The functional state of girls with high motor fitness in the conditions of digitalization

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Abstract. The article aims at revealing the functional state of girls aged between six-seven and 10-11 years with a generally high level of key motor skills due to the intensive use of digital technologies. Experimental studies comprised practically healthy girls aged between six-seven (n>1,200 and n=60) and 10-11 years (n>1,000 and n=74). To assess the information load of children, the authors of the article determined the total screen time and the digitalization of their living conditions. The level of digitalization was studied based on a modified Informatization Index (Imod). The heart rate and blood pressure were recorded. Based on these measurements, the authors calculated average pressure, the vegetative index of Kerdo, double product, the Myznikov index and changes in the functional index. They measured chest circumference, the length and weight of the body to calculate the body mass index. The battery of motor fitness tests included a 30-meter sprint, front bend, three sets of a 10-meter shuttle run, sit-ups, a long jump, a 6-minute run, PWC170. Physical activity was studied using the adapted questionnaire "Global Physical Activity Questionnaire (GPAQ)" and the timing of motor actions. During the intensive use of digital technologies, girls aged between six-seven and 10-11 years with a high level of motor abilities could be characterized by the most favorable functional state of their body in comparison with the same children with insufficient motor fitness. They had the hypertonicity of the parasympathetic division of the vegetative nervous system, the predominance of the autonomous regulation of the heart rate over central regulation, the expanded adaptive capabilities of the organism, harmonious physical development and high physical activity. The study results give reason to believe that an increase in the level of motor fitness of preschoolers and primary school children can have a significant effect on improving the functional state of their bodies due to the intensive use of digital technologies.

Keywords: digital technologies, motor abilities, physical activity, functional state.

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1 Introduction

Today, there is no sufficient information on the criteria for identifying gifted children in the field of physical education [1, 2]. The formation of motor skills in general and individual motor abilities, in particular, is genetically determined. At the same time, the individual development of motor abilities is regulated by polygenic mechanisms [3-5]. It is known that the initial indicators of human motor abilities are higher than their growth rate under the influence of physical exercises [3]. This circumstance is considered in the process of sports orientation and selection [4]. The tasks of sports orientation and selection also increase the relevance of issues related to the adaptation of motor-gifted children to modern information and educational environment.

Currently, there is an increasing number of scientific works concerned with the analysis of the relationship between the intensive use of digital technologies by children in everyday life and the functional state of the body [5-12], physical activity and motor fitness [6, 7, 13-18]. Despite the available data, there are some unsolved issues associated with assessing the impact of digital technologies on the health and functional state of children at various stages of ontogenesis with due regard to the development of motor abilities. In this regard, it is necessary to identify the functional state of children's organism with a high level of motor abilities under the conditions of modern information and educational environment.

The article aims at revealing the functional state of girls aged between six-seven and 10-11 years with a generally high level of key motor skills due to the intensive use of digital technologies.

2 Methods

Experimental studies comprised practically healthy girls aged between six-seven (n>1200 and n=60) and 10-11 years (n>1000 and n=74).

The daily use of digital technologies was analyzed based on the survey and timing of various activities. The timing was conducted in an experimental study during the entire awakening period. When analyzing the material, we summarized all the activities related to the use of digital technologies. The duration and other characteristics of sleep were assessed using a special diary [19].

To assess the information load of children, we have determined the total screen time and the digitalization of living conditions.

The level of digitalization was studied based on a modified Informatization Index (Imod). This index is equal to the ratio of hours of using electronic devices per day to the total awakening period (in %) [20].

During the study, heart rate, systolic and diastolic blood pressure were recorded in accordance with the WHO recommendations. Then we calculated average pressure, the vegetative index of Kerdo, double product, the Myznikov index and changes in the functional index [21].

Resting heart rate had been recorded in a sitting position in standard lead II for five minutes [21]. Time analysis was carried out to determine the average duration of the RR interval (RRNN), the spread of cardiointervals (MxDMn), the mode amplitude (AMo50), the standard deviation (SDNN), the number of cardiointerval pairs with a difference of more than 50 ms (in %) of the total number of cardiointervals (pNN50), the stress-index (SI).

We measured chest circumference, length and weight of the body to calculate the body mass index. The battery of motor fitness tests included a 30-meter sprint, front bend, three sets of a 10-meter shuttle run, sit-ups, a long jump, a 6-minute run, PWC170.

