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Relationships between characteristics of the spine-pelvis system and feet in boys aged 7 to 13 years

[1]Mirosław Mrozkowiak, [2]Marek Sokołowski

[1]Społeczna Akademia Nauk, ul. Kościuszki, Szczecinek 47, Poland
[2]Akademia Wychowania Fizycznego, ul. Królowej Jadwigi 27/39, Poznań

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Abstract

Introduction. Process of formation of physiological curvatures and foot arch should be considered spatially and with regard to several-level biokinetic chain formed by spine, pelvis and lower limbs. Huge variability and mutual relationships of parameters that describe this chain results from the effect of various stressors.
Material and Method. 7,509 observations were obtained in the study from urban (5,033 or 67.02%) and rural areas (2,476 or 32.97%). Observations focused on 104 characteristics of the spine and pelvis system in individual age categories. In order to assess these parameters, the authors used a system for computer analysis of body posture that is designed based on the phenomenon of projection moire.
Results.
Statistical analysis revealed that among characteristics of pelvis and spine, the correlations with characteristics of feet are observed for: differences in the distance of inferior angles of the scapulae from spinous processes measured horizontally along the straight lines; angle of body inclination to the right in the frontal plane and maximum deviation of spinous process of the vertebra to the right. Furthermore, characteristics of feet which are most frequently correlated with parameters of pelvis-spine system are: fifth toe hallux valgus angle and toe varus deformity angle in the right feet.
Conclusions
1. Mutual relationships between characteristics of feet and spine-pelvis system are incidental and random.
2. No regularities and logical relationships were found between the parameters of the pelvis-spine system and feet. No mutual effect on each other can be observed and the only observation is their coexistence.

1. Introduction

Process of formation of physiological curvatures and foot arch has been explored by numerous researchers from various fields of science. From the standpoint of current state of knowledge, this problem should be considered in spatial terms and with regard to several-level biokinetic chain formed by spine, pelvis and lower limbs. With regard to only a few processes such as syntony, synergy, synkynesis and multifaceted nature of these processes, some methodological difficulties in examination of relationships and mutual effect of the components of this chain can be observed. Huge variability of the characteristics that describe curvatures and dynamic arches of the foot results from the effect of various stressors. However, due to high lability of the parameters measured, various dillemas concerning

standardization of conditions, reliability, validity and objectivity of the measuring tools and researcher's diligence are arising. It is also important that measurements are taken using living bodies, i.e. children, spontaneously and emotionally reacting to any stressor.

Development of IT solutions allowed for approaching evaluation of body posture in a comprehensive manner and situation of individual components in time and space and reflecting of spatial balancing of the vertical body posture [Kabsch 1999]. Multitude of procedures for assessment of body posture and the lack of a method without any drawbacks causes that the choice should depend on the aim of the study. There have been relatively many scientific studies on assessment methods [Kutzner – Kozińska 1986; Kasperczyk 1983; Przewęda 1962; Ślężyński 1992; Zeyland – Malawka 1999a]. Source publications in the available Polish and foreign literature concerning projection moire are also frequent [Asamoah 1998; Adair 1977; Asazuma 1984; Bibrowicz 2003; Iwanowski 1992; Kovac and Pecina 1999; Mrozkowiak 2010; Nowotny 1992; Prętkiewicz – Abacjew 2001; Stokes et al. 1987; Takasaki 1998; Wong 1997; Zawieska 2003; Jaskólski, Śliwa 2003]. Contemporary diagnostics allows for determination of the most of characteristics of body posture in quantitative terms, thus reflecting the relationships between each other.

The aim of this study was to determine the relationships between selected characteristics that describe pelvis-spine system and feet in the population of boys in both (urban and rural) environments aged 7 to 13.

2. Human material and methodology

The examinations were carried out in randomly selected schools of urban and rural areas of the Warmian-Masurian and Pomeranian Regions among children aged 7 to 13. The study was approved by the Bioethics Committee. We recorded 7,509 observations from urban (5,033 or 67.02%) and rural areas (2,476 or 32.97%). On the first day of the examinations, in light of medical diagnosis, children were healthy in general terms. Therefore, it was adopted that the results and any signs of faulty posture found later in the study would remain within the range of physiological deviations typical of the population and age studied. Observations focused on 104 characteristics of the spine and pelvis system in individual age categories. In order to assess these parameters, we used a system for computer analysis of body posture that is designed based on the phenomenon of projection moire. The methodology used in the study was consistent with the principles adopted [Mrozkowiak 2010].

