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PRACA ORYGINALNA
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# A quality of body posture in early school-aged children after a pandemic and selected lifestyle components – preliminary report

## Jakość postawy ciała u dzieci w wieku wczesnoszkolnym po pandemii a wybrane elementy stylu życia – doniesienie wstępne

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## ABSTRACT

**INTRODUCTION:** There are many modifiable risk factors that disrupt proper motor development, including the development of body posture. Abnormal body positions taken repeatedly, frequent use of electronic devices, and motor passivity are all implicated in postural abnormalities. In the post-pandemic period, sedentary behavior is quite common among children and adolescents, contributing to increased overweight and obesity, as well as changes in lifestyle, which consequently lead to many health problems. The main aim of this study was to assess the quality of children's body posture and attempt to estimate the relationship between the occurrence of postural abnormalities and the level of physical activity.

**MATERIAL AND METHODS:** A pilot study was conducted on a sample of 200 children from early elementary school classes in the Silesia region, aged 6–10 years ($x = 8.25 \pm 1.06$). The respondents were classified into two subgroups of equal size of 100 girls (group I) and 100 boys (group II). The study groups did not have any differences in age ($p = 0.07$). Body posture was assessed in all three planes using a plumb line, scoliometer, and inclinometer, as well as functional status with Thomayer and Matthias tests. Body weight and height were measured using a Tanita analyzer and stadiometer with conversion to centile charts for weight, height, and body mass index (BMI).

**RESULTS:** Postural defects in the sagittal plane in both the thoracic and lumbar segments were found in approximately 20% of the subjects in both groups, regardless of the level of physical activity. In both study groups, excessive screen time and time spent in a sitting position were observed. Physical activity was largely below World Health Organization (WHO) recommendations.

**CONCLUSIONS:** Children of younger school age are noted to have numerous postural abnormalities that are unrelated to their level of physical activity. Children use screen time and spend too much time sitting and do not meet WHO recommendations for moderate to vigorous physical activity.

KEYWORDS

lifestyle, postural defects, pandemic, physical activity

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## STRESZCZENIE

**WSTĘP:** Istnieje wiele modyfikowalnych czynników ryzyka, które zakłócają prawidłowy rozwój motoryczny, w tym rozwój postawy ciała. Nieprawidłowe pozycje ciała, częste korzystanie z urządzeń elektronicznych, a także pasywność ruchowa, które nasiliły się w okresie pandemii, mają związek z występowaniem nieprawidłowości w obrębie postawy ciała. Głównym celem pracy była ocena jakości postawy ciała dzieci oraz próba oszacowania związku występowania nieprawidłowości w obrębie postawy ciała z poziomem aktywności fizycznej.

**MATERIAŁ I METODY:** Badaniom pilotażowym poddano próbę 200 dzieci z klas wczesnoszkolnych szkół na terenie Śląska w wieku 6–10 lat (x = 8,25 ± 1,06). Badanych podzielono na dwie podgrupy o równej liczebności: 100 dziewcząt (grupa I) i 100 chłopców (grupa II). Grupy nie różniły się pod względem wieku (p = 0,07). Ocenie poddano postawę ciała we wszystkich trzech płaszczyznach z użyciem pionu, skoliometru oraz inklinometru, a także stan funkcjonalny testami Thomayera i Matthiasa. Analizy składu masy ciała i pomiaru wysokości ciała dokonano z użyciem analizatora i wzrostomierza Tanita z przeliczaniem względem siatek centylowych dla masy, wysokości ciała i wskaźnika masy ciała (*body mass index* – BMI).

**WYNIKI:** Wady w płaszczyźnie strzałkowej w obu odcinkach piersiowym i lędźwiowym stwierdzono u około 20% badanych w obu grupach, bez związku z poziomem aktywności fizycznej. W obu grupach stwierdzono zbyt długi czas ekranowy oraz czas w pozycji siedzącej. Aktywność fizyczna była w zdecydowanej większości poniżej zaleceń Światowej Organizacji Zdrowia (World Health Organization – WHO).

