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ENVIRONMENTAL DIVERSITY IN BODY POSTURE OF SIX-YEAR-OLD CHILDREN

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Abstract
Introduction. Body posture is a somatic characteristic essential for the biological development of the child, especially in the periods of rapid growth and those associated with changes in lifestyle. Its lability and dimorphic and ontogenetic variability cause a lot of controversy. Doubts are also raised by environmental diversity of this development feature. Hence, the purpose of the studies undertaken is the comparative evaluation of postures of six-year-old children in urban and rural areas. ***Material and methods.*** The study was conducted in 2011-2013. A total of 1057 children, including the 371 boys and girls from the Warsaw agglomeration and 147 boys and 168 girls from the rural environment in the Lublin region were subjects of the study. The average age was 5.87 (± 0.30) years. Posture in the sagittal, frontal and transverse planes was diagnosed by a visual method using scanning technique. In the mathematical analysis of numerical data the selected techniques of descriptive statistics and Student's t-test and chi-square test were used. ***Results.*** The differences in body posture between the environments in favor of the children from the rural areas emerged most strongly in the sagittal plane. They related to posture components such as: setting of the shoulders and shoulder blades (boys and girls), abdominal bulge (boys) and the position of the head (girls). In the assessment of the lower extremities the study demonstrated favorable condition knees in rural children as compared with their peers from the city. The only element of posture better shaped in the urban subgroup was the size of thoracic kyphosis. ***Conclusions.*** Established posture quality – treated as one of the positive measures of health – allows for a higher rating of this school readiness component in lowly urbanized residential areas. The complexity of posture diagnostics and lability and variability of the analyzed somatic characteristics dictate caution in formulating radical and definitive opinions on the importance of urbanization as posturogenesis condition.

Key words: environmental diversity, body posture, six-year-old children

Introduction

Posture – next to the somatic and physical development – is an important element of the biological development of the child. The authors of some works point out that care about it is of particular importance at the turn of preschool and early school education, often referred to in the literature as 1st posturogenesis critical period [1, 2, 3]. Posture in the developmental age should also be considered as a component of school readiness, equated – according to the traditional definition formulated by Schuman [4] – with the whole physical, social and cognitive development, which makes the child sensitive and susceptible to teaching and education.

Body posture is affected by congenital and acquired influence [1]. However, bibliography of posturogenesis, taking into account the environmental impact [5-13], is poorer than the literature of somatic development and physical fitness. It contains less obvious confirmation on the existence of relationship between the posture status and exogenous factors, such as socio-economic and educational status or size inhabited cities. In the literature, however, one may encounter urbanization aspect posture assessment. In the context of these publications, it is difficult to formulate a relatively unambiguous opinion, supporting one of the communities – urban or rural – in shaping this somatic feature. Available studies indicate a similar range of city children with a better posture as compared with their peers from rural areas [7, 8], of a reverse trend [9, 10, 11] or the absence of clear relations in this regard [12, 13]. Sometimes the results of research carried out by scientists in different regions and environments are even contradictory. According to the publication of Sliwa et al. [11], regarding the impact of the size of the inhabited agglomerations (large town – small town – village) on the posture, we find that the respondents coming from the big cities have thoracic curvature larger than the others. In contrast, in the work of a similar nature Lichota [14], analyzing the incidence of types of body posture in the sagittal plane of six-year-old children in Bialsko-Podlaskie, documented dominance of kyphotic postures in the subgroup of boys and girls of peasant origin.

Górniak [15] is of the opinion that biological factors exert greater influence on the formation of body posture variations than environmental factors. In contrast, social conditions can contribute to deepening or foster the elimination of deficiencies.

In view of the controversial opinions on the urbanization determinants of posture interesting is the verification of the abovementioned opinions based on the views obtained in this study material. Hence, the purpose of this paper is a comparative as-

sessment of posture of six-year-old children in urban and rural areas.