3. Statistical methods

Statistical analysis was carried out for the results of measurements of children aged from 7 to 13 in 6 editions organized with half-year intervals. Due to the extensive research

material, we determined positional statistics (arithmetic means, quartiles), scattering of characteristics (standard deviation) and indices of symmetry (coefficient of asymmetry, coefficient of clustering), which provides some knowledge about characteristics studied with respect to age groups and genders. For selected 104 characteristics, we analysed the significance of changes in mean values in consecutive years with respect to one gender, correlation and multiple regression in order to determine the correlations between characteristics of feet and spine-pelvis system. The relationships between characteristics of spine-pelvis and feet were determined based on linear regression. Selection of significant characteristics of spine-pelvis system was based on backward method that employed Student's t-test and Snedecor's F test.

4. Results

Relationships between characteristics of the Spine-Pelvis System and Feet

Boys, urban areas

Characteristics of the spine-pelvis system that showed significant relationship with the characteristics of feet were (in decreasing order): depth of thoracic kyphosis, more rarely: height and length of thoracic kyphosis, length of lumbar lordosis, more rarely: height and depth of lumbar lordosis, angle of thoracic kyphosis, more rarely: angle of inclination of thoracic region of upper spine and asymmetry of width of waist triangles if the right one was wider, more rarely: the angle of body bent in the sagittal plane and angle of pelvic right rotation angle, more rarely convexity of the right inferior angle of the scapula, more rarely angle of body bent to the right, more rarely: asymmetry in the height of shoulders if the left one is higher, asymmetry of waist triangles if the right one is higher, asymmetry of convexity of the angles of scapulae if the right one is more convex, see Fig. 1.

Characteristics of the spine-pelvis system that showed significant relationship with the characteristics of feet (in decreasing order): width of right foot, fifth toe varus deformity angle in the right foot and width of the left one, more rarely: height and length of the first longitudinal arch of the right foot, more rarely fifth toe varus deformity angle in the left foot, more rarely: height of the second and and width of the third longitudinal arch in the right foot, more rarely length of the second longitudinal arch of the left foot, more rarely: length of the second longitudinal arch, transverse arch and surface area of plantocontourogram of the right foot, width of the third and fourth ones and height of the first arch of the left foot, more rarely: length of both feet, width and height of the second longitudinal arch of the left foot, more rarely: hallux valgus angle and transverse arch of the left foot, height of the fourth and length of the fifth arch of the right foot.

Of the characteristics analysed in the sagittal plane, the most significant relationship with the characteristics of feet were observed for the depth of thoracic kyphosis, which affects: toe varus deformity angle, surface of plantocontourogram and width of both feet, transverse arch of the right foot, length of the first and second and height of the second longitudinal arch of the right foot, height of the third and width of the fourth in the left foot. More rarely with length of thoracic kyphosis, having effect on: fifth toe varus deformity and and width of both feet, length of the first and the second, width of the third and height of the second longitudinal arch of the right foot, height of the second one in the left foot. With height of thoracic kyphosis, having effect on: transverse arch and width of both feet, width of the third and fourth arch and height of the first and the second arch in the right foot, length and height of the second and width of the third longitudinal arch of the left foot. With length of lumbar lordosis, having effect on: fifth toe varus deformity and surface of plantocontourogram of both feet, hallux valgus of the left toe and width of the right and length of the fourth, width and length of the second longitudinal arch, length and height of the second arch of the left foot. More rarely with the angle of thoracic kyphosis, having effect on: transverse arch, width and surface of plantocontourogram, length of the first and second and height of the second longitudinal arch in the right foot, length of the first, width of the fourth and fifth and height of the fourth arch of the left foot. More rarely with height of lumbar lordosis, having effect on: fifth toe varus deformity and and width of both feet, width of the fourth and fifth, length of the the first and the fourth and height of the second longitudinal arch of the right foot, height of the first one in the left foot. With depth of lumbar lordosis, having effect on: width and transverse arch of both feet, transverse arch, length of the first and height of the third arch of the right foot, length of the second and third and width of the second and fourth longitudinal arch of the left foot. With angle of inclination of upper thoracic region of the spine, having effect on: fifth toe varus deformity angle and width of both feet, length and surface of plantocontourogram and height of the first longitudinal arch of the right foot, height of the first and length of the second arch of the left foot. With angle of body bent, having effect on: transverse arch and width, height of the first and fourth, width of the third and fourth arch of the right foot, height of the first arch in the left foot. With angle of inclination of thoracolumbar region of the spine, having effect on: hallux valgus, length of the first and the second longitudinal arch of the right foot, width of the second and fourth arch of the left.

