

Original Article

Influence of physical activities on the posture in 10-11 year old schoolchildren

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Published online: February 15, 2017

(Accepted for publication January 11, 2017)

DOI:10.7752/jpes.2017.s1016

Abstract:

Purpose and problem: the aim of the study is to monitor the actual state of posture of schoolchildren in the Czech Republic. A large number of recent studies shows a declining trend of physical activity application in children who attend primary schools all over the world. We can assume that the factors that attract the attention of children more than everyday physical activity are significantly affecting the inactivity of children. *Materials and methods:* in this study, 50 10–11-year-old schoolchildren (primary school) were tested (25 boys, 25 girls). To determine the posture condition (position of individual body segments), the Jaroš and Lomíček test (standardized) and a Saehan metallic goniometer (Saehan Corporation, South Korea; 180 degrees) were used. Furthermore, a standardized questionnaire was used, which contained 9 questions that were focused on realization of physical activity in the observed children during the week. *Results:* the results of our study clearly indicate that basic schoolchildren do not have good posture. In obese children, a higher number of defective and very defective posture was observed in comparison with the normal weight children. The children that performed physical activity three times a week had a perfect posture. A defective or even very bad posture was detected in almost 83% of children who did not do any sports or exercised only once a week. The results of our study clearly demonstrated that schoolchildren who were less physically active during the week fell into the poor posture category ($p = 0.0001$, $\eta^2 = 0.09$). Furthermore, we determined that most schoolchildren, who applied 3 or more hours per week of physical activity, most often had a good posture ($p = 0.0001$, $\eta^2 = 0.12$). *Conclusions:* the prevention of this problem may be in a higher number of physical education lessons in schools or the interaction of state institutions, schools, families and sport clubs, which would ensure a sufficient amount of physical activity during the daily program of children.

Keywords: posture; obesity; physical activity; physical education; healthy physical education; primary school

Introduction

Postural stereotype is an integrated chain of reflexes that we observe as movement (Bautmans, Van Arken, Van Mackelenberg, & Mets, 2010). Repetition of the movement during the lifetime activates the same muscle groups and muscles between which a link is formed. Movement stereotypes of each person depend on the prerequisites of the individual human being (body shape, fat distribution, etc.).

In the last few decades, a decreasing trend is observed in the application of physical activity in the lives of people. In everyday human activities, for many people, physical activity is of the least importance in their daily routine. Without a doubt, technological advancements, workload at work and fast food options affect the physical activity of the population. These factors are very closely linked, and it is possible to say that they all have a negative effect on the movement of the current generation. The increase in the poor posture incidence is associated with changes in lifestyle, obesity and lack of exercise. Hodges and Tucker (2011) describe upright posture maintenance as a postural function that involves all muscles.

With the entry of children into school, there is a change in the musculoskeletal system, which is influenced by burdening the organism by sitting. Out of the total waking hours, children spend 1/3 of time at school in a static position (Kolisko, 2003). This fact begins to manifest itself right after the entry of children into school by weakening of the support motion system. This issue was addressed in a study by Murphy, Buckle, and Stubbs (2004), who found that the sitting of children in classrooms can cause painful conditions in the back area. The number of children, who keep upright stance without increased muscular effort, with the natural curvature of the spine is declining. Unfortunately, the family, which is the basis for harmonious and optimal development of children, is not always able to sufficiently engage children in physical activities during the day due to work duties of the parents. Currently, school cannot compensate enough for this fact. In the Czech Republic, children have only two physical education lessons a week. The degree of involvement of children in physical activities during these lessons is relative. Therefore, many authors from other countries highlight that more and more schoolchildren have back pain (Grimmer & Williams, 2000; Masiero, Carraro, Celia, Sarto, & Ermani, 2008;

