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Body posture in children with obesity – the relationship to physical activity (PA)

Postawa ciała u otyłych dzieci – związek z aktywnością fizyczną

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Abstract
Introduction. The modern world of electronic devices offers children and young people various forms of leisure activities, while reducing the need for natural movement, necessary for normal psychomotor development. Sedentary life contributes to an increased body weight and, thereby, to the development of body posture abnormalities. **The aim of the study** was to evaluate body posture, leisure activities, and the number of hours spent using electronic devices among children with obesity. **Material and Methods.** The study involved 51 children with obesity (BMI above 95 percentile) – A group, and 69 children with normal body weight at the age of 9–13 years (10.98 ± 1.29) – B group (control). Body posture has been evaluated with the scoliometer, the digital inclinometer and the plumb line. The hump ratio has been calculated on the basis of SOSORT recommendations. Time spent in front of electronic devices based on a questionnaire results has also been calculated. **Results.** Children with obesity have more body posture defects in the sagittal plane than children with normal z-scores ($p<0.001$). 46.8% of children in group A have distorted depth of the two curvatures of the spine. In the control group, the majority of deviations have been observed in the evaluation of the ATR (Angle Trunk Rotation) at the lumbar spine ($p<0.05$), while in group A, at the level of the thoracic spine (40.42% vs. 23.07%). Both groups of respondents use electronic devices at least 3 days a week ($p>0.05$). Obese children often use mobile devices, while children with normal body weight often use desktop equipment. **Conclusions.** Definitely more body posture abnormalities are found in the group of obese children. Children use electronic devices regardless of weight. It is worth to expand educational activities with programs that improve the quality of body posture through a daily change of abnormal patterns.
Key words
body posture, obesity, children, physical activity, sedentary life

Streszczenie
Wstęp. Współczesny świat urządzeń elektronicznych proponuje dzieciom i młodzieży różnorodne formy spędzania wolnego czasu, ograniczając tym samym naturalną potrzebę ruchu, konieczną do prawidłowego rozwoju psychomotorycznego. Sedenteryjny tryb życia sprzyja zwiększaniu masy ciała, a tym samym rozwojowi nieprawidłowości postawy ciała. **Celem pracy** była ocena postawy ciała, form spędzania wolnego czasu, a także ilości godzin spędzanych z użyciem urządzeń elektronicznych u dzieci z otyłością. **Materiał i metody.** Badaniom poddano 51 dzieci z otyłością (BMI powyżej 95 centyla) – grupa A oraz 69 dzieci z prawidłowym ciężarem ciała w wieku 9–13 lat (10,98 ± 1,29) – grupa B. Postawę ciała oceniono skoliometrem, inklinometrem cyfrowym i pionem, obliczono współczynnik Hump, przyjmując za normy rekomendacje SOSORT. Obliczono czas spędzany przed urządzeniami elektronicznymi na podstawie kwestionariusza ankiety. **Wyniki.** Dzieci z otyłością mają więcej stwierdzanych wad postawy ciała w płaszczyźnie strzałkowej aniżeli dzieci z prawidłowym z-score ($p<0,001$). 46,8% badanych ma nieprawidłową głębokość obu krzywizn kręgosłupa. W grupie kontrolnej najwięcej odchyleń zauważono w ocenie ATR (kąt rotacji tułowia) na poziomie odcinka lędźwiowego ($p<0,05$), w grupie A natomiast na poziomie odcinka piersiowego (40,42% vs. 23,07%). Obie grupy badanych korzystały przynajmniej 3 dni w tygodniu z urządzeń elektronicznych ($p>0,05$). Dzieci otyłe częściej korzystały z urządzeń mobilnych, dzieci z prawidłowym

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ciężarem ciała z urządzeń stacjonarnych. **Wnioski.** Zdecydowanie więcej nieprawidłowości postawy ciała odnotowuje się w grupie dzieci otyłych. Dzieci bez względu na masę ciała korzystają z urządzeń elektronicznych. Warto rozszerzyć działania edukacyjne o programy poprawiające jakość postawy poprzez codzienne przebudowywanie nieprawidłowych wzorców.
Słowa kluczowe
postawa ciała, otyłość, dzieci, aktywność fizyczna, siedzący tryb życia

Introduction

Nowadays, obesity is a huge epidemiological problem worldwide [1]. According to the World Health Organization (WHO), it is estimated that global problem of overweight and obesity concerns 42 million children under 5 years of age [2]. In Europe, the problem of overweight applies to 14 million children and adolescents. According to the International Obesity Task Force (IOTF), one in five children in Europe is overweight [3]. From the 2013 UNICEF report , children in Poland put on weight the fastest among European countries. In the past 20 years, the percentage of obese children increased from 2.5% to 20%. Overweight children represent 17% of those aged 11 – 15 years. Obesity is more common in boys than in girls [4].