Of the characteristics analysed in the frontal plane, the most significant relationship with characteristics of feet was observed for: asymmetry of width of waist triangles (if the

right one was wider), having effect on width of both feet, height of the first and the second longitudinal arch of the right foot, height of the first, length of the fourth and width of four first longitudinal arches in the left foot. More rarely body bent to the right, affecting the width of both feet, transverse arch and width of the third arch of the right foot, length of the fifth and height of the second arch in the left foot. More rarely asymmetry of shoulder height if the left one was higher, affecting the length of both feet, hallux valgus in the right foot, length of the third and fourth and width of the third arch of the left foot. Asymmetry of waist triangles if the right one was higher, having effect on: length of the first longitudinal arch in the right foot, fifth toe varus deformity, length of the second and the third arch and width of the left foot. More rarely inclination of pelvis to the left, having effect on: length of the fifth, width of the first and length of the right foot.

Of the characteristics analysed in the transverse plane, the most frequent relationships with characteristics of feet were found for: pelvis rotation to the left, having effect on fifth toe varus deformity, width of the right foot and length of the fifth, width of the third, height of the first, fourth and fifth longitudinal arch. More rarely asymmetry of convexity of angles of scapulae if the left was more convex, having effect on transverse arch, length of the second and fourth and width of the third arch of the left foot, height of the first arch in the right foot. If the right arch is more convex, asymmetry is observed for: fifth toe varus deformity, length of the fifth and second, width of the third and height of the first in the right foot.

Boys, rural areas

The characteristics of the spine-pelvis system that had significant relationship with characteristics of feet include (in decreasing order): height of thoracic kyphosis, angle of body bent in the sagittal plane, more rarely angle of inclination of the lumbar and thoracic section of the spine, length and angle of lumbar lordosis, asymmetry of shoulder angle convexity if the right one is more convex, angle of pelvis rotation to the right, more rarely: angle of body bent to the right, asymmetry of shoulder angle convexity if the right is more convex, asymmetry of height of waist triangles if the right one is higher, distance of the left angle of shoulders from the line of spinous processes, angle of inclination of thoracolumbar region of the spine, height of lumbar lordosis, maximum distance of the spinous process to the left in asymmetrical shape of their curve. More rarely: depth of thoracic kyphosis and lumbar lordosis, asymmetry of width of waist triangles if the right one is wider, angle of pelvis inclination to the left, see Fig. 1.

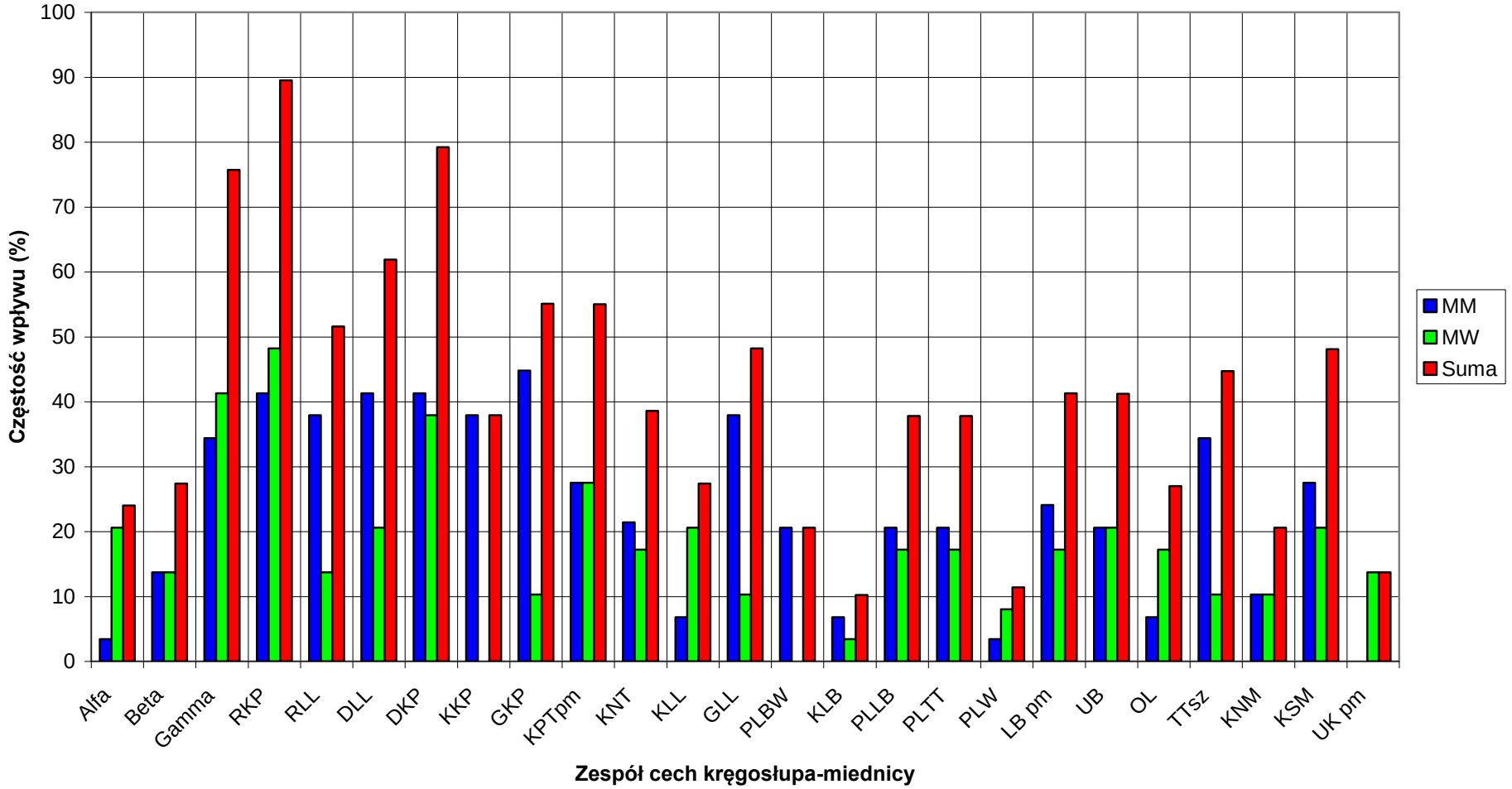
Characteristics of the spine-pelvis system which showed significant relationships with characteristics of feet (in decreasing order) were: width of the left foot, more rarely width of

