

IMPACT OF LEARNING ENVIRONMENTS ON THE PHYSICAL DEVELOPMENT OF MOSCOW SCHOOLCHILDREN: HYGIENE ASPECTS

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Physical development and health of today's schoolchildren are influenced by various factors, including the way the learning process is organized. This article presents data on some aspects of physical development of 1585 teenagers (15 to 17 years old) from 35 Moscow schools, including general education schools, specialized schools, schools with optional advanced courses in biomedical sciences, and health promoting schools. We studied basic anthropometric characteristics of the participants (body height and weight), assessed their psychoemotional status using the Children's Form of Manifest Anxiety Scale and their lifestyle using questionnaire surveys. The control group included teenagers from general education schools. The study showed that the number of teenagers with no abnormalities in their physical development was significantly higher in health promoting school while the number of overweight students there was significantly lower, compared to the controls ($p < 0.05$). For other groups of participants, the results were statistically insignificant. We established statistically significant correlations between well-proportioned physical development and the impacts of night sleep deficit ($r = -0.44$, $p < 0.05$), time spent working on the computer ($r = -0.44$, $p < 0.05$), psychological climate in the family ($r = -0.20$, $p < 0.05$), and meal frequency (Pearson's contingency coefficient was 0.41, with $p < 0.01$, Cramer's contingency coefficient was 0.32, with $p < 0.03$).

Keywords: physical development of schoolchildren, learning environment, health promoting schools, advanced courses in biomedical sciences, classroom AV equipment, physical activity

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ГИГИЕНИЧЕСКАЯ ОЦЕНКА ВЛИЯНИЯ ОРГАНИЗАЦИИ ОБРАЗОВАТЕЛЬНОГО ПРОЦЕССА НА ФИЗИЧЕСКОЕ РАЗВИТИЕ ШКОЛЬНИКОВ Г. МОСКВЫ

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На здоровье и физическое развитие современных школьников влияют различные факторы, в том числе организация образовательного процесса. В статье представлены данные об особенностях физического развития 1585 подростков в возрасте 15–17 лет из 35 школ г. Москвы: общеобразовательных школ, школ с углубленным изучением отдельных предметов, школ с медико-биологическими классами, школ здоровья. Изучали основные антропометрические показатели — длину и массу тела, а также психоэмоциональный статус по шкале явной тревожности для детей (The Children's Form of Manifest Anxiety Scale) и образ жизни с помощью анкетирования. За контрольную приняли группу подростков из общеобразовательных школ. Исследование показало, что среди учащихся школ здоровья статистически значимо больше подростков с нормальным физическим развитием и меньше — с избытком массы тела, чем среди учащихся группы сравнения ($p < 0,05$), в то время как для других групп результаты были статистически незначимы. Были установлены статистически значимые корреляционные связи между гармоничностью физического развития и несколькими факторами влияния: дефицитом ночного сна ($r = -0,44$, $p < 0,05$), продолжительностью работы за компьютером ($r = -0,44$, $p < 0,05$), психологическим микроклиматом в семье ($r = -0,20$, $p < 0,05$), кратностью приема пищи (коэффициент сопряженности Пирсона — 0,41, $p < 0,01$, коэффициент сопряженности Крамера — 0,32, $p < 0,03$).

Ключевые слова: физическое развитие школьников, организация образовательного процесса, школы здоровья, медико-биологические классы, технические средства обучения, двигательная активность

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Physical development in childhood and adolescence still remains an important area of research, because factors that influence it and the intensity of these factors are constantly changing. Modern literature reports the increase in the overall body size of young Russians as compared to their age-mates of previous generations, more rapid biological maturation, earlier menarche, thicker layers of subcutaneous fat, higher body mass index, and reduced functional abilities of the body [1–9].

The way the learning process is organized heavily affects health and physical development of modern schoolchildren [10]. Education quality standards are very strict and course load is increased, especially in specialized schools or schools that offer industry-specific training.

Reasonable adjustments in learning and teaching help to improve the quality of knowledge acquired at school, to motivate the child to voluntarily choose a future profession, to help him/her adapt to the learning environment in a higher

education institution in the future. Some researchers have shown that innovative practices introduced at schools are often accompanied by health problems in children and teenagers, including functional deficits and chronic diseases [11–13].

The aim of this study was to investigate how new learning and teaching practices influence physical development of modern children in Moscow schools.

METHODS

We have summarized and analyzed the data obtained during three scientific experiments in 2011–2015 [14–16].

We have described learning environments in 35 Moscow schools, including general education schools, specialized schools, schools with optional advanced courses in biomedical sciences, and health promoting schools. The following aspects were evaluated: sanitation and hygiene, technical equipment, medical service, food service, and learning arrangements according to the recommendations of the “Complex assessment of education of children and teenagers at educational institutions” guide [17]. The study included 1585 schoolchildren aged 15–17 (732 boys and 853 girls). Table 1 shows how children were distributed into groups depending on their school type. Teenagers from general education schools formed the control group.