Watson, Papageorgiou, Jones, Taylor, Symmons, Silman, & Macfarlane, 2002). However, poor posture more frequently happens in children of preschool age. By observing activities of children, Kolisko (1992) concluded that on average children actively move 2 to 14 minutes during a physical education lesson. Children are generally less physically active, and this leads to a more frequent occurrence of poor posture. Hercig (2005) stated that the range and frequency of weakening posture leads to a situation where physical education teachers need more knowledge of healthy physical education than of the sports. Kolář (2002) states that the incorrect use of muscles during the growth period may be considered as one of the major causes for the occurrence of poor posture. Kolisko (2003) states that the sources of poor posture are the static load at school, lack of physical activity and premature unilateral sports specialization in childhood. Spontaneous physical activity of children in preschool, when children enter the primary school, is significantly suppressed, and children spend most of the day in a static position (school desks, free time, activities on the internet, computer games, etc.). Over time, there has been an increase in the amount of static muscular work to the detriment of dynamic muscular work. In the early 19th century, hard physical work was compensated by a passive resting lying position, while the current young generation is used to relaxing in a sedentary position at a computer, tablet or television (Kučera, 1999). In adulthood, this fact may cause neuropsychological problems and consequent increased spending of funds to maintain health. It should be noted that back pain occurs in up to 80% of the adult population (Kopecký, 2014). Given these facts, it is certainly desirable to pay extra attention to the posture of children. An alarming sign is that some studies indicate that there is an increase in the number of children with bad posture (Dostálová, 2006, 2011). Pokorný (2003) even states that 95% of 6–8-year-old children have incorrect posture. This is also related to the claims of Kubánek (1992), who states that 70–80% of 6–11-year-old children need special balancing exercises for the weakened musculoskeletal system. In general, Kopecký (2014) states that in surveys dealing with bad posture it was found that 50–60% of schoolchildren have poor posture and therefore should regularly carry out special compensatory exercises during healthy physical education lessons. Healthy physical education is a form of controlled exercises that were designed by the qualified medical physical training practitioners for individuals who are included in the so-called III health group (Beránková, Grmela, Kopřivová, & Sebera, 2012). Similarly, Zanovitová, Zanolit, and Bendíková (2011) in their study found that nearly 60% of girls and 55% of boys have incorrect posture. During the long-term monitoring of children, Widhe (2001) determined that after 10 years of life, the body posture of children worsens. The author monitored the same children when they were 5-6 years of age and again when they were 15-16 years of age. These children had a larger inclination (approximately 6 degrees) of the thoracic kyphosis and lumbar lordosis within 10 years. At the same time, this study revealed a decrease in the mobility of the spine of the same observed children. The results of the survey investigation showed that approximately one third of 15–16-year-old children have an occasional back pain. Exercises for improving body posture are mentioned in the study of Torlaković, Muftić, Avdić, and Kebata (2013). A series of studies examined the effect of physical activity on body posture (e.g., Bogdanović & Marković, 2010).

It is evident that proper diet and ample physical activity can positively affect the health of children, which is associated with the correct posture. The question is how much time they should devote to physical activity per week for good posture.

The aim of this study was to determine whether the amount of applied physical activities during the week correlates with the posture of schoolchildren in the Czech Republic.

Materials and methods

The first part of this study focuses on monitoring the impact of BMI (body mass index) on posture and the influence of organized physical activity on posture. Next part monitors the results from a standardized questionnaire.

Participants

The research sample consisted of 50 children from primary school (25 boys, 25 girls) who were 10-11 years old. The measurement was conducted during physical education classes. Parents of the children provided their consent for the measurement of children. The authors have all informed consents on hand.

Procedure

The Jaroš and Lomíček test was used to diagnose poor posture. Five parameters are assessed in this test: a) posture of the head and neck, b) chest evaluation, c) abdomen and pelvic tilt evaluation, d) back curvature evaluation and e) posture in the frontal plane evaluation. Legs were evaluated separately. For each indicator tested, the students can receive a maximum of 4 points (large deviation from the standard posture) and at least one point (the posture does not show any deviation from the norm). With regard to the correct posture, it was optimal to obtain the lowest score for each indicator. The individuals were divided into four groups based on the score scale that was obtained from the results of the measurements. In group I (perfect posture), there were individuals who received a total of 5 points (the sum of all indicators). In group II (good posture), there were students who received 6-11 points. Group III (poor posture) consisted of individuals who received 11-15 points. In group IV (very bad posture), there were students who received 16-20 points. When evaluating lower extremities, the students can receive a minimum of one and a maximum of four points. A degree of flat and standing knee (varus, valgus) was observed.