the right foot, transverse convexity of the left foot, length of the second, height of the first arch of the right foot, height of the second and the third in the left foot, fifth toe varus deformity, height of the first arch in the left foot, more rarely: longitudinal arch of the left foot and surface of plantocontourogram of the right, more rarely: hallux valgus angle in both feet, fifth toe deformity angle and width of the first longitudinal arch of the right foot, length of the second arch of the left.

Of the characteristics analysed in the sagittal plane, the most significant relationship with the characteristics of feet were observed for the height of thoracic kyphosis, having effect on: fifth toe varus deformity angle in both feet, hallux valgus, transverse arch and width of the left foot, length of the first and fifth, width of the third and height of the second longitudinal arch of the right foot, height of the second and width of the fourth arch in the left foot. More rarely: angle of inclination of upper thoracic region, having effect on: fifth toe varus deformity, surface of plantocontourogram, length of the third and height of the second longitudinal arch of the right foot, transverse arch and width and height of the second and third, width of the first longitudinal arch of the left foot. More rarely: length of thoracic kyphosis, having effect on: transverse arch of both feet, fifth toe varus deformity, surface plantocontourogram, length of the fifth, height of the second and width of the third longitudinal arch of the right foot, length and height of the second arch of the left. More rarely: angle of thoracic kyphosis, having effect on: height of the first and second and width of the first arch of the right foot, transverse arch, height of the second and third arch and width of the left foot. More rarely: angle of body bent, having effect on: length of the first, second and fourth and height and width of the first arch of the right foot, heigh of the first one in the left foot. More rarely: angle of inclination of lumbosacral region of the spine, having effect on: width of both feet, angle of hallux valgus, height of the first and second longitudinal arch of the right foot, transverse arch of the left. Angle of lumbar lordosis, having effect on: width of both feet, angle of hallux valgus, height of the first and second longitudinal arch of the right foot, height of the second arch of the left. Length of lumbar lordosis, having effect on: width of the third longitudinal arch of the right foot, angle of fifth toe varus deformity, length of the first and height of the second and width of the left foot. More rarely: height of lumbar lordosis, having effect on: fifth toe varus deformity angle, length and height of the first and width of the left foot. Angle of thoracolumbar region inclination, having effect on: height of the first arch of the right foot, length of the fifth, height of the third and width of the left foot.

Of the characteristics analysed in the frontal plane, the most essential relationship with the characteristics of feet was observed for: height of the right angle of scapulae, affecting the length of the second and third and width of the fifth arch and width of the right foot, transverse arch, the second and fourth length and height of the third arch of the left foot. More rarely: angle of body inclination to the right, which significantly affects the length of the right and second arch and surface of plantocontourogram of the right foot, length and height of the first arch of the left foot. Asymmetry of height of waist triangles if the right one is higher affects: fifth toe varus deformity, length of the second and width of the first arch of the right foot, length of the second arch and width of the left foot. Distance from the left angle of scapula to the line of spinous processes, having effect on: width of the fourth and fifth arch and length of the right foot, height of the third and length of the fourth arch in the left foot. More rarely maximum distance from the spinous process to the left from their symmetrical curve, having effect on: transverse arch of the right foot, width of the second and third arch of the left foot.