Physical development of schoolchildren was assessed by the unified anthropometric method using standard tools [18]. Major anthropometric parameters of physical development were studied, namely, body weight and height. To assess how well-proportioned the child’s physical development was, we used a regional modified weight-on-height regression scale [19]. Psychoemotional status of teenagers was assessed by the Children’s Form of Manifest Anxiety Scale (CMAS) adapted by Prikhozhan AM [20, 21]. To identify risk factors responsible for developing health disorders and to describe children’s lifestyle, schoolchildren and their parents were surveyed using standard questionnaires [20].

Data were statistically processed using Statistica 6.0 software (StatSoft, USA). Statistical significance was assessed using Student’s t-test. Correlation and contingency coefficients were used to assess how studied factors affected body proportions. The study was approved by the Ethics Committee of Pirogov Russian National Research Medical University (Protocol 130 dated December 9, 2013). Headmasters and parent boards gave consent to include teenagers into the experiment.

RESULTS

Learning environments are generally favorable for Moscow schoolchildren: 83.3 % of educational institutions were assigned to category 1 of sanitary and epidemiological welfare; the rest 16.7 % were assigned to category 2.

Table 1. Participants’ distribution into groups according to their school type

School type	Number of schools	Number of students	
		Boys	Girls
General education schools	5	152	135
Specialized schools	5	185	204
Schools with optional advanced courses in biomedical sciences	23	347	476
Health promoting schools	2	48	38

Among the most common violations of sanitation regulations were the following: no public transport available in the vicinity of a school, small school grounds and lack of vegetation on them, sports grounds failing to meet sanitation requirements. School maintenance was also an issue, as well as small territories for medical facilities or the lack of the latter. Natural and artificial lighting checks revealed dirty windows and light fitting, unreplaced light bulbs and broken lamps. Besides, in some schools air and temperature conditions failed to meet the standards, technical equipment was arranged improperly, and the furniture did not match children’s height. Weekly study load met the requirements almost in every school [22], except for schools with optional advanced courses in biomedical sciences, where the number of hours was by 2.1–2.4 h higher and did not match the physiological performance curve based on the weekly performance of high school students.

The comparative analysis of physical development of schoolchildren showed that the number of teenagers with no abnormalities in their physical development was significantly higher in health promoting school, while the number of overweight students there was significantly lower, compared to the controls ($p < 0.05$) (see table 2). The numbers of children with no abnormalities in their physical development and body weight deficit in schools with advanced courses in biomedical sciences and in general education schools (the controls) were comparable; the number of overweight children was 1.3 times lower. In specialized school, the number of pupils with normal physical development was the lowest. Excess weight in this group was observed 1.4 times less often, and weight deficit — 1.4 times more often, compared to the controls. Still, those observations are statistically insignificant.

A more challenging curriculum and a wider range of information that children have to process lead to the increased volume of homework. In average, high school students (84.6 % girls and 71.6 % boys) spend 2 hours on it. We have not found any significant differences between the studied groups in relation to this parameter. Questionnaire results in all the groups were similar; summarized data are presented in the table below.

Normal sleep duration (8 hours or more) was observed in only a quarter of teenagers participating in the study, 32.9 % of them being boys and 26.7 % being girls. The majority of schoolchildren (51.3 % boys and 50.0 % girls) slept 6–7 hours a day. Another 15.8 % boys and 23.3 % girls slept less than 6 hours. We have found a statistically significant correlation between night sleep deficit and physical development ($r = -0.59$, $p < 0.05$): the excess weight was 1.9 times higher in teenagers who suffered from night sleep deficit, compared to those who slept more than 8 hours a day (fig. 1).

All the girls who participated in the study and 99.1 % of the boys had a computer at home and used it on a regular basis; 70 % of schoolchildren started using the computer at the age of 8–11 (at primary school). 74.3 % of high school students used their computer every day. In average, boys spent 12.36 ± 1.73 hours a week working on the computer, while girls spent 12.24 ± 1.95 hours.

Table 3 shows how schoolchildren are subgrouped depending on the weekly hours spent working on the computer. We found a statistically significant correlation between the hours spent working on the computer and the physical development of teenagers ($r = -0.44$, $p < 0.05$). Among those who use a computer 7 hours a week or more, prevalence of weight deficit is 1.5 times higher (24.6 %) than among those who use it less than 7 hours (16.9 %) ($p < 0.05$). The survey showed that 65–80 % teenagers knew about health problems associated

Table 2. Physical development of Moscow schoolchildren of 15-17 years of age from schools of various types

School type	Percentage of teenagers with no abnormalities in their physical development, %	Percentage of overweight teenagers, %	Percentage of teenagers with body weight deficit, %
General education schools	69.7	15.1	15.1
Specialized schools	66.1	10.7	21.4
Schools with optional advanced courses in biomedical sciences	68.4	11.1	17.7
Health promoting schools	80.8*	3.8*	15.4

Note: * — $p < 0.05$ (compared to the controls).

with using a computer but were still unwilling to give it up as a homework support tool.

