyh vidah potreblyaemogo kontenta [The relationship between Internet addiction and sleep disorders among adolescents in Central Siberia with different types of content consumed]. Zhurnal nevrologii I psihiatrii im. C.C. Korsakova [K.S. Korsakov Journal of Neurology and Psychiatry 2022; 122(5-2): 58-64 (in Russ.).] DOI:10.17116/jnevro202212205258.

3. Kolomejchuk S.N., 'Teplova L.I. Kachestvo i parametry sna u shkol'nikov [Quality and parameters of sleep in schoolchildren]. Specvypuski. 2017; 117: 11(2): 92-96 (in Russ.).] DOI: 10.17116/jnevro201711711292-96.

4. Kornejchuk A. Osobennosti sna v 28 stranah po dannym monitoringa sna v Polar Sleep Plus. Trekery aktivnosti v global'nyh nauchnyh issledovaniyah. 17.03.2018 [Sleep patterns in 28 countries according to sleep monitoring in Polar Sleep Plus. Activity trackers in global scientific research. 17.03.2018 (in Russ.).] URL: http://fit-test.ru/blog/2018/blog-sleep-polar-global-sleep-habits-research.aspx (data : 20.11.2024)

5. Gritsina O.P., et al. Osobennosti rezhima i kachestva sna sovremennyh shkol'nikov [Features of the sleep regime and quality of modern schoolchildren]. Zdorov'e. Medicinskaya ekologiya. Nauka [Health. Medical ecology. Science. 2019; 2 (78): 13-16 (in Russ.).] DOI:10.5281/zenodo.3262052.

6. Adam E.K., Snell E.K., Pendry P. J Fam Psychol. 2007; 21 (1): 4–19. DOI: 10.1037/0893-3200.21.1.4.

7. Marczyk Organek K.D., Taylor D.J., Petrie T., et al. Sleep Health. 2015; 1 ():36-39. DOI: 10.1016/j.sleh.2014.12.003.

8. Afzal U.M., Ali F.R. Clin Exp Dermatol, 2023; 48 (10): 1113-1116. DOI: 10.1093/ced/llad196.

9. Ohida T., Osaki Y., Doi Y., et al. Sleep. 2004; 27 (5): 978-985. DOI: 10.1093/sleep/27.5.978

10. Bah T.M., Goodman J., Iliff J.J. Neurotherapeutics, 2019; 16 (3): 554-568. DOI: 10.1007/s13311-019-00769-6.

11. Baranwal N., Yu P.K., Siegel N.S. Progress in Cardiovascular Diseases. 2023; 77: 59-69. DOI: 10.1016/j.pcad.2023.02.005.

12. Carskadon M.A., Acebo C., Jenni O.G. Ann N Y Acad Sci. 2004; 1021: 276-91. DOI: 10.1196/annals.1308.032.

13. Chang S.W., Kang J.W. Children (Basel). 2021; 18, 8(12): 1202. DOI: 10.3390/children8121202.

14. Corrêa M.M., Borges M.A.S., Oliveira E.R.A. Rev Bras Epidemiol. 2021; 28 (24): e210031. DOI: 10.1590/1980-549720210031.

15. Lorenzo K., Xie M., Cham H. et al. J Youth Adolesc, 2024, Sep 19. URL: https://pubmed.ncbi.nlm.nih.gov/39298096/ (accessed December 29, 2024) DOI: 10.1007/s10964-024-02086-4.

16. Brautsch L.A., Lund L., Andersen M.M., et al. Sleep Med Rev. 2023; 68:101742. DOI: 10.1016/j.smrv.2022.101742.

17. Teran E., Yee-Rendon C.M., Ortega-Salazar J., et al. Optom Vis Sci. 2020; 97 (3): 207-217. DOI: 10.1097/OPX.0000000000001485.

18. Qiu-Qiang Z., et al. J Affect Disord. 2024; 365 :105-111. DOI: 10.1016/j.jad.2024.08.068.

19. Hirshkowitz M., Whiton K., Albert S.M., et al. Sleep Health, 2015; 1 (4): 233-243. DOI: 10.1016/j.sleh.2015.10.004.

20. Saelee R., Haardörfer R., Johnson D.A., et al. Am J Epidemiol, 2023; 192 (1): 51-61. DOI: 10.1093/aje/kwac156.

21. Guglielmo D., Gazmararian J.A., Chung J, et al. Sleep Health, 2018; 4 (1): 68-80. DOI: 10.1016/j.sleh.2017.09.005.

22. Wheaton A.G., et al. MMWR Morb Mortal Wkly Rep, 2016; 65: 337–341. DOI: 10.15585/mmwr.mm6513a1.

23. Saxvig I.W., Bjorvatn B., Hysing M., et al. J Sleep Res, 2021; 30 (4): e13263. DOI: 10.1111/jsr.13263.

24. Taillard J., et al. Biochem Pharmacol, 2021; 191: 114438. DOI: 10.1016/j.bcp.2021.114438.

25. Sugimoto M., Murakami K., Sasaki S. Public Health Nutr, 2023; 26 (2): 393-407. DOI: 10.1017/S1368980022001148.

26. Omichi C., et al. Int J Environ Res Public Health. 2022; 19 (4): 2112. DOI: 10.3390/ijerph19042112.

27. Troynikov O., Watson C.G., Nawaz N. J Therm Biol. 2018; 78: 192-203. DOI: 10.1016/j.jtherbio.2018.09.012.