Postural defects are another major health problem concerning 30 – 69% of children and adolescents in Poland, which is directly related to the region of the country [5].

Children who are overweight or obese significantly more often lead sedentary lives than their peers of normal weight [6]. On the one hand, lack of physical activity influences a reduction in the oxygen capacity [7] and, on the other hand, it affects the development of wrong posture patterns during posturogenesis.

A sedentary lifestyle contributes to an increased body weight [6,8], a frequent avoidance of physical education lessons, which is again a limiting factor in the recommended physical activity, thus increasing symptoms of the disease [9]. The fear of the occurrence of early symptoms of fatigue and shortness of breath for the obese childern becomes the reason for the reduction of their participation in various forms of physical activity and sport. Hypokinesis will have a negative impact on body posture, which will gradually develop in accordance with the respective periods of posturogenesis regardless of comorbidities. In addition, various threats posed by the twenty-first century – the age of electronic devices, become a cause of decreasing physical activity [10,11] and physical capacity, which also have referencing in the formation of disturbances within the musculoskeletal system [12], creating a vicious circle.

Because obesity and postural defects are becoming increasingly serious health and social problems in Poland and worldwide, the authors decided to verify how the body posture in obese children looks like, taking into account the level of physical activity.

Following medical bases have been browsed: PubMed and NCBI Service, Medline using “body posture defects” and “obesity” and “electronic devices” or “sedentary life” and “physical activity”. We have also applied the filter for “children” and “adolescent” from January 2007 to February 2017, with no language restriction.

The aim of the study was to investigate how the body posture in children with obesity looks like and whether their body posture is associated with physical activity. Additionally, an attempt was made to check which forms of activity are preferred by this group of children and whether the choice is related to their body posture.

Material and methods

Ethical Statement

The study has been approved by the Bioethical Committee of the Medical University of Silesia under resolution No. KNW/0022/KB1/162/10 and No. KNW/0022/KB1/100/16. It is conformed to the Helsinki Declaration. All the children and their parents provided written informed consent prior to the study, including enrolment and data collection.

Participants

The study has been carried out in Katowice in the years 2011 – 2017 in the framework of two projects of the first author. The BMI index (Body Mass Index) was presented as a percentile (BMI index in kg/m^2 adjusted to age and sex and in accordance with the table on the population of children). The BMI was calculated for children; it is expressed as a percentile that can be obtained from a percentile calculator. Because weight and height change during growth and development as do their relations to body fat, a child’s BMI must be interpreted in relation to other children of the same sex and age. BMI-for-age status categories and the corresponding percentiles were based on World Health Organization growth standard reference date for 5-19 years. The cut-offs interpretation were defined: obesity with values >2 SDs; overweight >1 SDs; normal with values 1≥ z score BMI≥-2; thinness $<$-2SDs; severe thinness $<$-3SDs [13,14].

The study included a group of 120 school choldren. The group of obese children (group A) aged 9–13 years of age (10.78±1.31) included 51 participants for whom BMI was classified above the 95th percentile and z score BMI$> +$ 2SD. The control group (group B) included 69 children with normal BMI for age with the same age ($p>0.14$). Children in the control group were randomly selected from the examined group within the project. The cut –offs interpretation was used (1≥ z score BMI≥-2) [15].

Following exclusion criteria have been applied: age below 10 years of age and above 13 years, an indication of body posture defects and severe spinal deformities (scoliosis, Scheuermann disease) indicated by parents in the survey filled in before examination, participation in corrective gymnastics, wearing a corset, heart defects, scars on the chest and abdomen. The above-mentioned exclusion criteria have an impact on the level of physical activity and its choice due to the conduct of physiotherapy, which has a direct relationship with the PA. Girls who started menstruation a year before the survey have been excluded from the group, due to the possible occurrence of defects and its rapid progression. A specific diet and a special way of eating were the criterion of exclusion. Characteristics of the study group are presented in Table I.