A considerable number of schoolchildren (29.3 %) emphasized that they were permanently stressed throughout the learning process. Among them, the number of those overweight was 2.3 higher than among children who were under no stress (13.0 and 5.6 %, respectively), ($p < 0.05$). Only 29.3 % of boys and 20.9 % of girls said that there were no conflicts in their families. Children from families where frequent conflicts were typical had no abnormalities in their physical development 1.5 times less often than children from zero-conflict families; they also suffered from body weight deficit 3 times more often ($p < 0.05$) ($r = -0.20$, with $p < 0.05$).

In addition to the compulsory classes at school, 63.2 % of boys and 69.9 % of girls attended extra curricular classes where static postures prevailed 2–3 times a week in average. A total duration of such classes was 7–8 hours a week in average. 53.9 % of boys and 55.9 % of girls did sports or attended dance classes spending an average of 5–6 hours a week on these activities. Among the teenagers whose physical activity was limited to PE lessons at school, the number of those with no abnormalities in their development was significantly lower and the number of those with excess body weight was higher, with $p < 0.05$ (fig. 3).

There were some deviations from school hygiene standards regarding meals. 30.1 % of high school students never had breakfast and 35.7 % never had lunch at school. Only 76.3 % of boys and 60.0 % of girls had meals three or more times a day. Only 61.8 % of boys and 48.8 % of girls received hot meals two or more times a day. Long intervals between

the meals that exceeded 5-6 hours were reported by 67.1 % of boys and 85.9 % of girls. Among the teenagers who did not have regular meals, body weight deficit was observed 1.7 times more often than in the group of children whose meals were regular (fig. 4). We have found a statistically significant correlation between physical development and meal frequency (Pearson's contingency coefficient of 0.41, $p < 0.01$; Kramer's contingency coefficient of 0.32, $p < 0.03$). In the group of schoolchildren who had hot meals once a day or did not have hot meals at all, the number of overweight teenagers was twice as higher than in the group of schoolchildren who had hot meals twice a day or more frequently ($p < 0.05$; see fig. 5).

DISCUSSION

The data describing the impact of various forms of the learning process, including industry-specific training, on the physical development of children and teenagers are scanty and controversial [12, 23, 24]. Some studies report positive impact of industry-specific training on the functional and psychoemotional state of the students; others describe its negative impact. The majority of the results obtained in our study are statistically insignificant, but the analysis of various factors, such as night sleep deficit, long hours spent working on the computer, hypodynamia, irregular meals, that influence the physical development of teenagers indicates that the most negative impact is associated with those learning practices that increase academic loads.

The obtained data in support of the negative influence of night sleep deficit on the physical development of schoolchildren correlate with the results of other studies. Excess body weight is more likely to be found in children who suffer from sleep deficit than in those who get enough sleep [25, 26].

Hypodynamia is a distinct feature of the lifestyle of modern children and teenagers. Deficit of physical activity amounts to 30 % in preschool educational institutions [27]; in primary

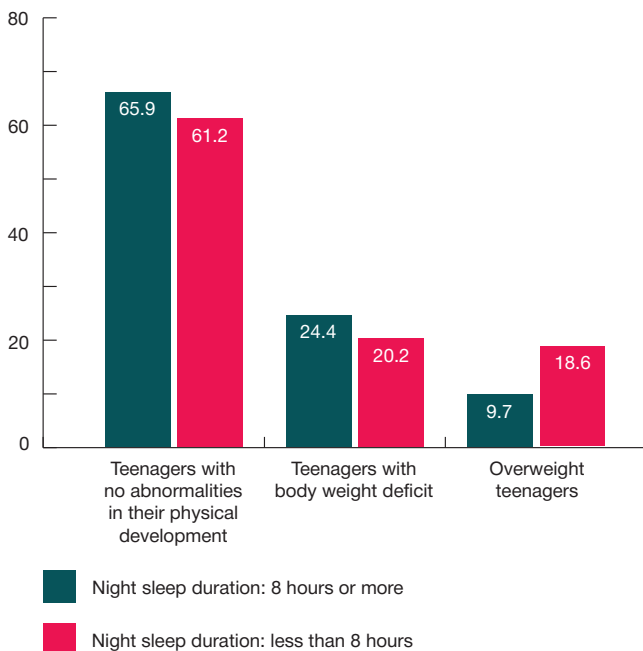


Fig. 1. The impact of sleep duration on the physical development of Moscow schoolchildren of 15–17 years of age

Table 3. The use of the computer and TV by Moscow schoolchildren of 15–17 years of age

Questionnaire question	Answer	Boys	Girls	Total
Computer use, times a week	1–2	8.4	7.6	7.9
	3–4	16.8	18.5	17.7
	Every day	74.8	73.9	74.3
Computer use, hours a week	1–7	34.4	47.3	41.3
	8–14	22.9	25.4	24.3
	15–21	21.9	16.4	18.9
	22 and over	20.8*	10.9	15.5
Watching TV, hours a week	I do not watch TV	10.1	8.2	9.1
	1–7	54.5	52.7	53.6
	8–14	20.2	29.1	24.8
	15–21	8.1	6.4	7.2
	22 and over	7.1	3.6	5.3

school this number drops by 2.0–2.5 times [28, 29]. According to some researchers, the deficit of physical activity among primary school children amounts to 35–40 % it amounts to 75–85 % among high school students [30]. The data on physical activity deficit obtained in our study correlate with the data provided by other researchers.

