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RESEARCH ARTICLE

ASSOCIATIONS BETWEEN SELECTED PELVIC TRAITS IN HABITUAL POSTURE AMONG MALE INDIVIDUALS OF URBAN AND RURAL ENVIRONMENTS AGED 3 TO 20 YEARS

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ABSTRACT

Introduction: The pelvis is part of the skeletal system. It constitutes a pelvic girdle formed by the sacrum, the coccyx bone and the two pelvic bones, the right and left one. During walking, it undergoes fluctuations of angular displacement in the frontal, sagittal and transversal planes. **Material and method**: The study was carried out in randomly selected kindergartens and schools of urban and rural environments, in Warmian-Masurian and Pomeranian Region among 18946 male individuals aged 3 to 20 years. **Tools and subject of the study:** A photogrammetric method was used to diagnose the left and right pelvic torsion angle in the transversal plane and the left and right tilt in the frontal plane. **Results obtained:** An overall analysis including positive and negative relationships shows that KNM- and KNM- ranges from -0.39 to -0.48, KNM- and KSM- from 0.15 to -0.08, KSM- and KSM- from 0.15 to -0.74. **Conclusions:** 1.The relationships between the angles of pelvic torsion in the transversal plane and tilt in the frontal plane are highly significant. 2. The interrelationships of torsion and pelvic tilt angles should be taken into account in postural error correction programs for ages 3 to 20 years.

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INTRODUCTION

The pelvis is part of the skeletal system. It constitutes a pelvic girdle formed by the sacrum, the coccyx bone and the two pelvic bones, the right and left one. It shows major gender differences. The female pelvis is low, wide and spacious, while the male pelvis is high, narrow and tight. In both sexes, the smaller pelvis is shaped like a section of a cone: in women it is cut off closer to the base, in men closer to the apex [1]. A study of posture carried out by Wolanski's method and simplified orthopedic inspection on 178 first grade students in rural and 189 urban elementary schools showed the incidence of pelvic obliquity in rural children at 9.6%, and urban at 11.1 [2]. Wilczynski's [3] study in a population of 199 girls aged 13-16 by photogrammetric method showed that the pelvic tilt angle (KNM) was the highest in 16-year-old girls, followed by 14-, 13-, and 15-year-old girls, respectively: 1.86, 1.78, 1.71, 1.54 degrees. The pelvic torsion angle (KSM) decreased with age, the largest was in 13-year-olds, followed by 14-, 15-, 16-year-olds, respectively: 3,93, 3,71, 3,7, $3,09^0$. Lateral curvature of the spine is, under physiological conditions, primarily an appropriate response of the spine to the asymmetrical position of the pelvis and lower limbs [4]. Thus, for example, when walking, we lift one limb together with this hip bone with each step, because of that the spine in the lumbar region tilts to the side and simultaneously twists to the opposite side. Therefore, a functional disorder of the spine cannot be evaluated solely based on scoliosis.

The condition manifested by pelvic asymmetry in the frontal and transversal planes, i.e., a lower position and retraction of the posterior upper iliac spine on one side and a higher and forward-facing position of the opposite side, indicates a pelvic misalignment and another pathomechanical way leading to scoliosis.Levit also finds a high percentage of children of younger school age with a twisted pelvis in the transversal plane. A study by Grabara [5] in a population of 162 girls and 140 boys found that pelvic asymmetries in the frontal plane were rare, occurring in only 3% of girls and 7% of boys. In contrast, pelvic torsion in the transversal plane was much more common because in 60% of girls and 65% of boys. The most common asymmetries of this type were observed in 10- and 11-year-old girls, 70% and 68%, respectively, and in 10- and 12-year-old boys, 82% and 79%, respectively. Similar observations were also made by Saulicz [1998]. Mrozkowiak's study shows that both left and right torsion angles significantly and positively affect: thoracolumbar angle, total spine length (C_7-S_1), percentage of total spine length, length and depth of thoracic kyphosis, length of lumbar lordosis, its percentage of DCK (DLL%), its depth and height. The angle of pelvic torsion to the right significantly and positively affects: height and percentage of the length of thoracic kyphosis DCK (DKP%). The angle of pelvic torsion to the right significantly and negatively affects the angle of thoracic kyphosis [6].