In both groups of children, the body posture assessment with classical certified tools (scoliometer, inclinometer, plumb line) based on recommendations of SOSORT (Society of Scoliosis Orthopaedic and Rehabilitation Treatment) has been carried out [16]. Measurements have been performed in the order described below and presented in Figure 1.

In addition, each group answered the questions included in the survey, concerning physical activity, its forms, its frequency, unit duration time, forms of organization (school activities, extracurricular). Questions also related to the time spent in front of a variety of electronic devices during the learning week and during weekends.

Statistical analysis

The relationships between particular results have been searched sequentially. The results are shown as a number (%), mean (x) and standard deviation (SD). For data analysis, the following statistical methods have been used: U Mann--Whitney test for continuous variables with non-normal distribution, T Student's t test for continuous variables with normal distribution

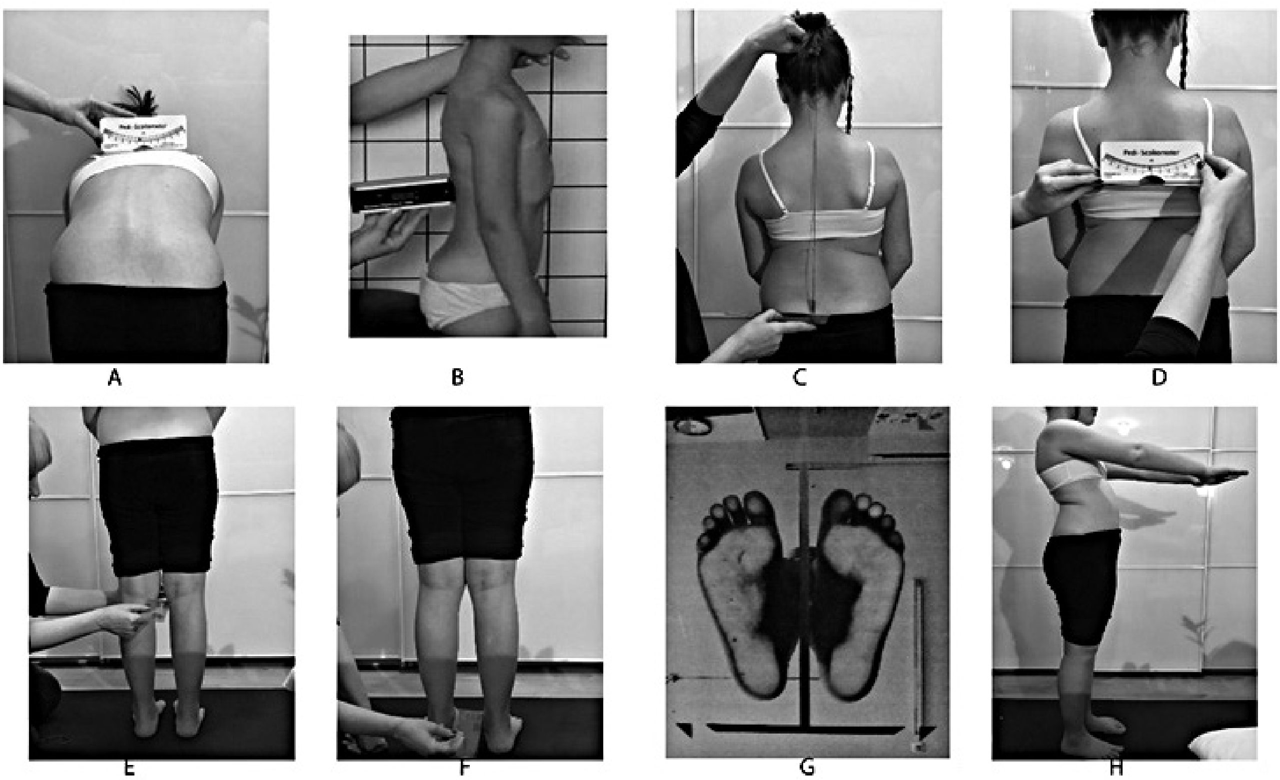

Fig. 1. The body posture assessment with classical certified tools in both groups: A) Torso Rotation Angle (ATR) by pediscoliometer; B) The depth of thoracic kyphosis and lumbar lordosis angles by a digital Sunders inclinometer TMX – 127; C) The plumb line; D) Position of the scapulas; E) The distance between medial femoral condyles F) The distance between medial tibia ankles; G) The foot archesby OPIW set podoscope; H) Mathiass test.