Ryc. 1. Odsetek istotnych związków zespołu cech kręgosłupa-miednicy z cechami stóp w populacji chłopców obojga środowisk w wieku od 7 do 13 lat (n) MM=5033, MW=2476



Of the characteristics analysed in the transverse plane, significant relationships with the characteristics of feet was observed for: asymmetry of convexity of scapulae if the right one is more convex, having effect on: surface of plantocontourogram, width of the first and length of the second arch of the right foot, hallux valgus angle and height of the first longitudinal arch of the left foot. Angle of pelvis rotation to the left, having effect on: transverse arch of both feet, surface of plantocontourogram, height of the second and width of the right foot, width of the fifth arch of the left foot. More rarely: asymmetry of convexity of inferior angles of scapulae if the right one is more convex, having effect on length of the second arch and width of the right foot, hallux valgus angle and height of the first arch of the left foot.

Relationships between the characteristics of feet and spine-pelvis system

Boys, urban areas

The characteristics which showed significant relationships with the characteristics of spine and pelvis more frequently were (in decreasing order): width of the right foot, transverse arch of the right foot, more rarely: height of the second longitudinal arch of the right foot and width of the third arch of the left, more rarely: width and angle of fifth toe varus deformity, height of the first and second and width of the first, second and fourth arch of the left foot, Fig. 2.

Characteristics of feet showed more frequently relationships (in decreasing order) with: height of lumbar lordosis, height of thoracic kyphosis, depth of thoracic kyphosis and length of lumbar lordosis, angle of inclination of thoracolumbar region of the spine, length of thoracic kyphosis, angle of rotation to the right.

Of the characteristic of the left foot analysed, significant relationships with the characteristics of the spine-pelvis system were most frequently found for: width of the third longitudinal arch, having effect on: angle of inclination of thoracolumbar region, length and depth of thoracic kyphosis, height of lumbar lordosis, angle of body bent in sagittal plane, angle of inclination of pelvis to the left. More rarely: fifth toe varus deformity, having effect on: angle of inclination of thoracolumbar region of the spine, length, height and depth of thoracic kyphosis, length of lumbar lordosis. Height of the first and the second longitudinal arch, having effect on: length and height of thoracic kyphosis, height of lumbar lordosis, asymmetry of waist triangles if the right one is wider, angle of pelvis rotation to the left. Width of the first and second longitudinal arch has an effect on: angle of inclination of the thoracolumbar region of the spine, height and depth of thoracic kyphosis, height of lumbar lordosis, angle of inclination of the pelvis to the left. Width of the fourth arch, having affect

on: angle of inclination of the thoracolumbar region of the spine, length and depth of thoracic kyphosis, angle of body bent in the sagittal plane, angle of inclination of the pelvis to the left. More rarely height of the third longitudinal arch, having effect on: length and height of thoracic kyphosis, height of lumbar lordosis, angle of inclination of the pelvis to the left. Height of the fourth arch, having effect on: length and depth of thoracic kyphosis, height of lumbar lordosis, angle of inclination of the pelvis to the left. Height of the fifth arch, having effect on: angle of inclination of thoracolumbar region of the spine, height and depth of thoracic kyphosis, height of lumbar lordosis.

Of the characteristic of the right foot analysed, significant relationships with the characteristics of the spine-pelvis system were most frequently found for: width of foot, having effect on: angle of inclination of upper thoracic region, length and depth of thoracic kyphosis, length, depth and height of lumbar lordosis, angle of body bent to the right, angle of inclination of pelvis to the left. More rarely transverse arch, having effect on: angle of inclination of thoracolumbar region of the spine, length and depth of thoracic kyphosis, length of lumbar lordosis, asymmetry of convexity of angles of scapulae, distance of the left inferior angle of scapulae from the line of spinous processes. More rarely height of the second arch, having effect on: angle of inclination of thoracolumbar region of the spine, height of thoracic kyphosis, length of lumbar lordosis, angle of body bent in the sagittal plane, distance of the left angle of scapula from the line of spinous processes, asymmetry of convexity of angles of scapulae. Transverse arch of the foot, having effect on: angle of inclination of the upper thoracic region of the spine, length and height of thoracic kyphosis, length and height of lumbar lordosis, angle of body bent to the right. More rarely length of the first longitudinal arch, having effect on: angle of inclination of the thoracolumbar region of the spine, depth of thoracic kyphosis, asymmetry of height an length of waist triangle. Height of the first and second longitudinal arch, having effect on: height of thoracic kyphosis and lumbar lordosis, angle of body bent in the sagittal plane, and pelvis inclination to the left. Height of the fourth arch, having effect on: height of lumbar lordosis, asymmetry of height of inferior angles of scapulae, angle of body bent in the sagittal plane. Width of the first arch, having effect on: angle of inclination of thoracolumbar section of the spine, depth of thoracic kyphosis, height of lumbar lordosis, distance of the left inferior angle of scapula from the line of spinous processes. Width of the fourth and fifth arch, having effect on: length and height of lumbar lordosis, asymmetry of height of inferior angles of scapulae.