**WNIOSKI:** U dzieci w młodszym wieku szkolnym obserwuje się liczne nieprawidłowości w obrębie postawy ciała, niezwiązane z poziomem aktywności fizycznej. Dzieci korzystają z czasu ekranowego i spędzają czas w pozycji siedzącej zbyt długo, nie spełniając rekomendacji WHO w zakresie umiarkowanej i intensywnej aktywności fizycznej.



SŁOWA KLUCZOWE

styl życia, wady postawy ciała, pandemia, aktywność fizyczna


## INTRODUCTION

Posture is variable, individual and characteristic of an individual, and has been defined for many years, by researchers in various ways, including as the way individuals hold themselves in a standing position, ensuring optimal postural stability with minimal effort on the part of the muscular system [1,2]. Definitions of correct posture do not present a pattern of correct posture – they talk about the optimal arrangement of posture.

The formation of posture at school age will be influenced by various factors, both endo and exogenous. Modifiable factors include body weight, quality of leisure activities, weight of the school bag/backpack, the way it is packed and carried, passivity of leisure time and use of electronic devices, as well as exemplifying patterns from the environment [3,4]. Sedentary lifestyles are becoming quite a popular phenomenon these days, including a group of children and adolescents. The natural reduction of physical activity, necessary for normal psychomotor development, is a consequence of it. Daily, repeated behaviors, the patterns of which (not always correct) are encoded in the central nervous system, will affect the formation of standing posture, as well as the maintenance of other postures, such as during study or play. The longer abnormal patterns are repeated as a consequence of muscle imbalance, other compensatory mechanisms within posture will develop, followed by postural abnormalities [5,6]. The earliest noticeable changes will be in the sagittal plane (round back, round-concave back), asymmetries in shoulder blade alignment, or abnormal vertical projection [7].

According to World Health Organization (WHO) recommendations, children and adolescents aged 6–17 need an appropriate dose of physical activity for proper psychomotor development. Physical exercises should be performed regularly for at least 60 minutes a day [8]. There are many modifiable factors that interfere with normal motor development including postural development [9]. As such, physical passiveness is quite common and also affects groups of children and adolescents, contributing to an increase in overweight and obesity, the Commission on Ending Childhood Obesity identified the need for guidance on physical activity, particularly for early childhood (< 5 y), a period of rapid physical and cognitive development. In 2019 with a modification in 2020 WHO developed the first global guidelines on physical activity, sedentary, and sleep behaviors, building upon high-quality systematic reviews [10,11]. Patterns and family behavior are exemplified by children and adolescents in terms of leisure activities, participation in sports or health habits. The development of new technologies and information and communication technologies (ICTs) encourages their frequent use in leisure time [12,13,14]. Also, do not forget about the restrictions associated with the COVID-19 coronavirus pandemic which can lead to a significant increase in motor passivity, thereby increasing active participation in virtual reality or changing and losing broad health behavior patterns, leading to difficulties in readaptation after a crisis [15,16,17]. There is still a limited of reports on the prevalence of postural disorders in post-pandemic

children and adolescents, so the authors decided to look into this topic. The main objective of the study was to assess the quality of children's body posture and attempt to estimate the relationship between the occurrence of postural abnormalities and the level of physical activity. Additionally, attempts were made to answer the following questions:

1. How much time do children spend in a sitting position, how much on the use of electronic devices and have there been any changes in this area after the pandemic?
2. What is the level of physical activity in children and is it consistent with WHO guidelines?

## MATERIAL AND METHODS

### Participants

The research project was planned to encompass 1000 primary school children from 10 primary schools in the Silesia region within the structures of the Regional In-Service Teacher Training Centre "Metis" in Katowice who participated in the project "Health Steps – education and learning as a determinant of a healthy and open society" co-financed by the "Social Responsibility of Science" program of the Ministry of Education and Science (2023–2024). The results of this study include a sample of 200 children, comprising 100 girls (Group I) and 100 boys (Group II) aged 6–10 ($x = 8.25 \pm 1.06$; $p = 0.07$, homogeneous group). The characteristics of the studied material are presented in Table I. Figure 1 shows the distribution of the number of children studied in terms of body mass index (BMI).