Poor and unbalanced diet negatively affects physical development of children and teenagers and their academic progress and increases the risk of diseases [3, 6, 31]. The results of our research confirm it.

Health promoting schools are the most beneficial for teenagers from a health perspective. Such schools provide two hot meals during the day (breakfast and lunch); third courses are enriched with vitamin C November through May; students have unlimited access to water. Physical education is an important

trend in such schools. To increase physical activity of students, an extra 20 minute break for active games was introduced; there are PT breaks during the lessons. 1st to 4th year students have 5 lessons in their weekly schedule that involve physical activity; 5th year students have 4 such lessons, 6th–11th year students — 3 lessons. Once a trimester health days are celebrated by playing outdoor games and holding competitions. In February children have extra holidays, namely, a sports week during which 2nd to 11th grade children participate in various team competitions in different kinds of sports, mainly outdoor sports. To preserve and improve neurological and mental health of schoolchildren, a weekly physical load is strictly regulated, the schedule is drawn considering physiological curves of daily and weekly performance of the students; a lesson's duration is reduced to 40 minutes; an individual approach to students

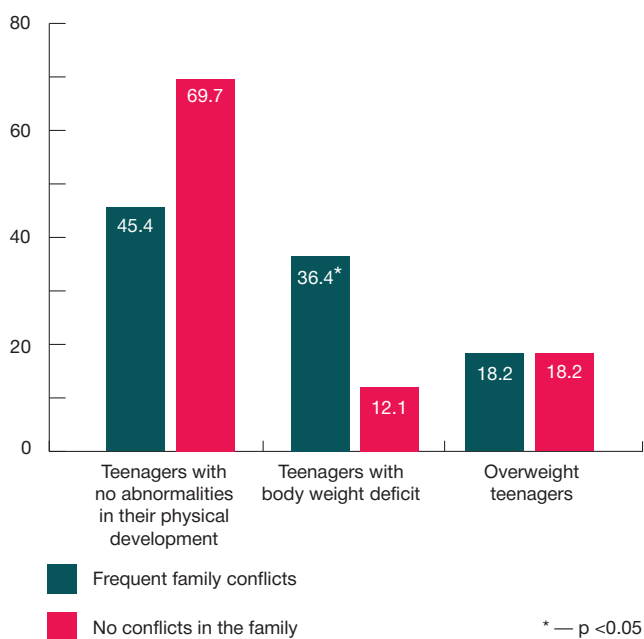


Fig. 2. The impact of family climate on the physical development of Moscow schoolchildren of 15–17 years of age

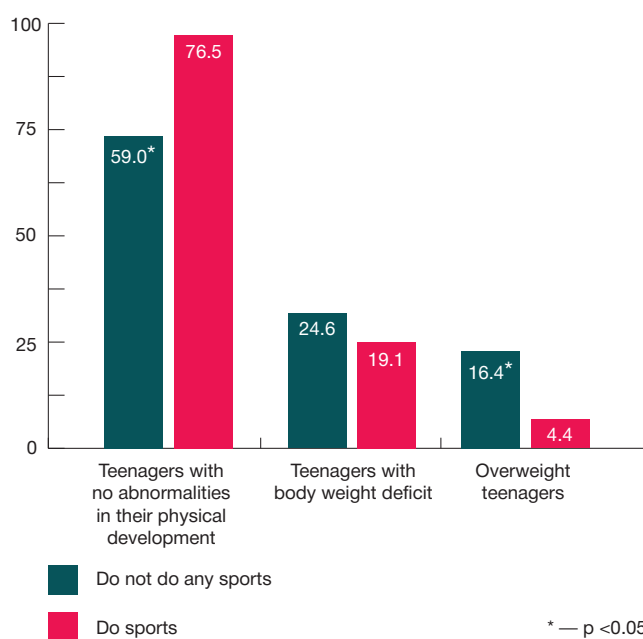


Fig. 3. The impact of extra sports activities on the physical development of Moscow schoolchildren of 15–17 years of age

