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BODY SOMATIC TYPE INFLUENCE ON THE SPINAL CURVATURES IN EARLY AGE SCHOOL CHILDREN: PRELIMINARY REPORT

TYP BUDOWY SOMATYCZNEJ CIAŁA A UKSZTAŁTOWANIE KRĘGOSŁUPA DZIECI W WIEKU WCZESNOSZKOLNYM: DONIESIENIE WSTĘPNE

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Abstract

Introduction: *Sedentary lifestyle and its consequences are becoming a serious problem not only among the elderly but also relate to children. Reduced muscle mass, disorder of normal spinal curves or problems related to the percentage of body fat are part of physical activity limitation. The aim of this study was to assess the relationship between somatic type of the body and spinal curvatures in school children.*

Material and methods: *This study included 94 randomly selected children from 1-3 elementary schools grades, 49 girls and 45 boys. The subjects were divided into 3 groups: a group of children with a BMI indicating underweight (BMI <14.5, n=25), a group of children with normal BMI (BMI=14.5-17.5, n=33) and children BMI indicating overweight (BMI> 17.5, n=36). The Posturometr-S was a device used for measurement and evaluation of the formation of the spine in the sagittal plane. There were three angles of inclination of anterior-posterior curvature of the spine identified: the α angle- upper thoracic spine, the β angle- thoraco-lumbar spine and the γ angle- lumbosacral spine.*

Results: *Analysing the results of the different angles of curvature of the spine in the sagittal plane we can notice a statistically significant difference between the groups only in the α angle.*

Conclusion: *The own investigations have showed that the somatic type of the body does not affect the shape of the spine in school children assessed using Posturometr-S. Ther investigations are needed.*

Key words: BMI, children, somatic body type, spine curvatures, body posture

Streszczenie

Wprowadzenie: *Siedzący tryb życia oraz konsekwencje z tym związane stają się poważnym problemem nie tylko osób starszych, ale także wśród dzieci. Zmniejszona ilość masy mięśniowej, zaburzenie prawidłowych krzywizn kręgosłupa, czy problemy związane z ilością tkanki tłuszczowej w organizmie to tylko niektóre ze skutków ograniczenia aktywności fizycznej. Celem pracy była ocena związku typu budowy somatycznej ciała z ukształtowaniem kręgosłupa dzieci w wieku wczesnoszkolnym.*

Materiał i metody: *Badaniami objęto 94 losowo wybranych dzieci z klas 1-3 szkół podstawowych, 49 dziewcząt oraz 45 chłopców. Badani zostali podzieleni na 3 grupy: grupę dzieci z BMI wskazującym na niedowagę (BMI<14,5, n=25), grupę dzieci ze wskaźnikiem BMI w normie (BMI=14,5-17,5, n=33) oraz dzieci z BMI wskazującym na nadwagę (BMI>17,5, n=36). Do pomiaru i oceny ukształtowania kręgosłupa w płaszczyźnie strzałkowej wykorzystano Posturometr-S. Określono 3 wartości nachylenia kątów krzywizn przednio-tylnych kręgosłupa: kąt α–nachylenie odcinka piersiowego górnego kręgosłupa, kąt β – nachylenie kąta piersiowo-lędźwiowego, kąt γ–nachylenie kąta lędźwiowo-krzyżowego.*

Wyniki: *Analizując wartości poszczególnych kątów krzywizn kręgosłupa w płaszczyźnie strzałkowej, istotną statystycznie różnica pomiędzy grupami zauważono jedynie w kącie α.*

Wnioski: *Badania własne wykazały, że typ budowy somatycznej ciała nie ma wpływu na ukształtowanie kręgosłupa dzieci w wieku wczesnoszkolnym ocenianych Posturometrem-S. Konieczne są dalsze badania w tym kierunku.*

Słowa kluczowe: BMI, dzieci, typ somatyczny, krzywizny kręgosłupa, postawa ciała

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INTRODUCTION

Serious problems that affect society in developed countries are diseases of affluence, called otherwise Western diseases. They are followed by some serious economic and social consequences, thus constitute one of the greatest challenges of modern civilization. Although most of these conditions apply to adults, some of them – i.e. overweight and obesity – occur at an early age [1].