Among the exclusion criteria for the study, the following were taken into account: the presence of diseases preventing participation in the study as indicated by a pediatrician, lack of parental consent for the child's participation in the project, and failure of the parent to complete the questionnaire survey.

**Table I.** Characteristics of studied groups

| Parameter | Group I – girls (n = 100) | | Group II – boys (n = 100) | | *P* |
|---|---|---|---|---|---|
| | X ± SD | Min–Max | X ± SD | Min–Max | |
| Age (yr) | 8.13 ± 1.02 | 6.00–10.00 | 8.4 ± 1.09 | 6.00–10.00 | NS |
| Height (m) | 132.83 ± 9.61 | 101.00–161.50 | 135.06 ± 8.27 | 111.00–150.51 | NS |
| Weight (kg) | 29.84 ± 7.98 | 17.00–60.21 | 31.91 ± 7.19 | 17.00–51.81 | NS |
| BMI | 16.50 ± 2.87 | 11.00–28.61 | 17.33 ± 2.72 | 12.40–25.71 | NS |

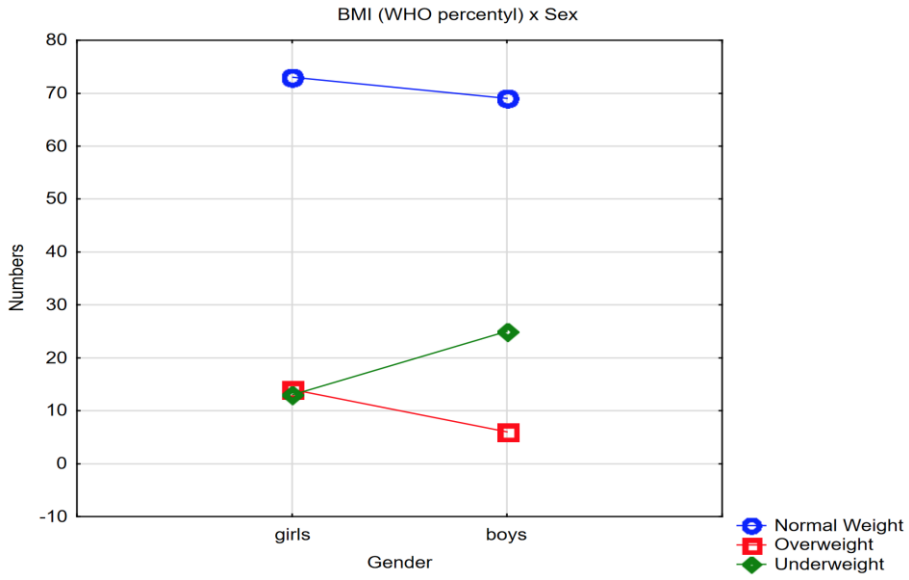


**Fig. 1.** Distribution chart of number of subjects in studied groups by BMI mass.

## Methods

The study is still being conducted as of 2020. In this study, only a sample of children in the younger grades (1st–3rd grade of elementary school) was analyzed. The methods relied on the assessment (Figure 2): 1) body posture: assessment of torso symmetry in the frontal by assessment of plumb line symmetry (taking the deviation of 0–0.5 cm as the norm), the symmetries of the blades (taking the deviation of 0–2°); transverse planes using the Bunnell scoliometer trunk rotation was assessed by the Adams test (taking 0–3° as the norm deviation); evaluation of spinal curvatures using the Saunders inclinometer (taking 24–36° as the norm deviation); in addition, the foot's arches were evaluated on a podoscope; 2) functional: Thomayer and Matthias's tests in 30 seconds; 3) body composition and height: Tanita analyzer permitted for children's examination, stadiometer – calculated relative to centile charts for weight, height, and BMI; 4) assessment of health behaviors based on a very comprehensive questionnaire, including health behaviors, during and currently after the pandemic. Questions included: level of physical activity (frequency of exercise per week in leisure time, duration of one exercise unit), screen time spent on all electronic devices available to the child per day and frequency of use of these devices per week, time spent sitting per day and frequency per week, number of hours of daily sleep. Parents were also asked whether, in their opinion, screen time and time spent sitting increased/shortened during the pandemic. These data were compared with in accordance with WHO recommendations for children aged 6–17, and Health Behaviour in School-aged Children (HBSC) guidelines, as well as the level of physical activity of parents/legal guardians and jointly spent leisure time. The questionnaire was completed by the parents of the study child [18].