The tested students stood upright in their underwear and without shoes. The arms were loosely positioned at their sides. Using a plumb line dropped from the occipital bone and a calibrated meter, the distances between the segments of the body were deducted using a vertical line that was represented by the dropped plumb line.

The individuals were divided into BMI categories by transferring the values into percentile graphs according to Vignerová and Bláha (2001), always with respect to gender and age of the monitored children.

Instruments

A calibrated goniometer (Saehan metallic goniometer, Saehan Corporation, South Korea, 180 degrees) was used to monitor the inclination of individual parts of the body. Height measurements were carried out using a calibrated measuring tool. The measurement of body weight was carried out using a calibrated digital scale with an accuracy of 0.01 kg.

All monitored students were given a standardized questionnaire (Posture comparison of preschool and schoolchildren). For this study, we only used the part that was designed for schoolchildren. The questionnaire contains 9 questions. The parents answered these questions:

- How far is your child's school from the residence?
- How is your child transported to school?
- How many hours per week does your child engage in organized physical activities (e.g., hobby groups, sports clubs)?
- How many times a week does your child attend these sports organizations?
- How does your child spend most afternoons outside the school?
- How many hours a week do you and your child perform a physical activity (prolonged)?
- How many hours a day does your child spend on a PC or watches TV?
- Does your child complain about pain (cervical spine, thoracic spine, lumbar spine)?
- Do you have a medically confirmed diagnosis of poor posture?

Data analysis

The measurements were conducted with the approval of the school director and parents who expressed agreement with the measurement via their signatures. The individuals did not suffer any pain, and parents and children were aware that the results were used for scientific purposes. The data were processed using the Microsoft Excel 2010 and Statistica 6.1 software. The results were evaluated using the Chi-square test at the level of statistical significance of $p < 0.05$.

Results

This portion of the study is divided into two parts. The first part focuses on tracking the actual state of posture in children. The second part detects relationships between the observed variables (i.e., BMI vs. posture, applied physical activity vs. posture).

First part – posture

Table 1 Results of posture evaluation for boys and girls

Gender	Posture							
	Perfect		Good		Poor		Very bad	
	n	%	n	%	n	%	n	%
Boys	1	4	12	48	11	44	1	4
Girls	2	8	7	28	11	44	5	20
N	3	6	19	38	22	44	6	12

From Table 1, it is clear that 56% of all measured students (boys and girls together) have a posture that is worse than good. Most children with bad posture belong to group III. It is very interesting that a perfect posture was identified in only 6% of 50 children.

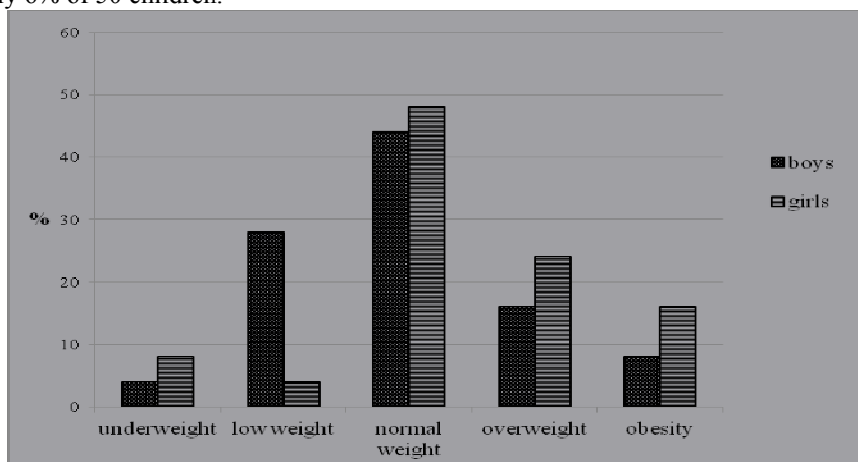


Fig. 1 Results of BMI evaluation of boys and girls

In Figure 1, it is evident that many children belong to the normal body weight group. Overweight and obesity were observed more frequently in girls than in boys. A significantly larger proportion of individuals with low weight was found in boys as compared with girls.