Physical activity was studied using the adapted questionnaire "Global Physical Activity Questionnaire (GPAQ)" and the timing of motor actions. As a result, we have revealed moderate and high physical activity [22].

Methods of mathematical statistics were used to determine the statistical characteristics of some measurements and prove statistical hypotheses based on the use of parametric and non-parametric criteria.

3 Results

While comparing the functional state of children, we have revealed the following age differences: six- and seven-year-old girls had ($p<0.05–0.001$) a higher heart rate, indicators of the vegetative index of Kerdo, the Myznikov index and changes in the functional index, and lower indicators of the average duration of the RR interval, systolic and diastolic blood pressure, average blood pressure, the length and weight of the body. They were also characterized by a relatively low level of life informatization in combination with the insufficient development of speed, strength, coordination, general endurance, strength endurance and a higher level of flexibility if compared to schoolgirls of 10-11 years old ($p<0.05–0.001$).

Based on a standard scale, girls aged between six-seven and 10-11 years were divided into five functional groups according to their level of informatization: low, below average, average, above average and high.

We have compared children with a high degree of life informatization differing in the level of general motor fitness. Motor fitness was assessed using the points received for the completion of seven control exercises described in the methodology section. The low level of each indicator was estimated at 1 point ($<M–0.67\sigma$), the average level at 2 points ($M\pm0.67\sigma$), the high level at 3 points ($>M+0.67\sigma$). A general assessment of motor fitness was given to represent the sum of points earned for completing all the tests. Girls with the level of motor fitness exceeding 19 points (five or more indicators had high-level development) belonged to a gifted group. Children who got less than 9 points (five or more indicators had low-level development) were included in an underdeveloped group.

When comparing the functional state of the body of six- or seven-year-old girls, we have revealed that preschool girls with a high level of motor development who used digital technologies were characterized by relatively low ($p<0.05$-0.001) values of the body mass index, heart rate, amplitude mode, stress-index, double product, the vegetative index of Kerdo and changes in the functional index, and higher ($p<0.05$) values of the RR interval, spread of cardiointervals and general physical activity if compared to girls with insufficient motor development (Fig. 1).

On the contrary, 10-11 years old girls with a high level of informatization of living conditions and a high level of motor development also differed from schoolgirls with a high Imod but low motor fitness in the functional state indices under consideration. These differences ($p<0.05$) related to the body mass index, chest circumference, heart rate, RR interval, standard deviation, spread of cardiointervals, stress-index, vegetative index of Kerdo, diastolic blood pressure, Myznikov index, changes in the functional index, general physical activity and intensive physical activity (Fig. 2).

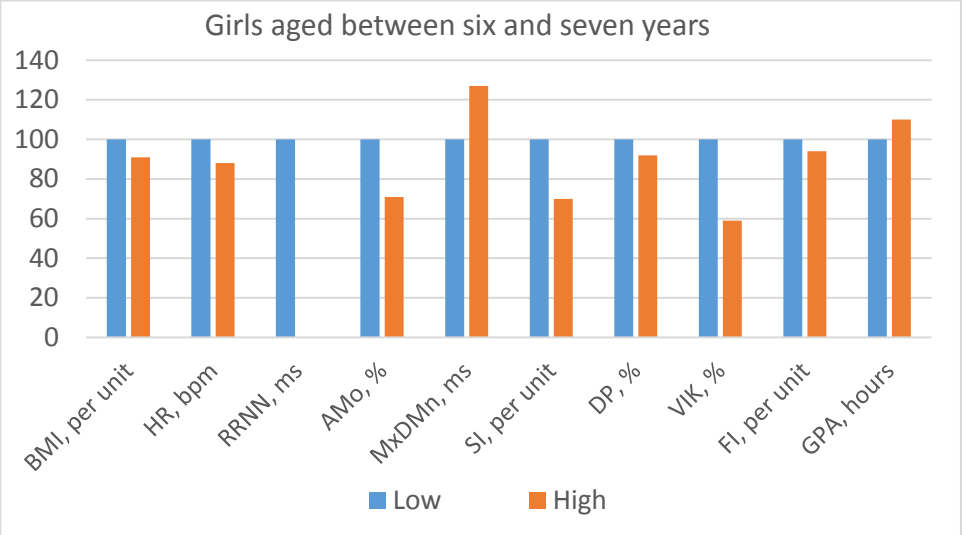

Fig. 1. The functional state of the body of girls aged between six and seven years with high- and low-level development of motor skills. Note: The indicators are presented in relation to which statistically significant intergroup differences were revealed ($p<0.05–0.001$).

