

Original Article

Daily assessment of physical activity in 6–11-year-old children

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Abstract:

The purpose is to study the volume of motor activity and the intensity of physical activity of children aged 6-11 years during their daily regime, to identify existing problems of motor activity at this age and compare the results with age norms. Research materials. The study involved children aged 6-11 years in the city of Belgorod (n=186, 94-girls, 92-boys). More than 250 research papers were analyzed, including those indexed in the Scopus database and the Web of Science. In these works, the issues of optimizing the motor activity of 6-11 years olds were touched upon. Research methods: studying and analyzing scientific papers on the problem under study by home and foreign scientists; pedometer, heart rate monitoring, timekeeping, statistical processing of the results obtained. Results. The average daily rate of motor activity in boys is 7310.87±301.55 steps per day, and in girls it is 6069.26±472.45 steps per day. The intensity of daily loads in most children corresponds mainly to low-and medium-intensity modes (increasing the heart rate to 110-140 beats per minute). During the week, high and high intensity loads were observed in 7.2 % of girls and 23.8% of boys. Conclusions. None of the examined children aged 6-11 years reaches the optimal level of motor activity. Analysis of the dynamics of motor activity and their comparison with the age norm indicates that the number of steps performed by younger students who participated in our study is significantly behind the norm. The biological need for movement is met by 43.4% in girls and 52.2% in boys. The results of heart rate monitoring indicate that physical activity corresponds mainly to low-and medium-intensity regimes for children of this age. At the same time, physical activity of high and maximum intensity was observed in 7.2% of girls, and in 23.8% of boys episodically. While in school, the average number of locomotion's for both boys and girls is lower than in the afternoon. Physical activity of 6-11 years of age in the day mode does not have a developing and training effect in physical education lessons and sports, as well as in independent motor activity. We believe that the problem of the volume and intensity of physical activity at this age stage requires additional in-depth study with a large sample size and duration.

Keywords: physical education, motor activity, evaluation of motor activity, norms of motor activity.

Introduction.

Movements in a child's daily life play a significant role and contribute to the harmonious development of 6-11 year olds. Motor activity is a biological need of the body, which affects the health, their physical and general development. Motor activity is derived not only from the individual characteristics of children, but also from the motor mode that is followed in the family and school.

According to Silaeva (2009), the satisfaction of the hourly need for movement should be carried out at the expense of small forms of physical education: morning gymnastics, gymnastics before lessons, physical culture in the classroom and gymnastics for the eyes, dynamic changes. In addition, the hourly motor need is realized in physical education classes and classes in sport clubs, as well as active games (Weinbaum, 1991; Weinbaum, Koval, & Rodionova, 2003; Silaeva, 2009).

It should be noted that in school conditions, children's need for movement is not met to the proper extent (Gil, Santos, Honorio, & Ieee, 2018). The reason for this is the specific nature of the younger student's educational activities and lifestyle. Significant mental stress, reduced motor activity, poor nutrition, stress and mediocre organization of physical education at school have a negative impact, including the health of primary school students.

The deterioration of children's health is confirmed not only by official statistics, but also by the results of selective in-depth scientific research (Gaidalina, 2010; Kondakova, 2013).

Assessment of the current state and tendencies of primary school children health, the Institute of Developmental Physiology Russian Academy of Education, testifies to the serious troubles that can lead to deterioration of life quality, significant limitations to achieve biological and social functions (Almanac «New research». Institute of Age Physiology, 2012).

This is largely due to a lack of motor activity. According to our data, it decreases by more than 30 % of children aged 6-7 at school and continues to fall steadily in the future (Pravdov, 2003; Palmer, Graham, & Elliot,

2005;Axford, Joosten, & Harris, 2018; Gil, Santos, Honorio, & Ieee2018). This is due to the fact that in the XXI century, the living conditions of children have changed significantly. In place of exciting outdoor games for children of the XX-th century, no less exciting computer games have come, as well as new various forms of leisure that exclude motor activity, which led to significant changes in the structure of free time for younger students (Beltukov, 2006; Kiefer, Pincus, Richardson, & Myer, 2017; Nagovitsyn et al., 2020; Stepanchenko, Hrybovska, Danylevych, & Hrybosky, 2020).

In connection with the steady trend of decreasing health indicators, physical development, physical fitness and functional capabilities of a growing person, the problem of filling the deficit of motor activity and regulating hyperactivity becomes particularly relevant. The analysis of numerous studies has shown that the existing system of physical education, despite its variability and focus on individualization, does not contribute to the harmonious development of the younger generation, strengthening their health and physical conditions (Kondakov, 2000; Moldagalieva, 2009; Voloshina et al. 2018). To do this, a sufficient amount of organized and independent forms of motor activity should be included in the lifestyle of children.