Ryc. 1. *Badanie postawy ciała z użyciem klasycznych narzędzi w obu grupach badanych: A) Kąt rotacji tułowia (ATR) mierzony pediscoliometrem; B) Głębokość kąta kifozy piersiowej i lordozy lędźwiowej mierzony inklinometrem cyfrowym Sundersa TMX-127; C) Ocena odchylenia od pionu; D) Ocena ułożenia łopatek; E) Odległość pomiędzy kłykciami przyśrodkowymi kości udowych; F) Odległość pomiędzy kostkami przyśrodkowymi kości piszczelowych; G) Odbicie stóp przy pomocy podoskopu systemu OPIW; H) Test Mathiasa*

Table I. Mean (X)and standard deviation (SD), median (Me) and 95% confidence intervals (CIs) ofvalues of anthropometric parameters in both groups
Tabela I. *Średnia (X)i odchylenia standardowe (SD), mediana (Me) i 95 CI wartości parametrów antropometrycznych w obu grupach*

PARAMETERS	GROUPS					
	A (n=51)			B (n=69)		
	X (SD)	95 CI	Me	X (SD)	95 CI	Me
Age (Year)	10.78 (1.31)	10.4–11.15	10.5	11.13 (1.27)	10.82–11.43	11
Weight (kg)	47.9 (4.66)	46.6–49.23	47.9	36.08 (7.16)	34.36–37.8	35
Height (cm)	141.63 (7.06)	139.62–143.64	41.5	147.84 (10.6)	145.29–150.38	149
Z score (BMI-for-age)	2.37 (0.71)	2.17–2.57	2.4	-0.74 (0.88)	-0.95–-0.53	-0.56
BMI (Percentile)	95.72 (0.96)	95.44–95.99	95	26.14 (18.91)	21.6–30.68	25

Table II. Mean (X) and standard deviation (SD), median (Me) and 95% confidence intervals (CIs)of values of posturometric parameters results, Mathiass test, Clarke's Angle in both groups
Tabela II. *Średnia (X) i odchylenia standardowe (SD), mediana (Me), 95 CI wartości parametrów posturometrycznych, testu Mathiassa, kąta Clarke'a w obu grupach*

PARAMETERS	GROUPS						P - Values
	A (n=51)			B (n=69)			
	X (SD)	95 CI	Me	X (SD)	95 CI	Me	
Frontal plane							
Plumb – line gluteal cleft (cm)	0.66 (0.53)	0.51–0.81	0.5	0.34(0.29)	0.25–0.39	1	0.0007[1]
Scapulae level (º)	0.98 (0.97)	0.7–1.26	1	0.33 (0.67)	0.17–0.49	0	0.0003[1]
Sagittal plane							
Kyphosis Angle (º)	37.24 (5.44)	35.61–38.88	39	31.55 (3.33)	30.75–32.35	31	0.00001[2]
Lordosis Angle (º)	27.86 (4.83)	26.34–29.37	27	27.55 (3.82)	26.63–28.47	27	0.68[1]
Transverse plane							
ATR C_7 – Th_1 (º)	1.13 (1.02)	0.84–1.44	1	1.01 (0.8)	0.81–1.2	1	0.63[1]
ATR Th (º)	3.25 (1.64)	2.77–3.74	4	2.13 (1.01)	1.89–2.38	2	0.00001[2]
ATR Th-L/L(º)	1.67 (0.96)	1.38–1.97	2	2.15 (1.09)	1.89–2.42	2	0.03[1]
HUMP SUM (º)	4.08 (1.47)	3.65–4.52	4	2.79 (1.08)	2.54–3.06	3	0.00001[1]
Postural muscle endurance							
Mathiass Test	21.51 (7.68)	19.14–23.87	22	24.58 (6.68)	22.95–26.21	28	0.02[1]

Data are presented as mean ± SD: Standard Deviation and Range; *P-value according to [1]Manna Whitney U test for continuous variables with non-normal distribution, [2]T Student's t test for continuous variables with normal distribution;
Abbreviations: ATR = Angle of Trunk Rotation;C = cervical spine; Th = thoracic spine; L = lumbar spine, Th – L = thoraco – lumbar spine

– to assess relationships between examinations and a non – parametric characteristics Chi Square and Spearman Rang test. Homogeneity between samples has been examined using the Kolmogorov – Smirnov two-sample test. Baseline characteristics of the two groups were compared using two-samples t – tests for continuous variables and Chi Square tests for categorical variables. 95% confidence intervals (CIs) have been calculated. All statistical tests have been performed at the two-tailed 5% level of significance.