Material and methods

The study was conducted in the years 2011, 2012, 2013 – each time in the spring months. In subsequent editions, it covered children born in 2005, 2006 and 2007. In 2011-12 the survey was carried out in the Warsaw agglomeration, and in 2013 in small-town and rural environment (Parczew the Lublin region and its surroundings). The study involved a total of 1057 boys and girls, whose average age was 5.87 (± 0.30) years. Particularized characteristics of the study group have been presented in Table 1.

Table 1. Numerical characteristics of the study group by gender and environmental

	boys (N=518)		girls (N=539)	
	city	rural areas	city	rural areas
n_1	371	147	371	168
age (years)	5.85±0.30	5.95±0.29	5.83±0.31	5.91±0.29

According to the information contained in Table 1, the arithmetic average age of the respondents was similar in both environments, and in both sexes. Also the standard deviation takes a similar value, which indicates comparable interindividual variation in all the distinguished cohorts. About 2.5 times the size of the subgroups of boys and girls in urban compared to rural peers result from the overall concept and stage division of the research projects (DS.139 and DM.8), on the basis of which this article was prepared.

Posture was diagnosed by visual method using the scanning technique. According to its assumptions, the correct setting for the selected elements of the head, trunk and lower limbs in the coronal, sagittal and transverse plain were given 0 points, and deviations from the desired rated according to a scale from one to three penalty points depending on the severity of the irregularity. A total of 15 posture elements were distinguished, and the maximum number of penalty points awarded was 30 (including 15 points for posture components in the sagittal plane, 9 – for its components in the frontal plane and 6 for the setting of the lower extremities). Research tool for diagnosing posture (child's medical card) and applied point scale were developed according to the proposal of Chrzanowska and Gołąb [16].

In posture assessment in the sagittal plane, the following components were selected and the following criteria adopted:

- positioning of the head (normal – 0 points, extended – 1 point, highly extended – 2 points);
- shoulders (correct – 0 points, extended – 1 point, highly extended – 2 points);
- shoulder blades (adjacent – 0 points, protruding – 1 point, extensively protruding – 2 points);
- chest (normal – 0 points, flattened – 1 point, flat – 2 points, chicken, funnel chest – 3 points);
- thoracic kyphosis (normal – 0 points, increased – 1 point, greatly increased – 2 points, flattened – 1 point, flat – 2 points);
- lumbar lordosis (normal – 0 points, increased – 1 point, greatly increased – 2 points, flattened – 1 point, flat – 2 points);
- belly (flat – 0 points, round – 1 point, extensively rounded – 2 points).

In the frontal plane (and transverse – structural scoliosis) the following elements of posture were taken into consideration:

- cervicobrachial angles (symmetrical – 0 points, asymmetric – 1 point);
- shoulders (symmetrical – 0 points, asymmetric – 2 points); shoulder blades (symmetrical – 0 points, asymmetric – 2 points);
- waist triangles (symmetrical – 0 points, asymmetric – 1 point);
- lateral curvature (none – 0 points, idiopathic scoliosis – 1 point, functional scoliosis – 2 points, structural scoliosis – 3 points).

Assessment of extremities covered the following:

- knee position in the frontal plane (normal – 0 points, valgus – 1 point, extensively valgus – 2 points, varus – 1
- point, extensively varus – 2 points); foot arch (correct – 0 points, flattened – 1 point, flat – 2 points, planovalgus – 3 points);
- axis of the hallux (normal – 0 points, valgus – 1 point).

In the mathematical analysis of the resulting figures the selected techniques of descriptive statistics were used (average values, percentage and standard deviations were calculated). To assess the significance of differences between the average values in the two subgroups (urban and rural) Student's t test was used. However, in order to determine the significance of differences between the frequencies of occurrence of posture types the chi-square test in logarithmic form was used. Standard significance levels were adopted: $p<0.001$ (***), $p<0.01$ (**), $p<0.05$ (*) [17].