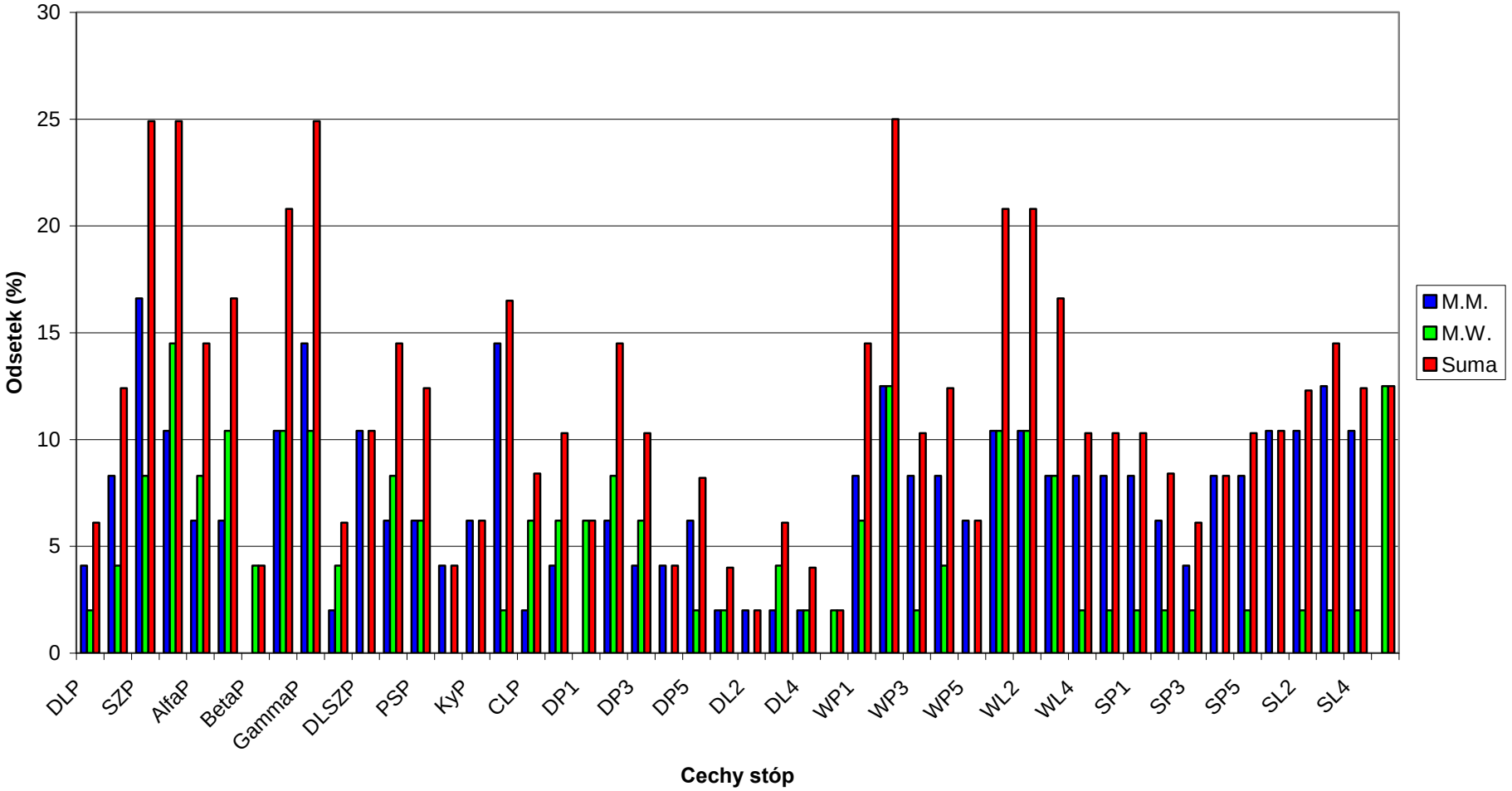
Boys, rural areas

Characteristics of feet that showed relationships with the characteristics of the spine-pelvis system were (in decreasing order): width of the left foot, height of the second longitudinal arch of the right foot and width of the fifth arch of the left foot, more rarely hallux valgus angle and fifth toe varus deformity angle in the left foot, transverse arch of the right foot, height of the first and second arch of the left foot, see Fig. 2.