The purpose of the study is to determine the interdependence of the values of left and right pelvic torsion angles in the transversalplane andleft and right tilt angles in the frontal plane among male children and adolescents aged 3 to 20 years.

MATERIALS AND METHODS

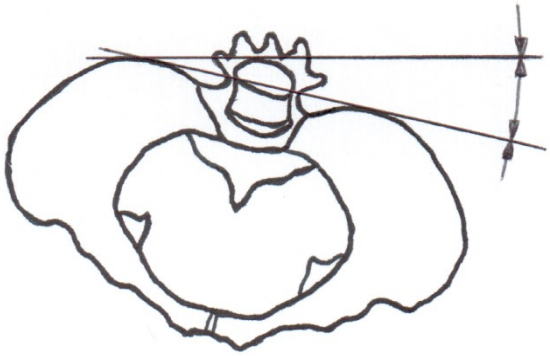
The research was carried out in randomly selected kindergartens and schools in urban and rural environments of the Warmian-Masurian and Pomeranian Region like 10 kindergartens, 20 primary schools, 6 junior high schools, 1 upper-secondary school after obtaining the consent of the Local Education Authority in Olsztyn, the school or kindergarten principal, and the teacher in charge of the given branch, parent and child and students of the Kazimierz Wielki University in Bydgoszcz. The general criteria for qualifying for the study were based on the selection of a sufficiently large number of similar healthy body postures during the study. The research involved 18,946 male individuals from both environments, aged 3 to 20 years, tab. 1.

Based on interviews with parents and school medical charts, all students with documented structural abnormalities in the musculoskeletal system were excluded. On the first day of the study, in the light of the medical diagnosis, the subjects were generally healthy, therefore it was assumed that the results and any postural errors found later would be within the limits of physiological deviations appropriate for the represented population and age range. This concerns small functional deviations of the vertebral process lines from the anatomical axis of the spine and the angle of trunk flexion in the frontal plane, the angle of flexion and extension in the sagittal plane, and the longitudinal arch of the foot.

Tab. 1. Research material in the age range categories

Age	Male
3-6	1024
7-13	16876
14-20	1046
Total	18946

Source: Mrozkowiak M. [6]

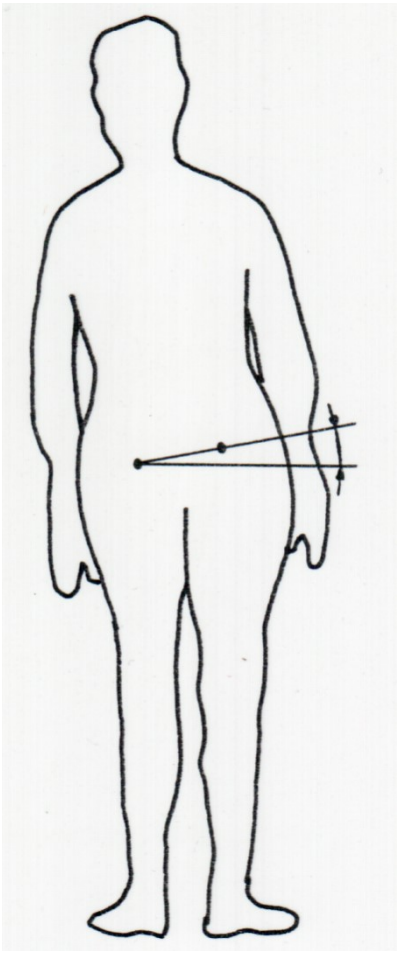


Source: Mrozkowiak M. [5]

Fig.1. Pelvis rotation angle to the right in the transversal plane (KSM)

Tools and subject of research: The measurement site consisted of a computer and a card, a programme, a monitor and a printer, a projection and reception device with a camera for measuring selected parameters of the pelvis-spine complex. Obtaining a spatial image is possible by displaying lines with precisely defined parameters on the child's back and feet. The lines falling on the skin are distorted depending on the surface configuration. Thanks to the use of a lens, the subject's image can be received by a special optical system with a camera and then transmitted to a computer monitor. The distortions of the line image recorded in the computer memory are converted by a numerical algorithm into a contour map of the examined surface [7]. The obtained image of the surface of the trunk and pelvis allows for a multi-aspect interpretation of body posture.