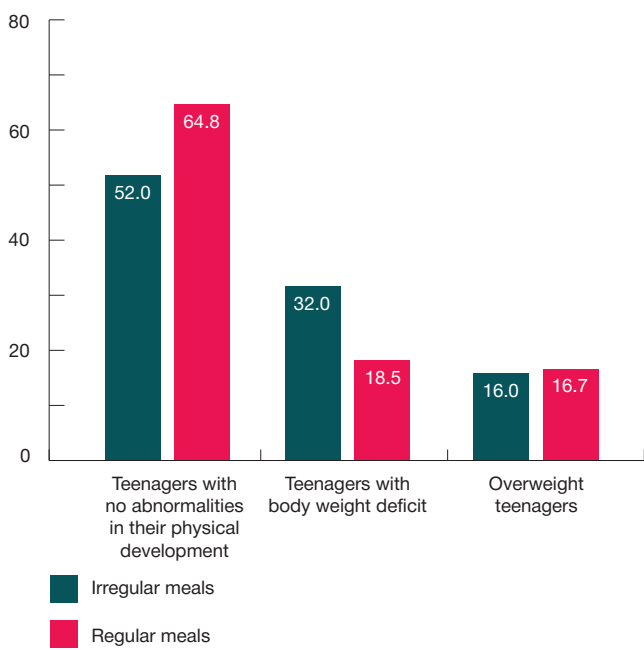


Fig. 4. The impact of meals regularity on the physical development of Moscow schoolchildren of 15–17 years of age

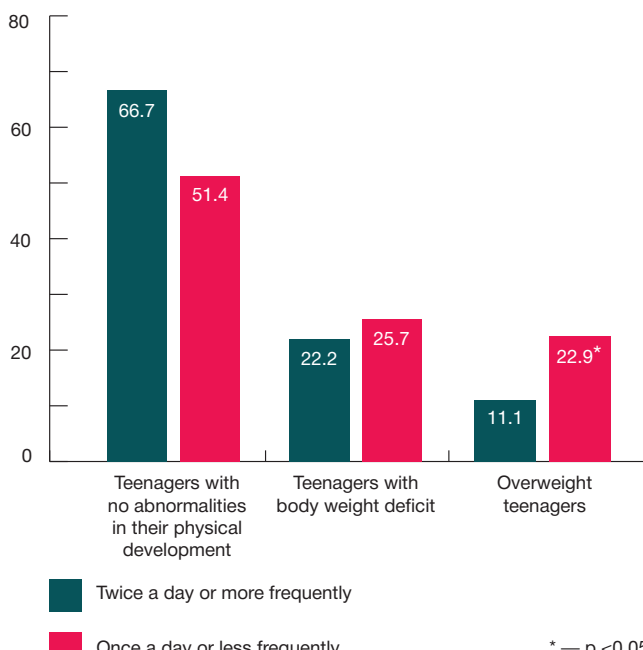


Fig. 5. The impact of hot meals frequency on the physical development of Moscow schoolchildren of 15–17 years of age

became possible after reducing the maximum number of pupils per class to 22; teachers are taught to identify the signs of intellectual exhaustion and to help alleviate psychoemotional tension; at school, children are supported by psychologists. Here, a particular focus is on teaching children, their parents and educators the basics of healthy lifestyle and nutrition, and on motivating them to be more active and do sports.

CONCLUSIONS

This study revealed a number of factors that have a negative

impact on the physical development of schoolchildren: increased academic load, unregulated use of technical equipment during the learning process, conspicuous hypodynamia, psychoemotional tension and stress associated with the learning process. Among the factors that negatively affect the physical state of the teenagers are night sleep deficit, family conflicts and irregular meals. The results of this work helped the authors to elaborate practical recommendations for preventing abnormalities in the physical development of schoolchildren that can be used by medical personnel, teachers, parents and schoolchildren themselves.