The characteristics of feet showed relationships with (in decreasing order): length of thoracic kyphosis, length of lumbar lordosis and height of thoracic kyphosis.

Of the characteristic of the left foot analysed, significant relationships with the characteristics of the spine-pelvis system were most frequently found for: width of the the foot, having effect on: angle of inclination of thoracolumbar region, length and height of thoracic kyphosis, height of lumbar lordosis, angle of inclination of pelvis to the left, angle of body bent in the sagittal plane. Length of the second arch, having effect on: angle of inclination of the lumbosacral region of the spine, height of thoracic kyphosis, height and depth of lumbar lordosis, asymmetry of height of waist triangles and heights of inferior angles of the scapulae, maximum deviation of spinous processes to the left in their asymmetric pattern. More rarely width of the fifth longitudinal arch, having effect on: angle of inclination of the thoracolumbar region of the spine, length and height of thoracic kyphosis, asymmetry of height of inferior angles of the scapulae, angle of body bent in the sagittal plane. Hallux valgus angle, having effect on: angle of inclination of lumbosacral region of the spine, length and height of thoracic kyphosis, asymmetry of width of wast triangles, angle of body bent in the sagittal plane. Fifth toe varus deformity, having effect on: angle of inclination of thoracolumbar region of the spine, length, depth and height of thoracic kyphosis, height of lumbar lordosis. Height of the first arch, having effect on: angle of inclination of the thoracolumbar and upper thoracic regions of the spine, length and depth of lumbar lordosis, asymmetry of convexity of inferior angles of scapulae. Height of the second arch, having effect on: angle of inclination of thoracolumbar and upper thoracic region of the spine, length and depth of lumbar lordosis, angle of body bent to the right. More rarely transverse arch, having effect on: angle of inclination of thoracolumbar region of the spine, length and depth of thoracic kyphosis, asymmetry of waist triangles. Height of the third arch, having effect on: angle of inclination

Ryc. 2. Częstość istotnego związku cech stóp z zespołem cech kręgosłupa-miednicy w populacji chłopców w wieku od 7 do 13 lat obojga środowisk (n) MM=5933, MW= 2476



of the lumbosacral region, height of thoracic kyphosis, length and depth of lumbar lordosis.

Of the analysed characteristics of the right foot, significant relationships with the characteristics of the spine-pelvis system were most frequently found for: angle of inclination of the thoracolumbar region of the spine, height of thoracic kyphosis and lumbar lordosis, asymmetry of width of waist triangles, angle of pelvis rotation to the left. More rarely fifth toe varus deformity, having effect on: angle of inclination of thoracolumbar region of the spine, length and height of thoracic kyphosis, maximum deviation of spinous processes to the left in their asymmetric curve, angle of body bent in the sagittal plane. More rarely width of the right foot, having effect on: angle of inclination of the thoracolumbar region of the spine, length and depth of lumbar kyphosis, angle of pelvis rotation to the right. Hallux valgus angle, having effect on: angle of inclination of the thoracolumbar region of the spine, length of lumbar lordosis, asymmetry of convexity of inferior angles of scapulae, angle of body bent in the sagittal plane. Length of the second arch, having effect on: asymmetry of height of waist triangles, maximum deviation of the spinous processes to the left in their asymmetric curve, asymmetry of convexity of inferior angles of scapulae, distance of the left angle of inferior angle of scapulae from the line of spinous processes.

Discussion

Due to its load-bearing nature, human foot represents a body part which is strongly correlated with overall body built. Its shape has an effect on body posture and function of the whole human body [Wolański 1956]. The assumption adopted by Steinmetz [1984] concerning the existence of the simple effect of the foot on the shape of the spine seems to be at least disputable. This author suggested that, if the foot can be used for improving the shape of the spine, the spine should be also easily corrected by the foot. He also emphasized the legitimacy of using the corrective footwear, since the foot which is properly oriented in the shoe causes spine deformation. A pilot study carried by Drzał-Grabiec and Snela [18] in the population of girls and boys aged from 7 to 9 years found correlations between convexity of the longitudinal arch of the right and left foot, measured with the Clark's angle and length parameters that describe body posture. Our own studies [2012] carried out in the populations of girls and boys aged from 14 to 18 years demonstrated that relationships of parameters of foot and body in each age and gender groups should be considered as incidental and random. We found no logical regularities and the relationships between each other. The only observation was their mutual coexistence. Effect of characteristics of foot in the population studied most frequently concerns sagittal characteristics of body: inclination of the

thoracolumbar region and the upper thoracic region and height of thoracic kyphosis. Furthermore, a very significant effect on body bent in the frontal plane can be observed. Effect on depth of thoracic kyphosis, height and length of lumbar lordosis and asymmetry of height of scapulae and shoulders can be observed less frequently. The most essential effect on body characteristics in the population of boys was found for height and length of longitudinal arches of the left foot, while in the population of girls, this effect was found for width of the right foot, length of the right and left foot, height and length of longitudinal arches of the left foot.