The special role of motor activity in children aged 6-11 is emphasized by many foreign scientists (Ericsson, 2011; Currie et al., 2012; Idamokoro, Goon, & Lyoka, 2019; RahmaniGhobadi, & ForghaniOzrudi, 2019). It has a great impact on the physical development, health promotion and personality formation of a growing person.

Thus, an increasing number of children are in conditions of physical inactivity. The biological need for children's movement in the modern educational space of Russia is met only by 60%. Similar trends are observed in other countries, too (Golubeva, 2008; Minicheva, 2009; Kriemler et al., 2010; Badicuet et al., 2019).

According to experts of Institute of Age Physiology of Russian Academy of Education, a comprehensive approach is needed to solve the problem of the health status of 6-11 years' old who are studying in educational institutions, including the efforts of both the education system and health care (Almanac «New research». Institute of Age Physiology, 2012).

Currently, the assessment of the existing motor activity of modern children aged 6-11 is of great scientific and practical importance. It is important to determine: scientific approaches to optimizing the motor activity of a growing person; optimal motor activity and ways to achieve it, which is necessary to ensure the harmonious physical development of a child at this age.

The purpose is to study the volume of motor activity, the intensity of physical activity of 6-11 years old in the day mode, to identify existing problems of motor activity at this age stage and compare the results with age norms.

Material & methods

Participants

The study involved children aged 6-11 years in the city of Belgorod (n=186, 94-girls, 92-boys). The parents' consent to the children's participation in the experiment was obtained. Protocol of recommendation of the BSU ethics Commission-no. 8, dated 28.08.2019. We analyzed more than 250 scientific papers on the research topic, including those indexed in the Scopus database and the Web of Science. In these works, the issues of optimizing the motor activity of children 6-11 years old were touched upon.

Procedure

Study and analysis of scientific papers on the problem under study by domestic and foreign scientists; pedagogical observations, pedometers, heart rate monitoring, statistical processing of the results obtained. We consider the intensity of motor activity by heart rate indicators, which were recorded using a fitness bracelet (Lerbyee Fitness tracker K1), and by the number of locomotion's performed per unit of time (steps / min).

Statistical analysis

Statistical analysis of the data obtained was performed using licensed Microsoft Excel spreadsheet packages (2016), Statgraphics 18.1.08. indicators of descriptive statistics (arithmetic mean, standard deviation and error of the average value) were Determined. The reliability of differences in values was assessed by the student's criterion. The difference was considered reliable at $p < 0.05$.

Results

With daily, significant mental stress and chronic fatigue, according to our data, more than 90% of primary school children are engaged in physical education not only within the curriculum, but also attend various sport sections. None of the examined children aged 6-11 years reaches the optimal level of motor activity.

The study of motor activity dynamics and their comparison with the age norm indicates that the number of steps performed by younger students who took part in our experiment is significantly behind the norm (according to Sukharev-14-20 thousand steps per day) (Sukharev, 1991). The biological need for movement is met by 43.4% in girls and 52.2% in boys. Thus, the average daily index of motor activity in boys is 7310.87 ± 301.55 steps per day, and in girls it is 6069.26 ± 472.45 steps per day. At the same time, the indicators of pedometer in boys' group are slightly higher than in girls'.

A significant role in the assessment of motor activity is played by the indicator of its intensity. We consider the intensity of motor activity by heart rate indicators, which were recorded using a fitness bracelet (Fig. 1, Fig.2), and by the number of locomotion's performed per unit of time (steps / min). (table. 1).