Results

Presentation of the results of own research is based largely on an assessment of the differences between the numerical values characterizing the setting of extracted out in methodical paragraph components of posture. These data are shown in Tables 2-4. In addition, Figures 1-6 present the percentage distributions of the volume of physiological spine curvatures and knees positions, including assessment of the significance of differences between the calculated frequencies. Supplementing the graphic material with the graphs is justified due to the fact that the penalty points were awarded for both the reduction and the increase of thoracic kyphosis and lumbar lordosis in the case of the lower limbs, both for their valgus and varus setting. Therefore, in the case of the above-mentioned three elements, the average values of the allocated penalty points constitute not reliable enough information about their condition.

Data presented in Tables 2-4 show that the most significant differences were noted with respect to the components of posture in the sagittal plane, and that the overwhelming majority of these differences is in favor of rural subgroups of respondents. In the side inspection, boys and girls from the rural environment were awarded penalty points significantly less ($p<0.001$) for setting of the shoulders and shoulder blades than their urban peers. In addition, in the case of boys from the rural areas favorable results for belly bulge were reported ($p<0.01$) and in girls of the same urbanization level – the position of the head ($p<0.01$). The only component of the body posture in the sagittal plane, for which the improvement in the status of urban children was observed, was the size of thoracic kyphosis ($p<0.001$ in boys and $p<0.01$ in girls) (Tab. 2). Differences in the average number of points awarded for posture components in the frontal plane in urban and rural children in no case reached statistical significance ceiling (Tab. 3). Among the elements that characterize the setting of the lower limbs, significant differences – in favor of the respondents from rural areas – were obtained for the formation of the knee ($p<0.01$ – boys and $p<0.001$ – girls). In a subgroup of girls the significance was also demonstrated in relation to the hallux axis ($p<0.05$) (Tab. 4).

Table 2. The average values (±SD) of points awarded for components of posture in the sagittal plane in the study group (by gender and environment, together with the differences marking)

posture component	boys			girls		
	city	rural areas	difference	city	rural areas	difference
head position	0.23±0.43	0.16±0.39	0.07	0.31±0.72	0.15±0.39	0.16**
position of shoulders	0.76±0.59	0.56±0.59	0.20***	0.71±0.59	0.36±0.53	0.35***
position of shoulder blades	1.01±0.52	0.73±0.53	0.28***	0.95±0.54	0.73±0.59	0.22***
chest	0.19±0.59	0.28±0.64	-0.09	0.17±0.56	0.14±0.47	0.03
chest kyphosis	0.47±0.56	0.73±0.63	-0.26***	0.47±0.56	0.63±0.63	-0.16**
lumbar lordosis	0.54±0.59	0.48±0.62	0.06	0.81±0.69	0.71±0.66	0.10
belly bulge	1.01±0.57	0.84±0.66	0.17**	1.14±0.53	1.05±0.60	0.09

* (p<0.05), ** (p<0.01), *** (p<0.001) – significantly different from the result obtained by the respondents from the second level of urbanization

Table 3. The average values (±SD) of points awarded for components of posture in the frontal plane in the study group (by gender and environment, together with the differences marking)

posture component	boys			girls		
	city	rural areas	difference	city	rural areas	difference
cervicobrachial angles	0.34±0.47	0.36±0.48	-0.02	0.30±0.46	0.29±0.46	0.01
position of shoulders	0.68±0.95	0.76±0.97	-0.08	0.63±0.93	0.68±0.95	-0.05
position of shoulder blades	0.65±0.93	0.76±0.97	-0.11	0.66±1.03	0.66±0.94	0.00
waist triangles	0.35±0.48	0.41±0.49	-0.06	0.36±0.49	0.40±0.49	-0.04
lateral curvature	0.32±0.52	0.31±0.56	0.01	0.32±0.53	0.36±0.57	-0.04

* (p<0.05), ** (p<0.01), *** (p<0.001) – significantly different from the result obtained by the respondents from the second level of urbanization