At the age of 10-11 years, there were more statistically significant differences due to the integral assessment of the development of key motor abilities than at the age of six-seven years. These differences reflect the specific functioning of physiological systems and the unique development of motor skills in different age periods.

The results obtained are consistent with the research results provided by other authors who revealed a reverse relationship between physical activity and physical fitness in conformity with the total time of using digital technologies [7, 13-16, 18].

Many scholars emphasize that as the time spent on digital technologies increases, the time allotted for physical activity and the level of motor fitness might decrease after a certain moment [5, 14, 17, 23-26].

Several studies have shown that an intensive and prolonged (more than two hours) use of digital technologies in everyday life can have a negative effect not only on motor fitness but also on various aspects of children's health and functional state. There is a deterioration in vision, musculoskeletal system, a decrease in the quality of sleep, an increase in the risk of overweight, cardiometabolic diseases, disorders of autonomic regulation, the development of fear, anxiety and depression [5-9, 11-13, 27].

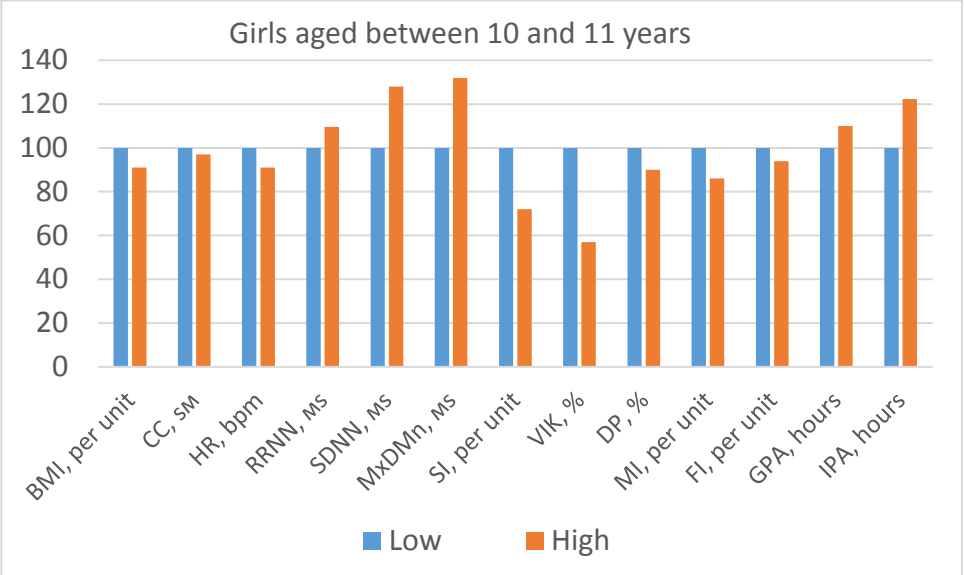

Fig. 2. The functional state of the body of girls aged between 10 and 11 years with high- and low-level development of motor skills. Note: The indicators are presented in relation to which statistically significant intergroup differences were revealed ($p<0.05–0.001$).

It is worth mentioning that today little attention is paid to increasing the level of motor fitness and physical activity of children during the intensive use of digital technologies to optimize the functional state of their body at different stages of age development.

4 Conclusion

During the intensive use of digital technologies, girls aged between six-seven and 10-11 years with a high level of motor abilities could be characterized by the most favorable functional state of their body in comparison with the same children with insufficient motor fitness. They had the hypertonicity of the parasympathetic division of the vegetative nervous system, the predominance of the autonomous regulation of the heart rate over central regulation, the expanded adaptive capabilities of the organism, harmonious physical development and high physical activity.

The study results give reason to believe that an increase in the level of motor fitness of preschoolers and primary school children can have a significant effect on improving the functional state of their bodies due to the intensive use of digital technologies. In the future, it is necessary to conduct longitudinal studies of the influence of motor abilities on the functional development of children in a modern social environment filled with information.

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