Excessive accumulation of body fat results in complex and multi-factorial disorders, which, in many cases, can be prevented. It is estimated that by 2030 overweight will cover 38% of the adult population, while obesity will concern approximately 20% of it. Fortunately, these projections appear to be less severe for primary school children [2]. However, overweight and obesity are significant problems. Low level of motivation to prevent children with increased BMI from overweight and obesity is a quite pessimistic predictor. It turns out that these children are characterized by as much as 20% less physical activity than children of normal weight [3]. This may result in a further increase of body fat, which significantly increases the probability of higher systolic and diastolic blood pressure [4].

On the other hand, equally significant, although much less learnt than the obesity problem seems to be low body mass of young school children. The prevalence of underweight in researches varies greatly among themselves because of the definition or even the year of publication of the data, reaching in some publications as much as 49% [5]. At this point we need to take into our consideration the fact that recent studies show the relationship between parents and their children that are all underweight and may be a predictor of future disease-related nutrient deficiency [6].

In recent years there has been a significant diversification of physical activity among children. Active children have become even more active. On the other hand, number of children who lack sufficient physical activity is increasing constantly [7]. It turns out that Lower Silesia is characterized by increased incidence of obesity and lack of physical activity among children than in other parts of the country [8]. It is worthy to notice a fact that urban areas are characterized by higher percentage of children with excess body weight [9]. On the other side, it is proven that spending time in sitting position depends on socio-economic status of the family. Children growing up in families with lower economic level, spend more time watching television than people from more prosperous families [10]. This results in a weakening of the paraspinal muscles, glutes and abdominal muscles. Silva et al. demonstrated that primary school children have weakened muscle strength at the lumbar spine and that this weakness can affect the pain in this spinal part [11]. In addition, it appears that BMI negatively correlates with the motor skills tests results of school age children. In other words, the higher children's BMI was, the lower score they got in physical activity tests [12].

Along with abnormal children's body composition, an important issue is the sedentary life style and the consequences of this habit. Watching TV or spending time playing video games causes significant asymmetries in the spine [13]. This results in an increased incidence of lateral curvatures of the spine and, in particular, disorders of the spine in the sagittal plane [14]. Additionally, Ortega et al. have shown that BMI can be a variable, which could be used to predict the occurrence of lateral curvature of the spine of children with obesity [15].

The aim of this study was to assess the relationship between somatic type of the body and spinal curvatures of school children.

MATERIALS AND METHODS

The study involved 94 randomly selected children, 49 girls and 45 boys. They attended to 1-3 classes of primary school in Oleśnica. The average age was 8.3±0.9 years, average body weight was 34.5±12.6 kg, and the average body height was 136.9±0.09 cm. In order to avoid differences in the measurements methodology, tests were performed by a single researcher. Table I reflects the somatic characteristics of involved children.

After children's BMI determination, they were divided into 3 groups (according to BMI tables for a specific age group, included on the WHO website): a group with BMI indicating underweight (BMI<14.5, n=25), a group with normal BMI (BMI=14.5-17.5, n = 33) and group with BMI indicating overweight (BMI>17.5, n=36). The spinal shape was evaluated via Posturometr-S [16]. It is a set of two coupled together systems: mechanical – track stick measurement used to select each point and electronic recorder to record these points in a computer program. This device allows automatic saving posture parameters in space. With it, we can determine the parameters of linear and angular in the planes. Body weight was determined using medical weight, and body height using the mechanical Stadiometer.

Table I. Mean values (±SD) of anthropometric parameters in examined underweight, overweight and normal children.

Tabela I. Wartości średnie (±SD) parametrów antropometrycznych badanych dzieci z niedowagą, nadwagą i w normie.