The accuracy of measurement and analysis of recorded spatial parameters means that the conclusions drawn may differ from those previously published. The short duration of recording the subject's figure allows to avoid postural muscle fatigue that occurs during examinations by somatoscopy. The most important in this method is the simultaneous measurement of all actual values of the spatial location of individual body sections. During the research, generally accepted principles and procedures were followed [8]. The angle of pelvic rotation to the left (KSM-) and to the right (KSM), fig. 1, was measured in the transversal plane, together with pelvic tilt angle to the right (KNM), and to the left (KNM-), fig. 2. Unfortunately, the method used does not measure the pelvic rotation angle in the sagittal plane.



Source: Mrozkowiak M., [6]

Fig. 2. Pelvis tilt angle to the left in the frontal plane (KNM-)

Statistical methods used: Four features describing the pelvis were analyzed. KNM: the angle of pelvic tilt in the frontal plane to the left, KNM-: the angle of pelvis tilt in the frontal plane to the right, KSM: the angle of pelvic rotation to the right in the transversal plane, KSM-: the angle of pelvic rotation to the left in the transversal plane. Results of the statistical analysis, Spearman's coefficient, understood here as a measure of the strength of monotonicity between two variables means an increase in the valu of one variable usually corresponds to an increase in the other. The coefficient ranges from -1 (this corresponds to the strongest negative relationship between the variables) to +1 (this corresponds to the strongest positive relationship). The values of Spearman's coefficients for the tested pairs are presented in the form of matrix colors, according to the scale on the right side of the figure. A completely red color corresponds to a coefficient value of -1, and a completely blue color corresponds to a coefficient value of +1. Additionally, the numerical values of the coefficient are entered in the corresponding field with the appropriate number of "stars" indicating the significance of the relationships, tab. 2.

Tab. 2. Chart of Spearman's coefficient values of features like KNM-, KSM-, KNM, KNM

Male from 3 to 6 years old			
	KNM-	KSM-	KSM
Płeć męska w wieku od 3 do 6 lat			
KNM	-0,48		
KNM-			0,13
KSM-			-0,74
Male from 7 to 13 years old			
KNM	-0,43	0,08	-0,05
KNM-		-0,08	0,06
KSM-			-0,7
Male from 14 to 20 years old			
KNM	-0,39		
KNM-		-0,15	0,15
KSM-			-0,74

Source: ownresearch

Results obtained: The general analysis including positive and negative relationships shows that KNM and KNM- ranges from -0.39 to -0.48, KNM- and KSM- from 0.15 to -0.08, KSM- and KSM from 0, 15 to -0.74. All analyzed results turned out to be highly significant, tab. 2.

A detailed analysis covers the positive and negative relationships of the analyzed characteristics of the examined individuals aged 3 to 6 years. All analyzed results turned out to be highly significant. However, they differ in terms of the Spearman coefficient. Thus, the correlation coefficient between the features of KNM and KNM- is: -0.48, between KNM- and KSM-: 0.13, between KNM and KSM: -0.11, between KNM- and KSM-: does not occur, KNM - a KSM: 0.11, KSM- a KSM: -0.74, Fig. 3.

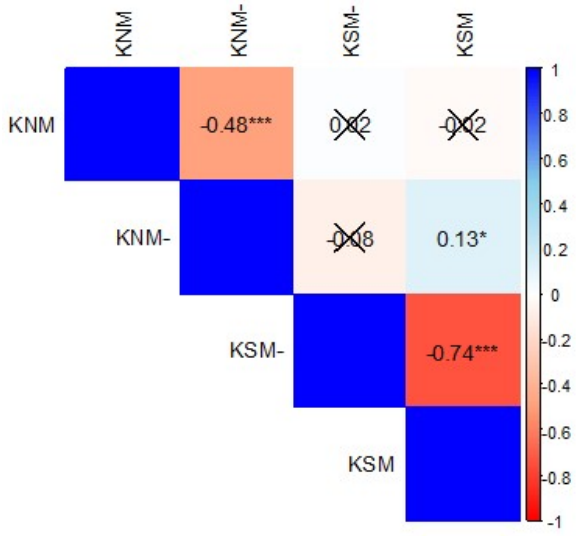


Fig. 3. Relationships between pelvic characteristics in male subjects aged 3 to 6 (n) 1024