References

- Islamova NM. Morfo-funktsional'nye osobennosti detey i podrostkov g. Naberezhnye Chelny v svyazi s etnicheskoj prinalozhnost'yu i vliyaniem faktorov okruzhayushchey sredy [dissertation]. Moscow: Lomonosov Moscow State University; 2008. Russian.
- Sokolov AY, Zavodchikova YuV. Uroven' fizicheskogo razvitiya i tipy teloslozheniya devochek i mal'chikov Magadana 7–10 let. Hygiene and sanitation. 2009; 3: 86–8. Russian.
- Polyakov VK. Sostoyanie zdorov'ya shkol'nikov: somatometricheskie pokazateli, osobennosti pitaniya i korrektsiya narusheniy nutritivnogo statusa [dissertation]. Saratov: Razumovskiy Saratov State Medical University; 2010. Russian.
- Bogomolova ES. Gigienicheskoe obosnovanie monitoringa rosta i razvitiya shkol'nikov v sisteme «zdorov'e–sreda obitaniya» [dissertation]. Nizhniy Novgorod: Nizhniy Novgorod State Medical Academy; 2010. Russian.
- Godina EZ, Khomyakova IA, Zadorozhnaya LV, Anisimova AV, Ivanova EM, Permyakova EYu, et al. Auxological investigations at Mikhailo Lomonosov motherland. Vestnik Moskovskogo universiteta. Seriya 23: Antropologiya. 2011; 3: 68–99. Russian.
- Povargo EA, Zulkarnaeva AT, Zulkarnaev TR, Ovsyannikova LB, Agafonov AI, Akhmetshina RA. Regional features of the physical development of schoolchildren in the city of Ufa. Hygiene and sanitation. 2014; 93 (4): 72–4. Russian.
- Bokareva NA, Skoblina NA, Milushkina OYu. Dinamika fizicheskogo i biologicheskogo razvitiya moskovskikh shkol'nikov. Doktor.Ru (Pediatriya. Gastroenterologiya). 2014; 11 (99): 5–8. Russian.
- Kuchma VR, Skoblina NA, Milushkina OYu, Bokareva NA, Yampolskaya YuA. Characteristics of morphofunctional indicators of Moscow schoolchildren aged 8–15 years (on the results of longitudinal studies). Vestnik Moskovskogo universiteta. Seriya 23: Antropologiya. 2012; 1: 76–83. Russian.
- Baranov AA, Kuchma VR, Skoblina NA, Milushkina OYu, Bokareva NA. The main mechanisms of morphofunctional development of children and adolescents in modern conditions. Annals of the Russian academy of medical sciences. 2012; 67 (12): 35–40. Russian.
- Baranov AA, Kuchma VR, Skoblina NA. Fizicheskoe razvitie detey i podrostkov na rubezhe tysyacheletiy. M.: Nauchnyy tsentr zdorov'ya detey RAMN; 2008. 216 p. Russian.
- Sukhareva LM, Kuchma VR, Stepanova MI, Aleksandrova IE, Shumkova TV. New approaches to the assessment of the sanitary conditions and modes of learning in educational institutions. Zdorov'e naseleniya i sreda obitaniya. 2013; 8 (245): 4–5. Russian.
- Minnibaev TSh, Timoshenko KT, Rapoport IK. Gigienicheskaya otsenka profil'nogo obucheniya v mediko-biologicheskikh klassakh i sostoyanie zdorov'ya uchashchikhsya. Zdorov'e naseleniya i sreda obitaniya. 2010; 5: 4–7. Russian.
- Sukhareva LM, Rapoport IK, Polenova MA. The health of he moscow schoolchildren and the factors, that influence its formation (longitudinal study). Zdorov'e naseleniya i sreda obitaniya. 2014; 3 (252): 28–31. Russian.
- Milushkina OYu. Zakonomernosti formirovaniya morfofunktsional'nykh pokazateley detey i podrostkov v sovremennykh sanitarno-gigienicheskikh i mediko-sotsial'nykh usloviyakh [dissertation]. Moscow: Pirogov Russian National Research Medical University; 2013. Russian.
- Bokareva NA. Vedushchie faktory, formiruyushchie fizicheskoe razvitie sovremennykh detey megapolisa Moskvy [dissertation]. Moscow: Pirogov Russian National Research Medical University; 2015. Russian.
- Ovchinnikova ZA. Gigienicheskaya otsenka vliyaniya usloviy obucheniya na fizicheskoe razvitie i sostoyanie zdorov'ya shkol'nikov mediko-biologicheskikh klassov [dissertation]. Moscow: Pirogov Russian National Research Medical University; 2015. Russian.
- Sukharev AG, Kanevskaya LYa. Kompleksnaya otsenka vospitaniya i obucheniya detey i podrostkov v obrazovatel'nom uchrezhdenii: metodicheskoe posobie. Moscow; 2001. 208 p. Russian.
- Baranov AA, Kuchma VR, editors. Metody issledovaniya fizicheskogo razvitiya detey i podrostkov v populyatsionnom monitoringe: rukovodstvo dlya vrachey. Moscow: Soyuz pediatrov Rossii; 1999. 226 p. Russian.
- Kuchma VR, Khramtsov PI, editors. Rukovodstvo po diagnostike i profilaktike shkol'no obuslovlennykh zabolevaniy, ozdorovleniyu detey v obrazovatel'nykh uchrezhdeniyakh. Moscow: Nauchnyy tsentr zdorov'ya detey RAMN; 2012. p. 144–170. Russian.
- Baranov AA, Kuchma VR, Sukhareva LM. Meditsinskie i sotsial'nye aspekty adaptatsii sovremennykh podrostkov k usloviyam vospitaniya, obucheniya i trudovoy deyatel'nosti: rukovodstvo dlya vrachey. Moscow: GEOTAR-Media; 2007. 352 p. Russian.
- Golovey LA, Rybalko EF, editors. Praktikum po vozrastnoy psikhologii. Saint Petersburg: "Rech"; 2002. 694 p. Russian.
- SanPIN 2.4.2.2821–10 "Sanitarno-epidemiologicheskie trebovaniya k usloviyam i organizatsii obucheniya v obshcheobrazovatel'nykh uchrezhdeniyakh". Rossiyskaya gazeta. 2011; 5430 (54). Available from: <https://rg.ru/2011/03/16/sanpin-dok.html>. Russian.
- Zaznobova TV. Osobennosti fizicheskogo razvitiya starsheklassnikov, obuchayushchikhsya v shkolakh raznogo tipa. Sibirskiy Medicinskij Zhurnal (Irkutsk). 2010; 5: 113–6. Russian.
- Suvorova AV. Pokazateli fizicheskogo razvitiya uchashchikhsya v shkolakh s razlichnoy formoy organizatsii uchebnogo protsesssa. In: Aktual'nye problemy zdorov'ya detey i podrostkov i puti ikh resheniya: Materialy 3-go Vserossiyskogo kongressa s mezhdunarodnym uchastiem po shkol'noy i universitetskoy meditsine; 2012 Feb 25–27; Moscow, Russia. Moscow: Nauchnyy tsentr zdorov'ya detey RAMN; 2012. p. 406–8. Russian.
- Taveras EM, Field AE, Berkey CS, Rufas-Shiman SL, Frazier AL, Colditz GA, Gillman MW. Longitudinal relationship between television viewing and leisure-time physical activity during adolescence. Pediatrics. 2007 Feb; 119 (2): e314–9.
- Spruyt K, Molfese DL, Gozal D. Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children. Pediatrics. 2011 Feb; 127 (2): e345–52.
- Agafonova NA. Kharakteristika fizicheskoy podgotovlennosti starshikh doshkol'nikov kompensiruyushchikh ortopedicheskikh grupp. Zdorov'e naseleniya i sreda obitaniya. 2006; 12 (165): 20–2. Russian.
- Khramtsov PI, Bakanov IM. Vliyaniye raznykh rezhimov dvigatel'noy aktivnosti na fizicheskuyu rabotosposobnost' mladshikh shkol'nikov. Zdorov'e naseleniya i sreda obitaniya. 2007; 2 (167): 7–9. Russian.
- Khramtsov PI, Bakanov IM. Gigienicheskaya otsenka organizatsii