**Fig. 2.** Posturometric measurements from left to right: assessment of plumb line, scapular positioning, trunk rotation, spinal curvatures in the sagittal plane, assessment of knees and feet, Matthias test, Thomayer test (all photos by Anna Brzęk).

## Statistical analysis

The results underwent professional statistical analysis with estimation of normal distributions using Shapiro--Wilk test, using t-tests for dependent and independent samples, R-Spearman tests assessing the relationship between variables. The statistically significant level was set at $p < 0.05$.

# RESULTS

The quality of body posture in children was comparable in both studied groups (Table II).

The girls exhibited both increased and decreased thoracic kyphosis, while in the boys' group, hyperkyphosis (29%) and hyperlordosis (39%) predominated. The lack of a defect in both thoracic and lumbar segments was found in about 37% of the surveyed girls and 34% of the surveyed boys (Figure 3).

Both studied groups predominantly exceeded the recommended time spent in a seated position as well as screen time. Parents rarely or never restricted electronic devices in 35% of the girls' group and 48% of the boys' group. Physical activity was fulfilled at a moderate or high intensity level in a small percentage of the participants. Children fully met WHO recommendations only in terms of sleep duration (Table III).

During the pandemic period, screen time increased (Figure 4), which currently remains at the same level ($p > 0.05$). It is also worth noting that prior to the pandemic, the use of electronic devices was similarly restricted ($p > 0.05$).

**Table II.** Posturometric measurements

| Parameter | | Group I – girls (n = 100) | Group II – boys (n = 100) | *P* |
|---|---|---|---|---|
| | | n | n | |
| Bad body posture | sagittal plane | 61 | 66 | NS |
| | SATR > 7° | 4 | 4 | NS |
| | knee deformities | 21 | 66 | NS |
| | feet deformities | 79 | 73 | NS |
| | referral to a specialist | 11 | 14 | NS |
| Postural muscles | weakness | 71 | 79 | NS |
| Hamstring muscles | weakness | 48 | 76 | 0.0002 |