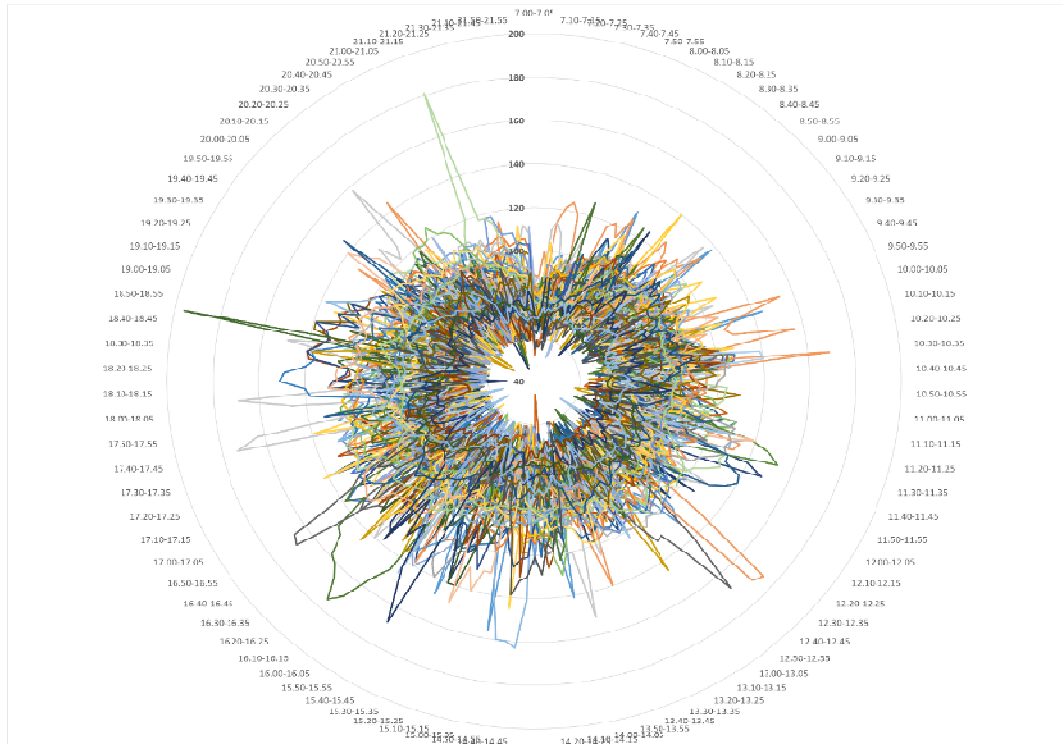


Fig. 1. Heart rate indicators during the day in girls' group.

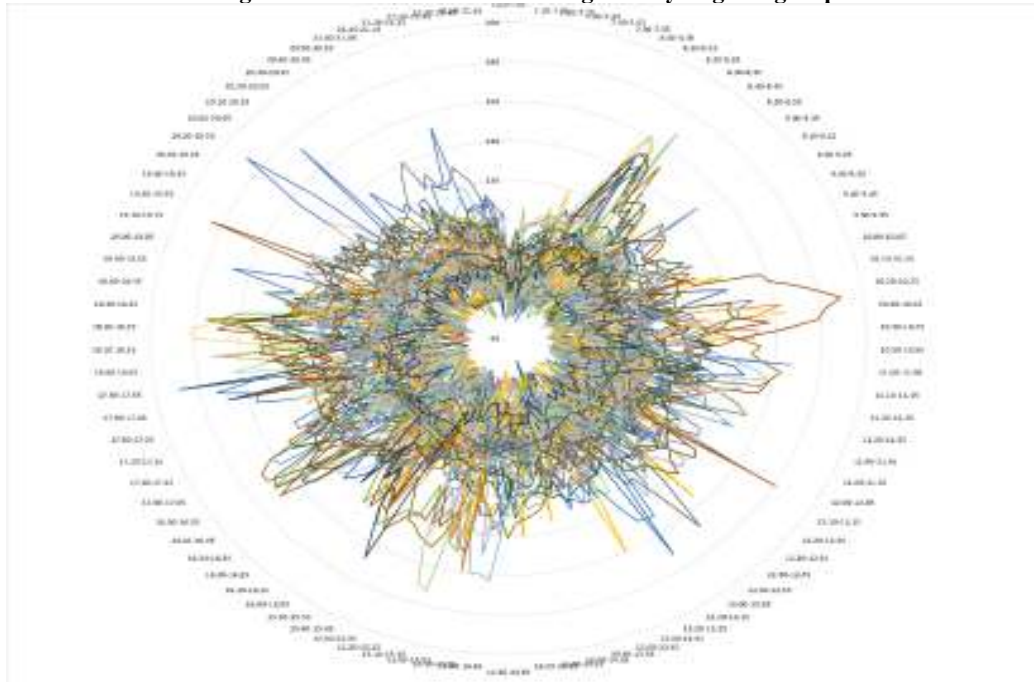


Fig. 2. Heart rate indicators during the day in boys' group.