divigatel'noy aktivnosti uchashchikhsya nachal'nykh klassov shkol polnogo dnya. Hygiene and sanitation. 2009; 2: 66–9. Russian.

30. Kuchma VR, Sokolova SB. Povedenie detey opasnoe dlya zdorov'ya: sovremennye trendy i formirovaniye zdorovogo obraza zhizni. Moscow: Nauchnyy tsentr zdorov'ya detey RAMN; 2014. p. 41–3. Russian.

Литература

1. Исламова Н. М. Морфо-функциональные особенности детей и подростков г. Набережные Челны в связи с этнической принадлежностью и влиянием факторов окружающей среды [диссертация]. М.: Московский государственный университет им. М. В. Ломоносова; 2008.
2. Соколов А. Я., Заводчикова Ю. В. Уровень физического развития и типы телосложения девочек и мальчиков Магадана 7–10 лет. Гигиена и санитария. 2009; 3: 86–8.
3. Поляков В. К. Состояние здоровья школьников: соматометрические показатели, особенности питания и коррекция нарушений нутритивного статуса [диссертация]. Саратов: Саратовский государственный медицинский университет им. В. И. Разумовского; 2010.
4. Богомолова Е. С. Гигиеническое обоснование мониторинга роста и развития школьников в системе «здоровье–среда обитания» [диссертация]. Нижний Новгород: Нижегородская государственная медицинская академия; 2010.
5. Година Е. З., Хомякова И. А., Задорожная Л. В., Анисимова А. В., Иванова Е. М., Пермякова Е. Ю. и др. Аутологические исследования на родине М. В. Ломоносова. Вестник Московского университета. Серия 23: Антропология. 2011; 3: 68–99.
6. Поварго Е. А., Зулькарнаева А. Т., Зулькарнаев Т. Р., Овсянникова Л. Б., Агафонов А. И., Ахметшина Р. А. Региональные особенности физического развития школьников Уфы. Гигиена и санитария. 2014; 93 (4): 72–4.
7. Бокарева Н. А., Скоблина Н. А., Милушкина О. Ю. Динамика физического и биологического развития московских школьников. Доктор.Ру (Педиатрия. Гастроэнтерология). 2014; 11 (99): 5–8.
8. Кучма В. Р., Скоблина Н. А., Милушкина О. Ю., Бокарева Н. А., Ямпольская Ю. А. Характеристика морфофункциональных показателей московских школьников 8–15 лет (по результатам лонгитудинальных исследований). Вестник Московского университета. Серия 23: Антропология. 2012; 1: 76–83.
9. Баранов А. А., Кучма В. Р., Скоблина Н. А., Милушкина О. Ю., Бокарева Н. А. Основные закономерности морфофункционального развития детей и подростков в современных условиях. Вестник РАМН. 2012; 67 (12): 35–40.
10. Баранов А. А., Кучма В. Р., Скоблина Н. А. Физическое развитие детей и подростков на рубеже тысячелетий. М.: Научный центр здоровья детей РАМН; 2008. 216 с.
11. Сухарева Л. М., Кучма В. Р., Степанова М. И., Александрова И. Э., Шумкова Т. В. Новые подходы к гигиенической оценке условий и режимов обучения в общеобразовательных учреждениях. Здоровье населения и среда обитания. 2013; 8 (245): 4–5.
12. Миннибаев Т. Ш., Тимошенко К. Т., Рапопорт И. К. Гигиеническая оценка профильного обучения в медико-биологических классах и состояние здоровья учащихся. Здоровье населения и среда обитания. 2010; 5: 4–7.
13. Сухарева Л. М., Рапопорт И. К., Поленова М. А. Состояние здоровья московских школьников и факторы, влияющие на его формирование (лонгитудинальное исследование). Здоровье населения и среда обитания. 2014; 3 (252): 28–31.
14. Милушкина О. Ю. Закономерности формирования морфофункциональных показателей детей и подростков в современных санитарно-гигиенических и медико-социальных условиях [диссертация]. М.: Российский национальный исследовательский медицинский университет им. Н. И. Пирогова; 2013.
15. Бокарева Н. А. Ведущие факторы, формирующие физическое развитие современных детей мегаполиса Москвы [диссертация]. М.: Российский национальный исследовательский медицинский университет им. Н. И. Пирогова; 2015.