SATR – Sum of Angle Trunk Rotation

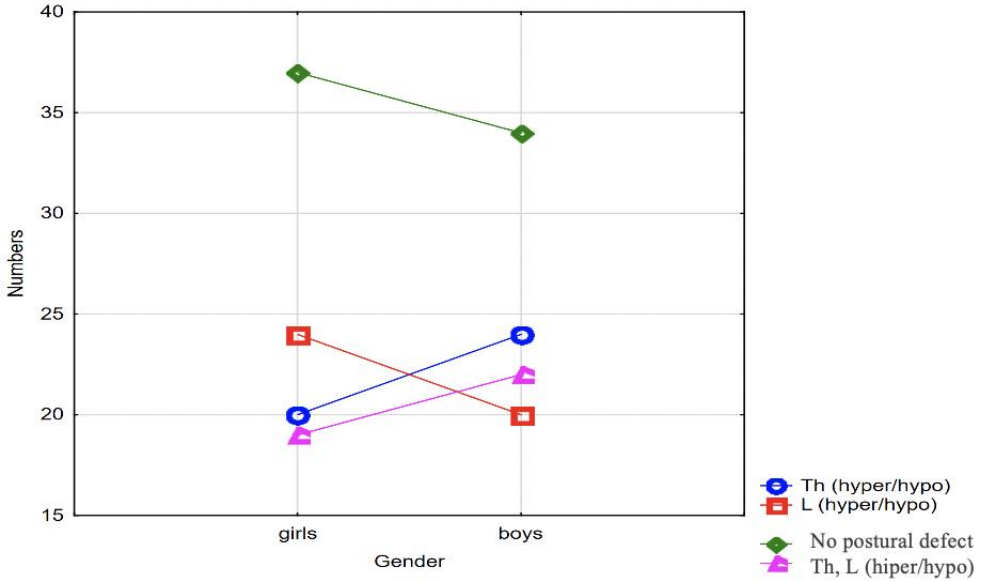


**Fig. 3.** Distribution of number of subjects in studied groups in terms of distribution of spinal deviations.

**Table III.** WHO recommendation in both groups

| Parameter | | Group I – girls (n = 100) | | Group II – boys (n = 100) | | *P* |
|---|---|---|---|---|---|---|
| | | n | % | n | % | |
| WHO recommendation (*YES*) | physical activity | 30 | 30 | 22 | 22 | NS |
| | sitting positions | 36 | 36 | 31 | 31 | NS |
| | electronic devices – *limiting* | | | | | |
| | *always* | 25 | 25 | 27 | 27 | *0.05* |
| | *often* | 28 | 28 | 15 | 15 | |
| | *sometimes* | 12 | 12 | 10 | 10 | |
| | *rarely* | 26 | 26 | 44 | 44 | |
| | *never* | 9 | 9 | 4 | 4 | |
| | sleep | 96 | 96 | 98 | 98 | NS |