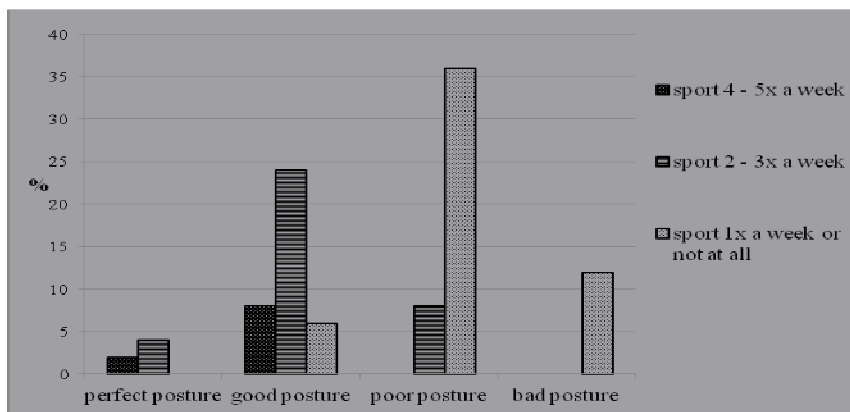


Fig. 2 Influence of physical activity on the posture category

Figure 2 shows that students who are less physically active during the week (do not do any sports even once a week) belong to the bad posture category. The relationship between these variables is significant, based on the Chi-square test ($p = 0.0001$, $\eta^2 = 0.09$).

Second part – Questionnaire

Based on the results of the survey in this study, there were only few answers that provided an overview of the application of physical activities for the examined students.

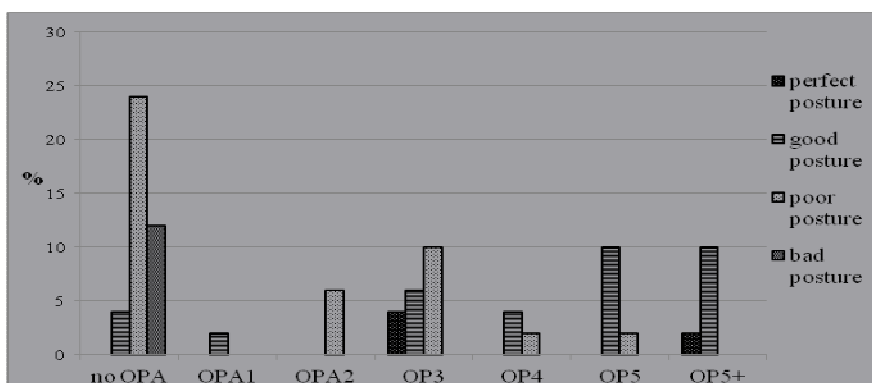


Fig. 3 Organized physical activities vs. posture

Legend: no OPA – no organized physical activity, OP1 – organized physical activity up to 1 hour a week, OP2 – organized physical activity up to 2 hours a week, OP3 – organized physical activity up to 3 hours a week, OP4 – organized physical activity up to 3 hours a week, OP5 – organized physical activity up to 5 hours a week, OP5+ - more than 5 hours of organized physical activity

From Figure 3, it is clear that 50% of children spend time doing organized physical activity less than three hours per week. On closer observation of this fact, it was found that most children (36%) with a very bad posture stated in the survey that they did not participate in organized physical activities. This clearly indicates the importance of physical activity on body posture. On the contrary, most children who spent 3 or more hours per week performing a physical activity most often had a good posture (30%). Therefore, it can be argued that the more hours children spend doing an organized physical activity, the better their posture is. The difference proved to be statistically significant ($p = 0.0001$, $\eta^2 = 0.12$).