31. Smetanina SA, Suplotova LA, Novakovskaya NA. Epidemiologiya izbytkha vesa i ozhireniya u detey v vozraste 9–12 let na yuge Tyumenskoy oblasti. In: Materialy V Vserossiyskogo Kongressa endokrinologov «Vysokie meditsinskie tekhnologii v endokrinologii»; 2006 Oct 30 – Nov 2; Moscow, Russia. Moscow; 2006. p. 644.
16. Овчинникова З. А. Гигиеническая оценка влияния условий обучения на физическое развитие и состояние здоровья школьников медико-биологических классов [диссертация]. М.: Российский национальный исследовательский медицинский университет им. Н. И. Пирогова; 2015.
17. Сухарев А. Г., Каневская Л. Я. Комплексная оценка воспитания и обучения детей и подростков в образовательном учреждении: методическое пособие. М.; 2001. 208 с.
18. Баранов А. А., Кучма В. Р., редакторы. Методы исследования физического развития детей и подростков в популяционном мониторинге: руководство для врачей. М.: Союз педиатров России; 1999. 226 с.
19. Кучма В. Р., Храмов П. И., редакторы. Руководство по диагностике и профилактике школьно обусловленных заболеваний, оздоровлению детей в образовательных учреждениях. М.: Научный центр здоровья детей РАМН; 2012. с. 144–170.
20. Баранов А. А., Кучма В. Р., Сухарева Л. М. Медицинские и социальные аспекты адаптации современных подростков к условиям воспитания, обучения и трудовой деятельности: руководство для врачей. М.: ГЭОТАР-Медиа; 2007. 352 с.
21. Головей Л. А., Рыбалко Е. Ф., редакторы. Практикум по возрастной психологии. СПб.: «Речь»; 2002. 694 с.
22. СанПиН 2.4.2.2821–10 «Санитарно-эпидемиологические требования к условиям и организации обучения в общеобразовательных учреждениях». Российская газета. 2011; 5430 (54). Доступно по ссылке: <https://rg.ru/2011/03/16/sanpin-dok.html>.
23. Зазнобова Т. В. Особенности физического развития старшеклассников, обучающихся в школах разного типа. Сибирский медицинский журнал (Иркутск). 2010; 5: 113–6.
24. Суворова А. В. Показатели физического развития учащихся в школах с различной формой организации учебного процесса. В сборнике: Актуальные проблемы здоровья детей и подростков и пути их решения: Материалы 3-го Всероссийского конгресса с международным участием по школьной и университетской медицине; 25–27 февраля 2012 г.; Москва, Россия. М.: Научный центр здоровья детей РАМН; 2012. с. 406–8.
25. Taveras EM, Field AE, Berkey CS, Rufas-Shiman SL, Frazier AL, Colditz GA, Gillman MW. Longitudinal relationship between television viewing and leisure-time physical activity during adolescence. Pediatrics. 2007 Feb; 119 (2): e314–9.
26. Spruyt K, Molfese DL, Gozal D. Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children. Pediatrics. 2011 Feb; 127 (2): e345–52.
27. Агафонова Н. А. Характеристика физической подготовленности старших дошкольников компенсирующих ортопедических групп. Здоровье населения и среда обитания. 2006; 12 (165): 20–2.
28. Храмов П. И., Баканов И. М. Влияние разных режимов двигательной активности на физическую работоспособность младших школьников. Здоровье населения и среда обитания. 2007; 2 (167): 7–9.
29. Храмов П. И., Баканов И. М. Гигиеническая оценка организации двигательной активности учащихся начальных классов школ полного дня. Гигиена и санитария. 2009; 2: 66–9.
30. Кучма В. Р., Соколова С. Б. Поведение детей опасное для здоровья: современные тренды и формирование здорового образа жизни. М.: Научный центр здоровья детей РАМН; 2014. с. 41–3.
31. Сметанина С. А., Суплотова Л. А., Новаковская Н. А. Эпидемиология избытка веса и ожирения у детей в возрасте 9–12 лет на юге Тюменской области. В сборнике: Материалы V Всероссийского Конгресса эндокринологов «Высокие медицинские технологии в эндокринологии»; 30 октября – 2 ноября 2006 г.; Москва, Россия. М.; 2006. с. 644.