Table 4. The average values (± SD) of points awarded for components of lower limbs position in the study group (by gender and environment, together with the differences marking)

posture component	boys			girls		
	city	rural areas	difference	city	rural areas	difference
position of knees	0.68±0.56	0.53±0.55	0.15**	0.67±0.55	0.50±0.52	0.17***
foot arch	1.41±1.05	1.59±1.05	-0.18	1.24±1.15	1.35±0.98	-0.11
hallux axis	0.02±0.13	0.00±0.00	0.02	0.05±0.21	0.01±0.08	0.04*

* (p<0.05), ** (p<0.01), *** (p<0.001) – significantly different from the result obtained by the respondents from the second level of urbanization

Data presented in Figure 1 show that in the category of boys, among 3 distinguished, due to its size, types of thoracic kyphosis in an urban environment most frequently there occurred correct curvature (over 55%), in rural areas – reduced curvature (almost 40%). The difference between the incidence of increased (and reduced) thoracic kyphosis among respondents from rural areas and from the city was approximately 10%. The correct type occurred with the 20% higher frequency in the urban subgroup. These differences proved significant in each case (Fig. 1).

In the case of girls – both among respondents from the city (over 55%) and the rural areas (45%) – most commonly there occurred thoracic kyphosis of correct sizes. Environmental differences between the scope of the increased thoracic curvature proved to be negligible (less than 2%). There were more significant (approximately 11%, p<0.05) in the case of normal kyphosis. Type of posture with reduced thoracic curvature was found significantly more often among the rural girls (around 13%, p<0.01) (Fig. 2)

The most common type of lumbar lordosis in the category of male gender was the correct size curvature (more than 50% in the city and close to 60% in rural areas). Significant environmental differences were observed in the case of increased lordosis (over 13%, p<0.05), occurring in urban environment with a frequency of approximately 35%, in the rural areas in more than 20% of boys. Increased curvature of the lumbar spine was more typical of rural than urban subgroups (Fig. 3).

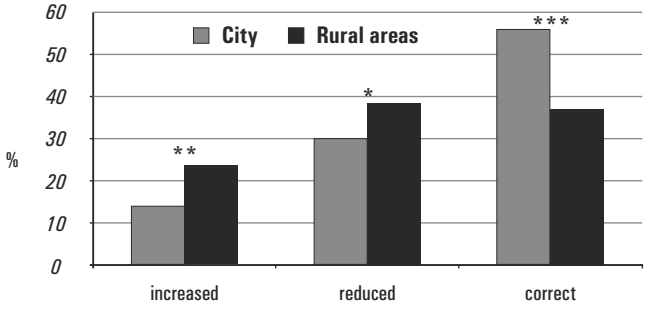

Figure 1. Incidence of types of thoracic kyphosis in the subgroup of boys (including environment and marked the significance of differences)

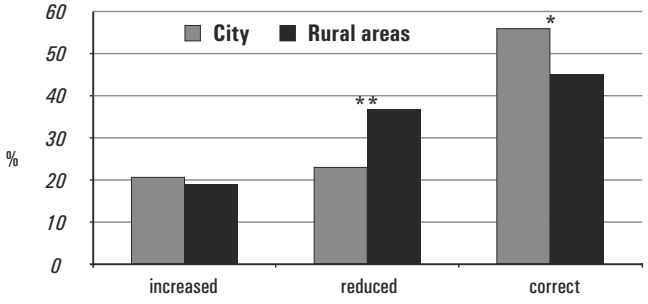

Figure 2. Incidence of types of thoracic kyphosis in the subgroup of girls (including environment and marked the significance of differences

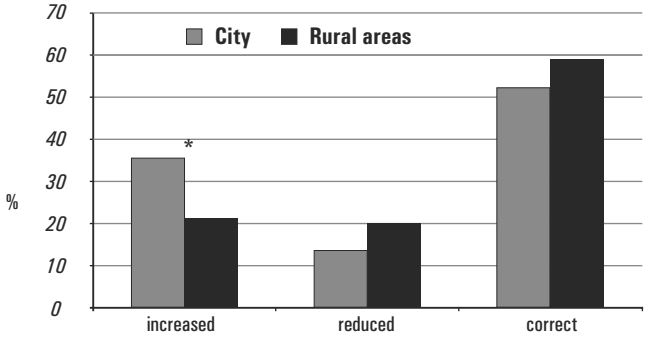

Figure 3. Incidence of types of lumbar lordosis in the subgroup of boys (including environment and marked the significance of differences)