Analysis of heart rate monitoring results (Fig.1, Fig.2) indicates that the intensity of loads corresponds mainly to low and medium intensity modes (increasing the heart rate to 110-140 beats per min) (according to Abrosimova&Karasik) (Abrosimova, &Karasik, 1977). At the same time, high and maximum intensity loads (increased heart rate over 141 beats/min) were seen in 7.2% of girl's group, and 23.8% of boys's group sporadically.

Table 1. The indicators of intensity of physical activity.

Time interval	STEPS (quantity)						Heart Rate (beats per min)					
	girls			boys			girls			boys		
	M ± m			M ± m			M ± m			M ± m		
average per hour/day	404, 62	±	31, 50	487, 39	±	20, 10	89, 17	±	0, 76	92, 37	±	0, 93
average per minute/day	6, 74	±	0, 52	8, 12	±	0, 34						
sum per day	6069, 26	±	472, 45	7310, 87	±	301, 55						
average sum per PH classes days at school	6883, 83	±	494, 22	7735, 49	±	627, 60						
average per PH classes days at school							91, 06	±	1, 26	93, 37	±	1, 84
average sum per training days	6758, 74	±	459, 97	7507, 83	±	475, 49						
average per training days							91, 17	±	1, 17	93, 77	±	1, 83
average per PH class	869, 50	±	123, 25	766, 00	±	130, 00	96, 67	±	1, 79	102, 50	±	3, 18
average per minute during PH class	14, 49	±	2, 05	12, 77	±	2, 17						
average per training	785, 99	±	65, 54	807, 37	±	68, 27	99, 47	±	2, 11	106, 41	±	2, 91
average per minute of training	13, 10	±	1, 09	13, 46	±	1, 14						
in the morning (Mn-Fr)	381, 41	±	50, 64	497, 21	±	40, 14	90, 86	±	0, 23	93, 04	±	0, 37
in the morning per minute	6, 36	±	0, 84	8, 29	±	0, 67						
in the afternoon	460, 46	±	51, 45	542, 86	±	37, 07	89, 76	±	0, 56	93, 88	±	1, 23
in the afternoon per minute	7, 67	±	0, 86	9, 05	±	0, 62						
for weekdays	6890, 38	±	390, 17	7726, 26	±	494, 60						
average sum per weekends	5558, 04	±	568, 05	6322, 38	±	591, 03						
average per weekends							86, 42	±	1, 44	91, 48	±	5, 31
average per days without PH classes	6160, 93	±	523, 66	6971, 97	±	624, 02						

The intensity of motor activity in physical education classes at school and in training in various sport clubs is from 766.00±130 to 807.37±68.27 steps for boys' group, and from 785.99±65.54 to 869.50±123.25 steps for girls 'group, while the heart rate for boys is from 102.50±3.18 to 106.41±2.91 bpm., and for girls from 96.67±1.79 to 99.47±2.11 bpm. Accordingly, the intensity of motor activity in physical education classes at school and in training in various sport clubs for boys 'group is from 12.77±2.17 to 13.46±1.14 steps/min., and for girls 'group from 13.10±1.09 to 14.49±2.05 steps/min., which is significantly lower than the age norms. It is necessary to pay attention to the fact that girls perform more locomotion's in physical education classes, and boys in training, since this primarily depends on the chosen sport. At the same time, the heart rate of children in training sessions is slightly higher than in physical education classes.

The average index of motor activity on days when there is a physical education lesson in the schedule of training sessions is 7735.49 ± 627.60 steps for boys, and 6883.83 ± 494.22 steps for girls, while on days when there is no physical education lesson in the schedule of training sessions, boys have 6971.97 ± 624.02 steps, and girls have 6160.93 ± 523.66 steps. The data obtained indicate that a physical education lesson contributes to an increase in children's motor activity, although slightly.

Comparing the motor activity of children in the regular time (from 8.00 to 13.00 hours, Monday-Friday) and out of school (from 13.00 to 22.00 hours, Monday-Friday), we can trace the following trend: while in school, the average number of locomotion's for both boys and girls is lower than in the afternoon.

Analyzing the results of motor activity, it was found that on weekends, children aged 6-11 move much less than on school days. This is due to the fact that, firstly, students have lots of home work; secondly, exciting outdoor games have been replaced by no less exciting ones – computer ones, as well as new various forms of leisure that exclude motor activity; thirdly, parents pay more attention to the intellectual development of children, rather than physical. All this helps to reduce the motor activity of children, does not allow to meet the biological need of the growing body in movements.

The data obtained by us, which characterize the volume and intensity of loads of children 6-11 years old, indicates that they do not have a developing and training effect in physical education lessons and sports, as well as in independent motor activity.