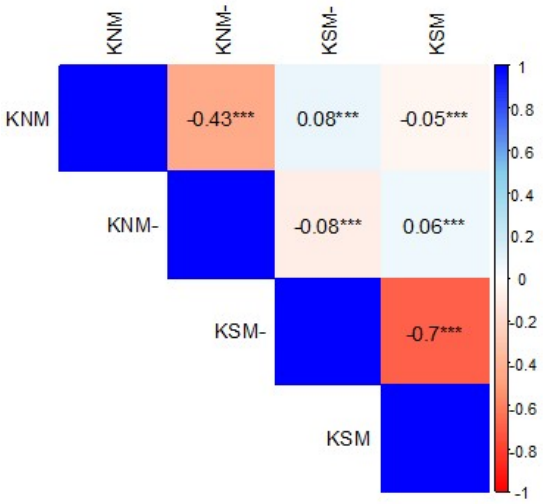


Fig. 4. Relationships between pelvic characteristics in male subjects aged from 7 to 13 (n) 16876

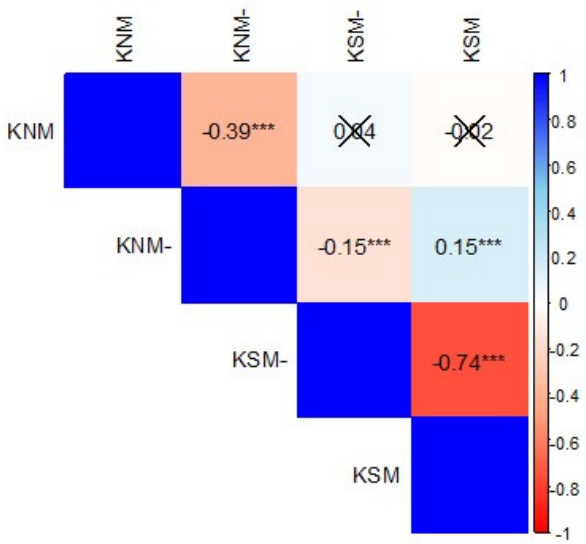


Fig. 5. Relationships between pelvic characteristics in male subjects aged from 14 to 20 (n) 1046

Among analyzed characteristics aged 7 to 13, all results turned out to be highly significant. However, they differ in terms of the Spearman coefficient. Thus, the correlation coefficient between the features of KNM and KNM- is: -0.43, between KNM- and KSM-: 0.13, between KNM and KSM: -0.07, between KNM- and KSM-: -0.11 , KNM- and KSM: 0.11, KSM- and KSM: -0.74, Fig. 4. Among analyzed characteristics aged 14 to 20, all analyzed results turned out to be highly significant. However, they differ in terms of the Spearman coefficient. Thus, the correlation coefficient between the features of KNM and KNM- is: -0.39, between KNM- and KSM-: -0.15, between KSM- and KSM: -0.74, Fig. 5.

Comparison to other authors: The available literature on the subject does not contain any studies describing the interdependence of pelvic features. The measurement results of other researchers very often concern body posture in a general sense and do not refer to individual features describing it. Analysis of research results by Burdukiewicz et al. [9], Bibrowicz [10], Cieśla [11], Kabsch [12], Lewit [4], Saulicz [13], Tylman [14], Walker and Dickson [15] and Wielkie [16] on the influence of the angle of pelvis tilt and rotation on the characteristics of the spine showed that this influence is definitely negative and multidirectional.

CONCLUSION

- Correlations between angles of pelvic rotation in the transversal plane and pelvic tilt in the frontal plane are highly important.
- Postural error routines should include mutual dependencies of the angles of pelvis rotation for subject aged 3 to 20 years.

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