Feature *Cecha*	**Underweight (n=25)** *Niedowaga (n=25)*	**Overweight (n=36)** *Nadwaga (n=36)*	**Normal (n=33)** *Norma (n=33)*
Age/*Wiek*	7.9±0.7	8.8±0.9	8.0±0.9
Body height [cm]/*Wysokość*	131.9±0.1	144.2±0.1	132.6±0.1
Body weight [kg]/*Masa ciała*	24.2±3.0	47.7±10.3	27.9±4.1
BMI [kg/m^2]/*BMI*	13.8±0.7	22.6±2.9	15.7±0.9
μ ratio/*Wskaźnik μ*	-1.4±7.0	-1.8±5.6	0.5±6.0

Table II. Characteristics of spine curvatur in sagittal plane of all subjects in relation to body weight.

Tabela II. Charakterystyka ukształtowania kręgosłupa w płaszczyźnie strzałkowej u wszystkich badanych w zależności od masy ciała.

	Underweight *Niedowaga*	**Overweight** *Nadwaga*	**Normal** *Norma*	**p-value** *P*
α [°]	14.4±3.6*	14.8±3.5*	16.9±3.3	0.01
β [°]	8.6±3.4	9.3±3.5	8.7±2.6	ns
γ [°]	15.9±5.9	16.2±4.6	16.0±4.7	ns

Based on the results obtained using a measuring device, 3 following angles of anterior-posterior curvatures were set: the α angle – upper thoracic spine inclination, the β angle – the thoraco-lumbar angle inclination, the γ angle - lumbosacral inclination. Then, using the obtained values angle of thoracic kyphosis (KKP, the sum of the α and β angles) and the angle of lumbar lordosis (KLL, the sum of the β and γ angles) were calculated. Additionally, coefficient μ (MI) was calculated. It is the difference between the value of KKP and the KLL. Based on MI, the posture type of a subject was determined. It is assumed that lordotic type occurs when the value of $\mu<(-3°)$, the balanced type $(3°)\leq\mu\leq3°$ and kyphotic type if $\mu>3°$. Figure 1 illustrates the values of analyzed angle.

Statistical calculations were performed using Statistica 10. The results were presented using descriptive statistics – the average and standard deviation. Having considered a normal distribution of all parameters, the statistical significance of results of compared groups was examined using analysis of variance and set at a level of $\alpha< 0,05$

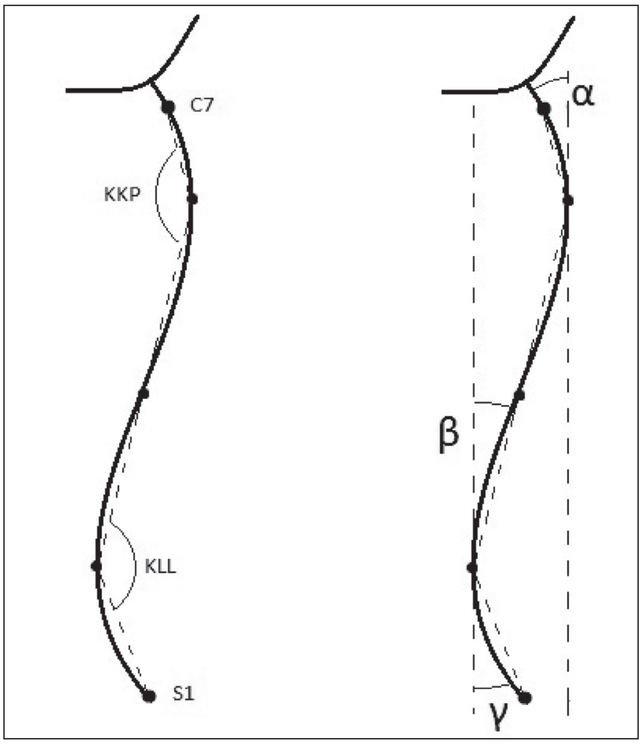

Fig. 1. Points and parameters needed to analyze the type of body posture.