Thus, the relevance of the studied problem is determined by the existing contradiction between the need of modern society to preserve and strengthen the health of 6-11 years old and the lack of motor activity corresponding to their biological norm.

In the course of our research, it was important for us to get the initial reliable and objective information that allows us to discuss the level of motor activity of 6-11 years old in modern conditions. In further studies, with larger sample sizes and longer duration, will be possible to justify an adaptive model for regulating motor activity of a growing person in the conditions of a modern variable system of physical education.

Discussion.

Motor activity is one of the indicators that determine the health and physical development of each person, especially a child.

As numerous studies show, the motor activity of modern children significantly lags behind the proper standards, and continues to decline in dynamics.

The close relationship between physical education and the state of health of modern schoolchildren is proved. Complication of educational programs, lack of free time, and preference for passive recreation are the reasons for a significant deficit in students' motor activity, which is manifested in a number of adverse socio-biological consequences, in particular, a decrease in the level of health and an increase in morbidity (Weinbaum, Koval, & Rodionova, 2003).

At the same time, researchers pay more attention to the problems of nutrition and overweight of children (Laukkanen, Pesola, Finni, & Saakslähti, 2017; Draper et al. 2019; Sanchez-Lopez et al. 2019) and the relationship of the level of motor activity of children with a number of social indicators (country of residence, nationality, level of parents' education, economic conditions of family, level of motor activity of the mother, material base of educational institutions, etc.) (Adeyemi-Walker, Duncan, Tallis, & Eyre, 2018; Ward et al. 2018; Hacke et al. 2019; Maatta et al. 2019).

Over the past 10-15 years, the number of healthy children has decreased by 8.1%; the number of children with physical disabilities and predisposition to pathologies has increased by 6.7%. the number of healthy children has decreased 5 times, and among children entering the school, they make up only about 10% (according to the Institute of hygiene and health of children and adolescents of Scientific center of children health RAMS); 1 – diseases of the respiratory system (44, 8%); 2 – diseases of the digestive system (6.0 percent); in Russia on average, 10% of children (0-14 years old) decreased indices of physical development (according to Agapitova, 2010); about 7% of preschool and primary school children are obese (Weinbaum, Koval, & Rodionova, 2003; Voloshina, & Musanova, 2012).

Unfortunately, the problem of physical inactivity of a growing person is observed at an early stage – in the educational process of primary school. Anxiety about the health of the younger generation initiates the search for effective solutions to the problem of motor activity deficit and hyperactivity all over the world (Krivolapchuk, 2007; Islamova, Kiamova, & Kirillova, 2009; Gorelik, Filippova, & Knysheva, 2018; Quanet al., 2018).

The problem of regulating motor activity of a growing person is significant for specialists in the field of physical culture and medicine in Poland, Sweden, Ukraine, Australia and other countries of the world (Jurg et al., 2006; Huhman et al., 2007; Haerens et al., 2007; Wenet et al., 2008). We will present a more detailed description of some modern foreign strategies for regulating motor activity in our future research papers.

However, considering scientific works that are devoted to solving the problem of regulating motor activity of a growing person, it is necessary to study all aspects of the implementation of this type of activity. To do this, we propose the development of an adaptive approach that takes into account the internal components of

regulation and external aspects of stimulating motor activity in social, psychological, and biological environments.

Conclusions.

With daily, significant mental stress and chronic fatigue, according to our data, more than 90% of primary school children are engaged in physical education not only within the curriculum, but also attend various sports sections. None of the examined children aged 6-11 years reaches the optimal level of motor activity.

Analysis of the dynamics of motor activity and their comparison with the age norm indicates that the number of steps performed by younger students who participated in our study is significantly behind the norm. The biological need for movement is met by 43.4% in girls and 52.2% in boys.

The results of heart rate monitoring indicate that physical activity corresponds mainly to low-and medium-intensity regimes for children of this age. At the same time, physical activity of high and maximum intensity was observed in 7.2% of girls, and in 23.8% of boys sporadically.

Comparing the motor activity of children in the regular and extra-curricular hours, we can trace the following trend: while at school, in the first half of the day, the average number of locomotion's in both boy's group and girls's group is lower than in the second half of the day.

The data obtained by us, which characterizes the volume and intensity of loads of 6-11 years old, indicates that they do not have a developing and training effect in physical education lessons and sports, as well as in independent motor activity. We believe that the problem of the volume and intensity of physical activity at this age stage requires additional in-depth study.

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Conflict of interests.

The authors declare that there is no conflict of interests.

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