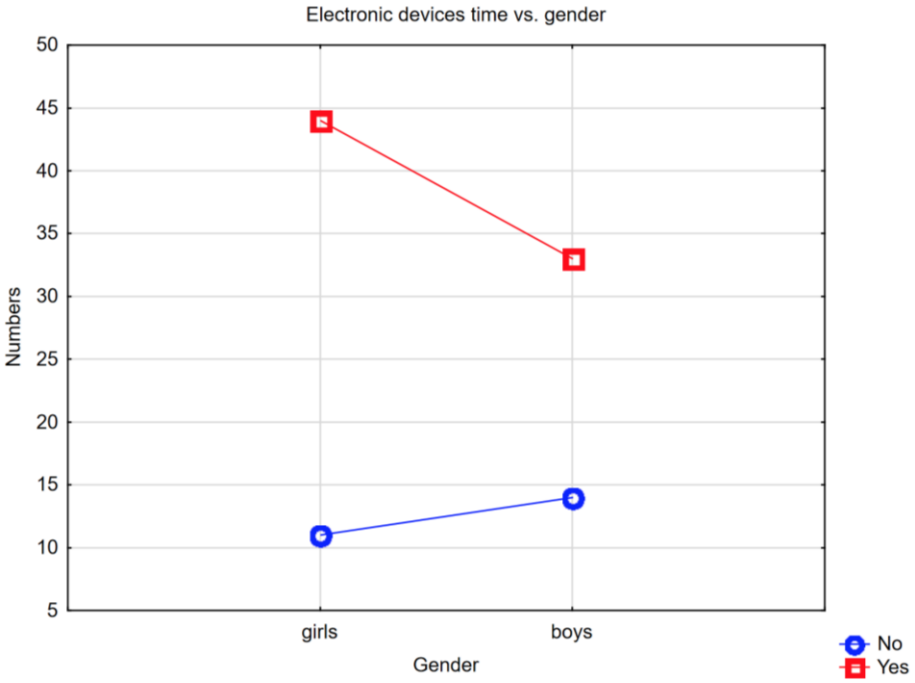


**Fig. 4.** Distribution of number of surveyed groups based on increased screen time during pandemic.

## DISCUSSION

The results of these studies are unsatisfactory, particularly regarding the occurrence of postural defects in the age group where they least frequently occur. A second important finding worth highlighting is the trend of too much screen time and sitting, beyond the standards indicated by the WHO. It also noted lower reducing its limitation by parents/legal guardians, which can lead to serious disorders not only in terms of body posture but also in the broader sense of mental and social health. Most postural abnormalities were found in the sagittal plane, which could suggest the influence of the earlier pandemic period. These considerations may be reinforced by the fact that there are so many abnormalities in this group in terms of postural muscle performance and reduced flexibility of the muscles of the ischiofemoral group. A review of the literature shows that the fastest appearing defects are precisely in the sagittal plane and are related to the sitting position. Such a study was conducted by Czaprowski et al. [7] indicating that relaxed sitting position in children is characterized by kyphotic spinal alignment caused by misalignment of the pelvis and lumbar spine. The period of pandemonium, and teaching remotely without control to maintain the sitting position, in non-ergonomic conditions may be related to this. Another study by Czaprowski et al. [19] emphasizes that sitting time increases with age. And there would be nothing surprising in this, but it should be emphasized that this is about free time. In our study, we also found that screen time increased in both girls and boys during the pandemic period. Of course, these results should be approached with caution due to the questionnaire nature of the study, which may be subject to error. Nevertheless, parents indicated exactly how many minutes, how many times a day and how many times a week their child uses the electronic devices. This time was evaluated separately for each device, i.e. tablet, mobile, computer, PC, active games. A detailed study on this topic in complete isolation was conducted by the last author of this paper, but on a group of younger children under the age of 5, which also showed that the screen time was far too long and the level of physical activity insufficient [20], as in our own study.

It should be emphasized that adequate physical activity is necessary for the proper psychomotor development of children and adolescents. Despite the high level of scientific popularization in this area, the implementation of theories into daily practice is often neglected by adults [12,21,22]. A systematic review of data and meta-analyses available in PubMed has synthesized the relationship between physical activity, sedentary lifestyle, and health-related quality of life in generally healthy populations of children and adolescents worldwide [23,24]. It should also be noted that the use of electronic devices is generally excessive among contemporary youth [20,25]. Time spent in front of screens (i.e., watching TV/DVD and using computers) has also been negatively associated with several health outcomes, and interventions aim to

reduce sedentary behavior from an early age, thereby building habits [26,27]. On the one hand, our project has cognitive value in assessing the existing situation. Moreover, based on the obtained results, it will provide a basis for finding appropriate preventive physioprophylactic solutions for a sedentary lifestyle in the youngest group as an investment in a healthy socjety, taking into account the aspect of preventing the development of postural abnormalities, following the example of other effective solutions in the field of physioprevention [3].

The work has its limitations, which are due to the lack of comparative analyses of posture from before the pandemic and currently to be able to say unequivocally whether the problem of postural dysfunction is increasing or permanent, then it would be possible to answer unequivocally whether the pandemic was related to it. Inactivity and limited mobility combined with postural abnormalities will undoubtedly have long-term consequences in the future, so it is worthwhile to include observation of the children under study in future years.

## CONCLUSIONS

A number of postural abnormalities that are unrelated to the level of physical activity are noted in children of younger school age. Children take advantage of screen time and spend too much time sitting. This time is, according to parents, similar to the period of restrictions resulting from the pandemic. Children do not meet WHO recommendations for moderate to vigorous physical activity. Parents' activity level is related to their children's physical activity.

### Practical implications

It is essential to adhere to physioprophylactic recommendations, especially during various limitations similar to pandemic times (e.g., remote learning, prolonged illness of a child), which could constitute an algorithm for minimizing the risk factors for abnormalities in body posture. Since the use of electronic devices is clearly beyond WHO recommendations, there is a need to develop systemic activation solutions in leisure time for the youngest group as an investment in a healthy society.

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**Author's contribution**

Study design – R. Wysocka, A. Brzęk
Data collection – R. Wysocka, J. Sołtys, M. Mikuś-Nowak, E. Grabska-Klein, A. Jaunich, A. Brzęk
Data interpretation – R. Wysocka, J. Sołtys, A. Brzęk
Statistical analysis – A. Brzęk
Manuscript preparation – R. Wysocka, J. Sołtys, A. Brzęk
Literature research – R. Wysocka, J. Sołtys, M. Mikuś-Nowak, E. Grabska-Klein, A. Brzęk
Final approval of the version to be published – A. Brzęk

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