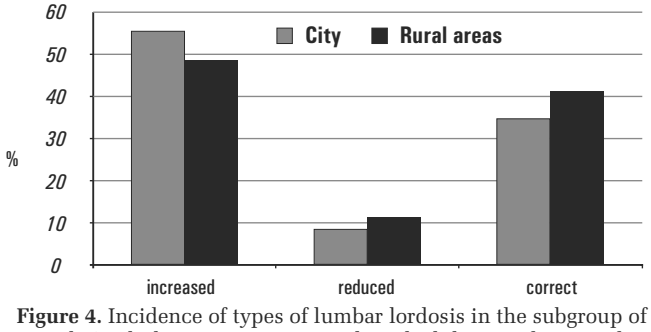

Figure 4. Incidence of types of lumbar lordosis in the subgroup of girls (including environment and marked the significance of differences)

Among the girls in both environments there dominated lumbar lordosis of larger sizes, with a prevalence of about 55% in the city and close to 50% in rural areas. Accordingly, about 10% less frequently there occurred lumbar curvature of the correct size. Decreased lordosis at both levels of urbanization occurred with frequency oscillating around 10%. These environmental differences were not statistically significant (Fig. 4).

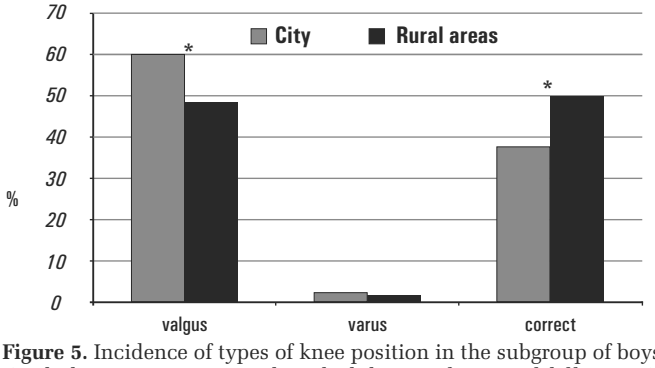

Figure 5. Incidence of types of knee position in the subgroup of boys (including environment and marked the significance of differences)

In knee shapes of the urban boys there dominated valgus knee (60%). Among the respondents from rural areas the setting was correct and valgus knees occurred with compensated (about fifty percent) frequency. Varus axis of the lower limbs was rare in both environments. Differences in the incidence of valgus and normal knees between urban and rural boys were around 11-12%, and were statistically significant. (Fig. 5).

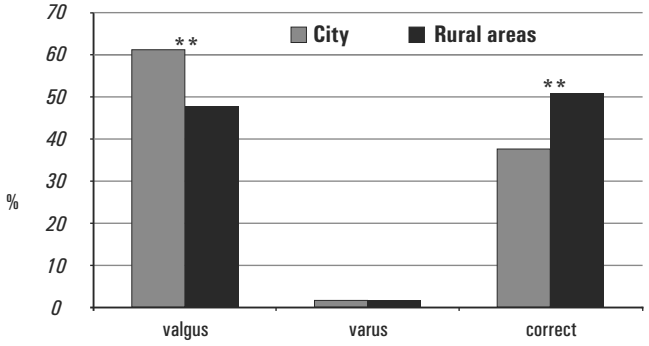

Figure 6. Incidence of types of knee position in the subgroup of girls (including environment and marked the significance of differences)

Condition of the lower limbs axis in the case of girls was close to knee setting of the boys, which is confirmed by the data presented in the Figures 5 and 6. Among the respondents from the city valgus prevailed, and in the rural subgroup – the correct configuration of the knees. In both cases the environmental differences were significant. Varus occurred marginally (slightly exceeded 1%) and with a similar incidence in urban and rural areas (Fig. 6).