Results

Compared groups were homogeneous in terms of age and gender. BMI differentiated the entire group to group A (above 95 percentile) and a control group of normal weight (group B). The values of measured body posture parameters in different planes, the results of Mathiass test and the results of the evaluation of proper feet arches and their valgity are presented in Table II.

Comparison of percentages of respondents who fit into norms clearly indicates the higher values in the group of children with normal weight and the differences were statistically significant. The exception is the ATR value in thoracolumbar spine and the occurrence of knee defects, which were comparable in both groups (p> 0.05), as shown by test between the two components of the structure.

Most of deviations from proper normative values were observed in the transverse and sagittal planes. In the assessment of thoracic kyphosis depth, its deepening of 50.98% in the group of obese children has been found. In the group of obese children, the sum of trunk rotation assessed with scoliometer (Hump Sum) was within normal limits in only 12 cases. The value above 7˚ and prescribed urgent consultation with specialist have been recommended in 7 cases in this group, while in the control group only in one case.

28% of the children in group A declared active leisure time activities (after school), while in the group of children with normal body weight, slightly above 84% (p <0.00001). In the vast majority in both groups, the children practice under the supervision of a trainer (p> 0.059). Training sessions of obese children are shorter in relation to children in group B (p <0.0008). The frequency of trainings does not depend on gender in group A (p> 0.62) and in group B (P> 0.24). Obese children choose forms of activities organized outside of the school more frequently in comparison with children with normal weight, who prefer activities organized in the school (school sport club, swimming). As many as 56% of obese children do not like physical education, and 16% admit it in half. In the control group, these values were respectively 13.04% and 4.35%. Children in both groups started to use electronic devices at the age of 5 – in group A: 5.2(1.37) and in group B 5.16 (1.46) (p> 0.93). Time spent with various electronic devices per week is presented in Table IV.

Table III. Differences in evaluated body posture parameters between the examined groups
Tabela III. *Różnice w badanych parametrach pomiędzy badanymi grupami*

PARAMETERS	GROUPS				P – Values
	A		B		
	n	n (%) of Normative results	n	n (%) of Normative results	
Frontal plane					
Plumb – line gluteal cleft (cm)	50	30 (60)	69	66 (95.65)	0.00001
Scapulae level (º)	50	42 (84)	69	67 (97.1)	0.01
Sagittal plane					
Kyphosis Angle (º)	50	24 (48)	69	69 (100)	0.00001
Lordosis Angle (º)	42	32 (76.19)	69	67 (97.1)	0.0005
Transverse plane					
ATR C_7 – Th_1 (º)	47	44 (93.62)	69	69 (100)	0.03
ATR Th (º)	47	17 (36.17)	69	66 (95.65)	0.00001
ATR Th-L/L(º)	50	45 (90)	69	64 (92.75)	0.59
HUMP SUM (º)	49	12 (24.49)	69	58 (84.06)	0.00001
Assessment of the knees and feet					
Knees	50	28 (56)	69	35 (50.72)	0.56
Clarke's Angle	51	21 (41.18)	67	36 (53.73)	0.0004
Valgus heels	50	30 (60)	68	44 (64.71)	0.01
Postural muscle endurance					
Mathiass Test	43	30 (69.77)	67	32 (47.76)	0.02

P – value according to *the test between two components of the structure;
Abbreviations: ATR = Angle of Trunk Rotation; C = cervical spine; Th = thoracicspine; L = lumbar spine, Th–L = thoraco – lumbar spine

Table IV. Mean (X) and standard deviation (SD), median (Me) and 95% confidence intervals (CIs) oftime using electronic devices **in both groups**
Tabela IV. *Średnia (X) i odchylenia standardowe (SD), mediana (Me), 95 CI wartości czasu spędzanego przed urządzeniami elektronicznymi w obu grupach*