Discussion

It is known that physical activities have a positive effect on human health. Dylevský, Korbělář, and Kučera (1996) state that movement determines normal growth and physical, mental and social development. Therefore, lack of physical activities can result in adaptation disorders and may affect the mental development of a child. Cooper (1991) mentions that a sufficiently intense physical load increases physical fitness of children, which has a positive influence on the work function of internal organs and muscular system. By intentionally influencing the functionality of the muscle apparatus, poor posture and the subsequent development of orthopedic problems can be prevented. To receive a positive effect from physical activity, it should be performed

at 60–85% of the maximum heart rate for 15 to 20 minutes at least three times a week. However, the intensity of activities during the physical education class does not meet this requirement (Mužik & Krejčí, 1997). Based on the existing research that clearly indicates that preschool and school-age children often have poor posture, we decided to investigate the relation between the physical activity and posture of 10–11-year-olds. Our results (Table 1) show that 56% of all measured students have worse than good posture (boys and girls together). Most children with poor posture belong to group III. Perfect posture was identified in only 6% of 50 children. This is consistent with the research findings of Kopecký (2014), which state that 50-60% of children have bad posture. Similarly, in their study, Zanutová, Zanut, and Bendíková (2011) found that nearly 60% of girls and 55% of boys have incorrect posture. Additionally, the authors stated the difference in posture among children who do sports and those who do not. Furthermore, using the diagnostic test and survey results, we concluded that students who are less physically active during the week (no sport even once a week) fall into the poor posture category (Figure 2). The relationship between these variables is significant, based on the Chi-square test ($p = 0.0001$, $\eta^2 = 0.09$).

In our investigation, we determined that the monitored children do not get enough organized physical activity during the week. This fact is understood in the context of recommending to perform physical activities with a necessary intensity at least 3 times a week. In this respect, an interesting finding was that 50% of children did an organized physical activity less than three hours a week. Furthermore, it was found that most children (36%), who have poor or a very bad posture, stated in a survey that they did not participate in organized physical activities. This clearly indicates the importance of physical activity on body posture. On the contrary, most children who applied 3 or more hours a week to a physical activity most often had a good posture (30%). Therefore, it can be argued that the more hours children spend doing an organized physical activity, the better their posture is. The difference proved to be statistically significant ($p = 0.0001$, $\eta^2 = 0.12$). Similar finding appeared in the study of Bogdanović and Marković (2010) who determined that poor body posture is related to the participation of children in organized sport activities. In the survey, the parents reported that 46% of children spend their free time doing passive activities (on a PC or watching TV). We showed that children, who are physically active outside of school, are more likely (42%) to have a good or a perfect posture compared with children who are physically passive. Children, who are physically passive, have a poor or a very bad posture (44%). To the question of how many hours per week the child spends on a PC or watching TV, 50% of respondents stated that it was 1–2 hours. Only 8% of parents stated less than an hour. Up to three hours is spent watching TV or on a PC (28% of children). In total, 16% of the monitored children watch television or a PC screen for more than three hours. An interesting finding was that most children with poor or very bad posture watch TV or PC screen for up to three hours a day. Most children, who were identified to have a poor posture, spent three or more hours per week watching TV or a PC screen. This clearly testifies to the fact that passive activities outside school have a negative effect on the posture. An interesting solution to this problem is mentioned in the study of Robbins, Johnson, and Cunliffe (2009) who used computers to draw attention of children to the importance of the correct body posture. Dvořáková (2012) states that the main effort of educators should be to create a positive relationship between the children and the movement. We believe that family is the most important part in this interaction. Valuable information about posture can be derived using a surface electromyography signal from measured muscles such as in the study of Nosko, Razumeyko, Iermakov, and Yermakova (2016). We can obtain an especially important information from the measurements in which the relationship of one sided loads in children (e.g., school bags) and EMG signals from the selected (overloaded) muscles is monitored.

Conclusion

From the abovementioned results, we determined that poor posture can be prevented either spontaneously or in a controlled manner using physical activities during the school day by reducing the static load in the classroom and by modifying physical schedule of children in their spare time. A larger number of physical education hours and a focus on physical education would allow this negative trend to change, assuming a close cooperation between parents, school, sports institutions, and physical training doctors. Regular and adequate pursuit of physical activities by children and the prevention of poor posture associated with the use of special compensatory exercises can be considered as a valuable investment in the future. By monitoring the current state of posture and frequency of physical activity among children in primary schools, the prognosis of the health status of the Czech Republic population can be characterized.

The study was realized with the support of SGS UJEP Ústí nad Labem.

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