Discussion

The discussion should start with a brief summary of the results, presented in detail in the result part. Their arrangement was quite regular, indicating a better state of body posture in rural subgroups studied. The environmental differences in body posture in favor of the children of the rural areas emerged most strongly in the sagittal plane. These related to such components of the body posture as setting of the shoulders and shoulder blades (boys and girls), abdominal bulge (boys) and the position of the head (girls). In the assessment of the lower extremities favorable knee condition of rural children as compared with their peers from the city was demonstrated. The only element of posture better shaped in the studied urban subgroup was the thoracic kyphosis sizes.

The results arrangement presented above – because of the clear regularity almost unprecedented in the literature – tends to be regarded as surprising and allows for including them in the group of opinions indicating the predominance of the rural over urban environment in shaping the proper body posture [9, 10, 11].

Given the complexity of factors affecting the statics of the body and its disorders [18], justification of own research results is not a simple task. These difficulties are rooted even in the definition of the posture, from which we learn about the triple – morphological, physiological, and environmental foundation of this somatic feature [1]. Its specificity is also determined by lability, especially typical for the early stages of ontogenesis, which include the pre-school and early school period breakthrough. Thus the results obtained in own study should be regarded rather as the effect of coincidence of a variety of conditions.

Given the fact that most of the observed differences related to body posture inspection from the side, it is worth noting that

the diagnostic profiles in the sagittal plane is more ambiguous than that in the frontal plane (due to the lack of clearly established evaluation criteria and greater individualization of the back and both rims image in such setting). In two-legged standing the anterior-posterior unsteady silhouettes are more pronounced than the lateral. The range of movement of center of gravity in the sagittal plane is 2-3 times larger in comparison with the frontal plane. This is due to more extensive anterior-posterior than the lateral range of motion in the spine and at the upper ankle, knee and hip [1, 19].

Contrary to stereotypical opinion, the higher socio-economic and educational status of urban children families presented in the group covered by own research [20], need not explicitly mean more favorable conditions for the formation of body posture. Although Śliwa and Chlebicka [21] documented the positive impact of maternal education on the state of the body statics of their children at three levels (especially in the male subgroup of respondents), but Skorupka [22] drew attention to another aspect of this issue. She conclude that "higher education of parents, while ensuring opportunities to provide children with better socio-economic, educational, and recreational-sport conditions, is at the same time associated with increased working hours, often of both parents. Creating just the right conditions, combined with regularity and continuity of prevention and treatment, lack of personal responsibility in health shaping may limit the effectiveness of the impact on child development".

Part of own research results, deviating from the general trend (preferred sizes of thoracic curvature in the urban environment) is partially confirmed in the literature. The advantage of kyphotic types among six year-old children of peasant origin, compared with their peers from families of intellectuals and workers was confirmed in a study by Lichota [14]. Also Burdukiewicz et al. [23] on the basis of study of nearly 5000 person rural population from the area of Rabka (including approximately 200 girls and boys aged 6) showed that among the abnormal postures of both sexes the most numerous was kyphotic II type (equivalent to increased thoracic kyphosis). On the other hand, Śliwa et al. [24] expressed the view of larger physiological spine curvatures in the subgroup of respondents growing up in urban conditions, as compared to their peers from small towns and villages. These views are another example of the existence of numerous ambiguities in the issues related to the posture assessment.

Conclusions

Based on the survey the following conclusions were formulated:

1. Established quality posture – treated as one of the positive measures of health – allows for a higher rating of this component in school readiness in the case of residence places of low urbanization.
2. The complexity of the posture diagnostics, lability and variability of the analyzed somatic characteristics dictate caution in formulating radical and definitive opinions on the importance of urbanization conditions in posturogenesis.

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