TIME (minutes per week)	GROUPS						P – Values
	A (n=51)			B (n=69)			
	X (SD)	95 CI	Me	X (SD)	95 CI	Me	
Tablet	86.25 (46.57)	47.3–125.19	75	93.47(61.44)	72.68–114.26	60	0.5[1]
PC	187.14 (80.8)	140.49–233.79	187.5	200.49 (101.66)	174.45–226.52	180	0.36[2]
TV	80.33 (68.49)	42.4–118.26	60	114.92 (92.49)	91.62–138.21	90	0.19[1]
Mobile	274.09 (184.83)	149.92–398.26	250	237.84 (127.53)	201.97–273.71	225	0.08[1]
Fb	65 (34.64)	41.72–88.27	60	53.72 (26.43)	46.29–61.16	60	0.62[1]
Sum of electronic devices time	353.0 (172.1)	257.69–448.31	360	381.23 (171.93)	338.63–423.83	390	0.92[2]

Data are mean ± SD: Standard Deviation and Range; *P-value according to [1]Manna Whitney U test for continuous variables with non-normal distribution, [2]T Student's t test for continuous variables with normal distribution

Discussion

We searched PubMed, using "body posture" and "obesity" or "postural defects" We applied the filter for "children" and "adoloscent" of the last 10 years, with no language restriction and visiting key libraries in region. The findings were related to physical activity, obesity and its consequences, sedentary leisure time. No work based on the same research methodology as the own research was found. Obesity affects body posture, which is also confirmed by studies of Macialczyk-Paprocka et al. [17]. The authors emphasize that girls in the 10-11 age group were more likely to experience body posture examination errors than girls with normal body weight. In our study, significantly more normative values were noted in the postural examination of the body in the control group. However, some postural impairments were noted, especially in the rotational component of the Adams test, which may result from preferential leisure activities in sitting positions. In the study of Jodkowska et al. – as in our study – there were no relationships between sitting and body weight in the group of thirteen years old children [18]. Studies by Czaprowski et al. show significantly longer time spent on watching television and using computers than in own research. The authors point out that children aged 7-15 spend more than 80 hours per week on sedentary behaviors, including meals and school activities [19].

Physical activity is essential for normal psychomotor development of children and young people [9]. Forms of spending free time often depend on predisposition skills preferences, but also on financial possibilities of the parents of the children. In the younger age, the choice of forms of physical activity depends heavily on the decision of parents and often on their level of physical activity [20]. Older children independently choose PA forms. Overweight and obesity are limiting factors in the natural need for movement [21]. The lack of full fitness, limitations resulting from obesity [22] as well as a desire to hide their body are the predictors of limited participation in physical education classes [9]. The lack of physical activity in a sufficient dose will affect the psychological state of children and young people. All these factors are not without significance for the development of body posture. It is natural that during adolescence the willingness to participate in physical activities is reduced – it is the so-called „motion laziness" [9], which especially affects girls [23] – it has been confirmed in our study. The activity is important in the formation of the correct movement and postural patterns. The recommendations of CDC / ACSM (Centers for Disease Control and Prevention American College of Sports Medicine) clearly indicate for at least 30 minutes of moderate-intensity physical activity five days a week or alternatively vigorously increased activity for at least 20 minutes three days a week [24]. Among the examined groups only 18% of children meet the above mentioned criteria in group A with no contraindications to PA in the group of obese children and up to 59.42% children in group B. Children in both groups spent their leisure time in a similar amount of time in front of the computer, tablet or cellphone (above 350 minutes per week in both groups). Thus, movement habits encoded in the early stages of the development will have their representation in the habitual posture of an adult [25]. Physical activity or the lack of it will be an important modifiable factor influencing the wider definition of health and quality of life. Developing disease is often a factor which modifies a functional and structural body condition usually by limiting physical activity level [10,11]. Intensive physical exercise can cause health deterioration but its absence can have far more serious consequences. Discussions about physical activity are very broad and include basically every age group and disease entity. Exercise has been introduced as the basis for a new nutrition and physical activity pyramid in 2016. However, there is no mention about the negative effects of distant posture defects in children with obesity. By searching the database, numerous medical papers on the occurrence of pain, including obese people can be found [26]. The subject of consequences of body posture defects and their distant effects is still treated very sketchily.