Ryc. 1. Punkty i parametry niezbędne do analizy typu postawy.

RESULTS

Most frequent type of the body in the study group was balanced type (45%). The second most frequent was lordotic type (34%) and most rarely occurred was kyphotic type of the body posture which represented approximately one-fifth of examined (21%). Analysis of body posture in relation to BMI showed that children classified as underweight and overweight, in the majority were characterized by the balanced type of body posture. Children with normal BMI were mostly placed into the lordotic group.

Analysis of the spine curvature angles in sagittal plane, there were statistically significant difference only in α-angle. Other parameters did not differ significantly. Table II shows values of the angles of the sagittal plane spine curvatures.

DISCUSSION

The body posture and its deviation from normal in school children is widely described in literature. However, few publications were created specifically about correlations between somatic type of the body and spinal curvatures in school children so far. Taking into account the considerable diversity in the degree of body fat in primary school children and what is very important continuous change of outliers among children at the same age, we cannot discontinue further researches in this field and what is more, publications that are several years old shall not be considered as up to date.

In this study μ-indicator of compensation was used, which has been recognized as a well-differentiating types of body posture indicator also by other authors [17]. Our results allowed us to make theories about origins of certain phenomena. The balanced type of body posture proved to be most frequent type of all examined children (45%). Thus μ values are placed in the range of (-3) to 3. In other words, less than half of the respondents is characterized by the type of the body posture which is most similar to an ideal physiological body posture. Due to an optimal values of the angles of spinal curvature this is the most effective way of carrying the load occurring in the majority of healthy people.

Focusing on the shape of the spinal curvatures and its components within examined groups, only differences in α-angle appears to be statistically significant. The values of β- and γ-angles increase with increasing children's body fat, while the α-angle reaches the highest value among the normal BMI group. That occurrence may be present due to lordotic type in the normal BMI group, which may be an explanation of biomechianic segmental mobility. Hyperlordotic lumbar spine will cause less mobility in thoracic spine which in turn will have an impact on more mobility in cervical spine. Such a sequence of events may cause the thoracic spine set a little in flexion position resulting in a higher values of the β-angle. Higher values of the upper thoracic spine may be present when child often takes a bad sitting position setting the spine in kyphotic or when carrying big load in the form of a backpack. That load, according to some authors, should not exceed 10% body weight [18].

Slight, but statistically non-significant difference occurs in the μ-indicator in reference to BMI. The type of the body posture in normal BMI children is close to the ideally balanced (μ=0), but mean values above and below proper body weight are also in the range of norm of the balanced type of the body posture (respectively [-1,4] and [-1,8]).

The above studies, despite of the interesting and useful results are affected by certain restrictions, arising from the researcher and equipment capabilities and also organization of researches in schools, which have prevented one from carrying out the researches on much larger groups. The Posturometr-S is a useful and effective device for measuring spine curvatures. However, the disadvantage is constrained position of the body of the examined person during the measurement. Undoubtedly, above-mentioned restrictions must be taken into account in further researches and be eliminated as much as possible.

In conclusion, according to our researches, the somatic type of the body posture does not have an impact on the shape of the spinal curvatures in school children. Based on the above results it can be concluded that the number of children with the body fat above normal is still increasing, which is worrying and not a good predictor. What is more, those values are almost doubled in comparison to underweight children at a similar age range. Among reasons we can mention reduced physical activity and poor nutrition [19, 20]. Attention concerning basic elements of the correct body posture, first symptoms of the pathology and possibilities of treatment including health resort treatment needs to be paid to parents' knowledge, because the sooner we notice the deviation, the easier it will be to take care of the correct posture of the child's body.

CONCLUSIONS

The own investigations have showed that in our study demonstrated that the somatic type of the body does not affect the shape of the spine in school children assessed by Posturometr-S. This area requires further researches.

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