The significant relationships found in the study cannot be used for any interpretations, since this might lead to rejection of other solutions during the scientific investigations, whereas the structure of the spine cannot be more important than the spine itself and the structure of the foot cannot be more important than the foot itself. The manifestations of relationships found in the study lead also to the certainty that some correlations do exist. The question remains: isn't it going to far when a researcher attempts to find correlations in areas where they are not logically justified or the correlations are random? Can such an observation be reliable in biomechanical terms and does it depend on the number of cases which were rejected as not proving the case.

Conclusions

1. Mutual relationships between characteristics of feet and spine-pelvis system are incidental and random.
2. No regularities and logical relationships were found between the parameters of the pelvis-spine system and feet. No mutual effect on each other can be observed and the only observation is their coexistence.

References

Adair I. i wsp., 1977, Moire topography in scoliosis screening, Clin. Ortop., No. 129, pp. 165 - 171.

Bibrowicz K.,2003, Powtarzalność wyników badań postawy ciała metodą komputerowej topografii moire'a i najczęstsze błędy w jej stosowaniu, IV Międzynarodowy Dzień Fizjoterapii, Wrocław.

Iwanowski W., 1992, Teoretyczne i praktyczne przesłanki standaryzacji krzywizn kręgosłupa, [W:] Ślężyński J. [red.], Postawa ciała człowieka i metody jej oceny, Katowice, pp. 189 – 191.

Jaskólski E., Śliwa W., 2003, Nieinwazyjne metody pomiaru i oceny postawy ciała człowieka, Fizjoterapia, No. 11, 2, App. 1.

Kabsch A., 1999, Biomechaniczne i biocybernetyczne podstawy ćwiczeń osiowo-symetrycznych według Hoppe, Wojewódzki Ośrodek Metodyczny, N. Sącz, pp. 11 – 18.

Kasperczyk T., 1983, Metody oceny postawy ciała, AWF Kraków.

Kovac V., Pecina M., 1999, Moiré topography in measurement of the sagittal curvatures of the spine, Coll Antropol. No. 23(1), 1999, pp. 153 - 158.

Kutzner–Kozińska M., 1986, Korekcja wad postawy, Wyd. II, WSiP, Warsaw.

Mrozkowiak M., 2010, Uwarunkowania wybranych parametrów postawy ciała dzieci i młodzieży oraz ich zmienność w świetle mory projekcyjnej, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra.

Nowotny J., 1992b, Fototopografia z wykorzystaniem rastra optycznego i komputera jako sposób oceny postawy ciała, Postępy Rehabilitacji, No. 1 (6), pp. 15 - 23.

Prętkiewicz-Abacjew E., Wróblewska A., Zajt-Kwiatkowska J., Rogo B., Zeyland-Malawka E., 2001, Spostrzeżenia i uwagi dotyczące oceny postawy ciała na podstawie badania metodą fotogrametryczną, Pediatria Polska, LXXVI, No. 9, pp. 643 - 650.

Przewęda R.,1962, Przegląd ważniejszych metod oceny postawy ciała. Roczniki Naukowe, University of Physical Education in Warsaw, vol. 1.

Steinmetz M., 1984, Le pied, le rachis, la course et lachaussure, Medicine du Sport, vol. 58, 1, 34-45.

Stokes I.A.F, Pekalsky J.R., Moreland M.S., 1987, Surface topography and spinal deformity. Proceedings of the 4-th International Symposium. Gustaw Verlag, New York.

Świerc A., 2006, Komputerowa diagnostyka postawy ciała – instrukcja obsługi, Czernica Wrocławska.

Takasaki H.,1998, Moiré topography, Appl. Optics, No. 9, pp. 1467 - 1472.

Wolański N., 1956, Postawa ciała a funkcjonowanie organizmu człowieka, Kultura Fizyczna, No. 10, pp. 737-743

Wong H.K., 1997, Direct spinal curvature digitization in scoliosis screening - a comparative study with Moiré, Spinal Disord, No. 10 (3), pp. 185 – 192.

Zawieska D., 2003, Rozprawa doktorska. Badanie przydatności techniki mory projekcyjnej w fotogrametrycznych pomiarach deformacji kręgosłupa, Politechnika Warszawska, Warsaw.

Drzał-Grabiec J., Snela S., 2012, Spinal curvatures and foot defects in children: an experimental study, Spine, 36-47.