This problem is worth talking about with particular care. Preventive programs should be based not only on the reduction of body weight but also on the rules of ergonomics and shaping correct postural habits from an early age. Severe spinal deformities like scoliosis [27] or Scheuermann disease [28] are always a serious problem of physical therapy connected with corset treatment. Chenau corset treatment for scoliosis with a large angle of curvature between 25˚- 40˚ [29] is quite difficult in the initial period of the therapy due to the number of hours [30], abrasions [31] chafes, discomfort during the summer or lack of acceptance by peers [32]. These problems and feelings will be definitely felt more strongly in obese children [33]. What can come down to the fact that the corset will not be worn in such amount in which it is advisable. Limitation of physical activity in children leads to sedentary lifestyle and it has its impact on body posture according to the scientific research [34].

When making a comparative analysis according to the UNICEF Innocenti Research Centre report [35] in terms of the percentage of children aged 11–13 who declare daily intense exercise lasting at least one hour – Poland ranks at 11th place directly behind Luxembourg and the United Kingdom. In the first place are Ireland, USA, Austria and Spain. The lowest in the table are Italy, France, Denmark – where the percentage of active children is within the range of 8–12%.

The medical team taking care of a child with obesity (doctor, physiotherapist, nurse, dietitian, and psychologist) should remember that besides medical treatment, education related to the promotion of healthy behaviors, including physical activity of the child and his family, stages of motor development and consequences of obesity in body posture are also important.

Conclusions

Body posture defects represent a serious and undervalued problem among children with obesity. Among the most dynamically changing parameters in the screening tests, special attention should be paid to rotational and sagittal components. Due to the difficulty of assessing body posture in this group of children and young people, tools which allow the reliability and repeatability of measurements should always be used. Limitations of physical activity are noticeable in obese children, and their worse tolerance of physical education reduces their frequently only chance for practicing movement. Children and young people use electronic devices in a similar manner (time) regardless of body weight.

The differentiating factor in these two groups is the fact that there are extremely different levels of physical activity, as well as the attitude to regular physical exercise.

There is a need of ongoing education of parents, families of obese children but also of teachers about the risks resulting from obesity, but not only for the promotion of healthy, proper nutrition, but also for the reduction of time spent in front of computer or TV, and also in terms of body posture defects and severe spinal deformities.

References

1. WHO.int [Internet]. *WHO Factsheet: Obesity and overweight*. [updated 2015 January; cited 2016 Feb 25]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/.
2. WHO.org.pl [Internet]. *WHO - Biuro Światowej Organizacji Zdrowia w Polsce*. [updated 2016 May 29; cited 2012 April 04]. Available from: http://www.who.un.org.pl/.
3. *International Obesity Task Force and the European Association for the study of obesity*. EU Platform on Diet Physical Activity and Health. Obesity in Europe, Brussels 2005.
4. docplayer.pl [Internet]. *Warunki i jakość życia dzieci w krajach rozwiniętych*. [updated 2014 April; cited 2014 April 29]. Available from:http://docplayer.pl/214684-Warunki-i-jakosc-zycia-dzieci-w-krajach-rozwinietych.html.
5. Maciałczyk – Paprocka K, *Epidemiologia wad postawy u dzieci i młodzieży.* UM w Poznaniu, praca doktorska, 2013.
6. Dumuid D, Olds T, Lewis LK, et al. *International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) research group. The adiposity of children is associated with their lifestyle behaviours: a cluster analysis of school-aged children from 12 nations*. Pediatr Obes. 2016 Dec 27.
7. Jeans KA, Johnston CE, Stevens WR Jr et al. *Exercise Tolerance in Children With Early Onset Scoliosis Spine Deform.* 2016; 4(6):413-419.
8. Katzmarzyk PT, Barreira TV, Broyles ST et al. *Relationship between lifestyle behaviors and obesity in children ages 9-11: Results from a 12-country study*. Obesity (Silver Spring). 2015;23(8):1696-702.
9. Styne DM, *Obesity in childhood: what's activity got to do with it*? AM J CLIN NUTR. 2005; 81: 337-338.
10. Froberg K, Andersen LB, Mini Review: *Physical activity and fitness and its relations to cardiovascular disease risk factors in children*. Int J Obes (Lond). 2005; Suppl 2:S34-9.
11. Blair SN, *Physical inactivity: the biggest public health problem of the 21st century*. Br J Sports Med 2009;43:1–2.
12. Sedrez JA, da Rosa MI, Noll M et al. *Risk factors associated with structural postural changes in the spinal column of children and adolescents*. Rev Paul Pediatr. 2015; 33(1):72-81.
13. http://www.who.int/growthref/who2007_bmi_for_age/en/
14. de Onis M, Onyango AW, Borghi E et. al. *Development of a WHO growth reference for school-aged children and adolescents.* Bulletin of the World Health Organization. 2007; 85:660-7

15. de Onis M, Lobstein T, *Defining obesity risk status in the general childhood population: Which cut-offs should we use?* Int J Pediatr Obes. 2010; 5(6):458-60.
16. Negrini S, Hresko TM, O'Brien JP et al. *SOSORT Boards; SRS Non--Operative Committee Recommendations for research studies on treatment of idiopathic scoliosis. Consensus 2014 between SOSORT and SRS non-operative management committee.* Scoliosis. 2015;10:8.
17. Paprocka-Maciańczyk K, Krzyżaniak A, Kotwocki T et al. *Postural defects in primary school students in Poznan.* Prob Hig Epidemiol. 2012; 93(2): 309-314
18. Jodkowska M, Tabak J, Oblacińska A et al. *Sedentary behavior 13 year-olds and its association with selected health behaviors parenting practices and body mass*. Developmental Period Medicine; 2013,17(2): 165-173
19. Czaprowski D, Stoliński Ł, Szczygieł A i wsp. *Sedentary behaviours of girls and boys aged 7-15.* Zdr Publ; 2011, 121(3): 248-252.
20. Ross SE, Francis LA, *Physical activity perceptions, context, barriers, and facilitators from a Hispanic child's perspective*. Int J Qual Stud Health Well-being. 2016; (1):31949.
21. Stodden DF, Goodway JD, Langendorfer SJ, et al. *A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity:* An Emergent Relationship Quest, 2008; 60, 290-306.
22. Cairney J, Hay JA, Faught, BE et al. *Developmental coordination disorder and overweight and obesity in children aged 9–14 years*. Int J Obesity. 2005; 29, 369–372.
23. Dumith SC, Gigante DP, Domingues MR et al*. 3rd. Physical activity change during adolescence: a systematic review and a pooled analysis.* Int J Epidemiol. 2011; 40(3):685-98.
24. Garber CE, Blissmer B, Deschenes MR et al. *American College of Sports Medicine. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise.* Med Sci Sports Exerc. 2011; 43(7):1334-59.
25. Benden M et al. „*Evaluating a school based childhood obesity intervention for posture and comfort.*" Health 2013.
26. Smuck M, Kao MC, Brar N et al. *Does physical activity influence the relationship between low back pain and obesity?* Spine J. 2014; 14(2):209-16.
27. Berdishevsky H, Lebel VA, Bettany-Saltikov J et al. *Physiotherapy scoliosis-specific exercises - a comprehensive review of seven major schools*. Scoliosis Spinal Disord. 2016; 4;11:20.
28. Tsirikos AI, Jain AK, *Scheuermann's kyphosis; current controversies*. J Bone Joint Surg Br. 2011; 93(7):857-64.
29. Chêneau J, *Scoliosis treating brace evaluation of our brace since 1970: an evaluation of the normalization of rotation, of rib static and of the wedge shaped vertebrae*. Locomot Syst. 2003;1:29–38.
30. Kotwicki T,,Durmała J, Czaprowski D, *Zasady leczenia nieoperacyjnego skolioz idiopatycznych-wskazówki oparte o zalecenia SOSORT 2006*. Ortopedia, Taumatologia Rehab, 2009; 11(5): P:379-95.
31. Aulisa A G, Mastantuoni G, Laineri M et al. *Brace technology thematic series: the progressive action short brace (PASB)* Scoliosis. 2012; 7: 6.
32. Rivett L, Rothberg A, Stewart A et al. *The relationship between quality of life and compliance to a brace protocol in adolescents with idiopathic scoliosis: a comparative study* BMC Musculoskelet Disord. 2009; 14;10:5.
33. Wearing SC, Hennig EM, Byrne NM et al. *Musculoskeletal disorders associated with obesity: a biomechanical perspective.* Obes Rev. 2006; 7(3):239-50.
34. Brzęk A, Plinta R, *Exemplification of Movement Patterns and Their Influence on Body Posture in Younger School-Age Children on the Basis of an Authorial Program „I Take Care of My Spine"*. Medicine (Baltimore). 2016; 95(12):e2855.
35. UNICEF Office of Research Innocenti Report Card 11.[https://www.unicef-irc.org/publications/pdf/rc11_eng.pdf]