

EDUCATION VS. WELLNESS
CHAPTER XXIV

"Akton"
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Description of differences in the length and width of the left and right foot burdened with its weight with reference to males and females at the age from 4 to 18 presented in percentages in the light of projection moiré

In the Polish society the percentage of occurrence of different posture defects is high. Any spatial asymmetries within the region of the spine—pelvis among children and youth are of particular concern. The reason for this is usually found in bad postural habits, sedentary mode of living, low level of health education.

The osseous system is a passive element of the locomotor system. Its external and internal architecture ensures the support of the body weight and adjustment of the foot to any changes of surfaces and burdens.

The foot cavity is formed in the about 3rd-4th year of life at the time of intensive development of bony frame in the period of the first three years. In the about 4-5th year the foot reaches the length twice greater than at the time of birth, the width doubles in the about 6-7th year of life. At the age of 6 prominently formed foot cavity can be noted, which indicates the existence of both arches – the transverse and longitudinal ones. The foot shape is subject to lengthening at the age of 8, and afterwards it becomes wider. At the age of 7-8 the coefficient of the foot width quickly increases, which is connected with its firmer arch. After the 8th year of life, a certain lowering of arch takes place; however, after the puberal peak the foot rises again [10].

In the Polish publications there are many papers assessing the condition of children and youth's body posture in various age groups and various selections of analysed characteristics. In view of the variety of applied methods, it is difficult to compare the obtained research results. However, certain regularities and general tendencies of changes at the successive stages of ontogenetic development manage to be reflected in them. Nadolska [5] states that with time a foot changes from a wide and short one in newborns into a more balanced one in elder children. In the ontogenetic respect, researching the structure and arch of foot has

been undertaken, among others, by Lebioda [1], Łuba [2], Wolański [9]. Siemienova [4] notices that from the 10th week of foetal life to the 2nd year of life there occur the greatest morphological and physiological changes of foot. However, the time of the most intensive functional and anatomic changes is the time of assuming of two-legged erect position by man and learning to walk. The research carried out by Nadolska [5] shows that the female left foot is characterised by a greater measurement than in the case of the right foot.

Irregularities as regards lower limbs constitute considerable percentage of posture defects diagnosed by means of screening tests. This may result in defects and overloads in the area of spine. The asymmetry of foot structure, walking, pelvis position and scoliosis of the spinal segment is a logical cause-and-effect which may finally lead to double-curve scoliosis. Early diagnostics is one of the significant elements of prophylaxis and treatment of posture defects. The research carried out by Nadolska [5] shows that the male left foot is characterised by a greater measurement than in the case of the right foot. The research carried out by Ignasiak and collaborators [1995], Demczuk – Włodarczyk [2003] shows that in boys this occurs in the period between the 12th and a half to 13th year of life. Tanner [8] states that the length and width of foot in boys increase up to the 18th year of life.

The paper aims at the analysis of the percentage of differences in the length and width of feet burdened with their weight in the male and female population at the age from 4 to 18 in the light of projection moiré.

SUBJECTS AND RESEARCH METHODOLOGY

The research covered the population of 9804 females and 8699 males at the age from 4 to 18 from randomly selected nursery and other schools in the Warmińsko-Mazurski region, table 1. The statistical analysis covered only these research results where the doctor had not diagnosed any considerable posture defects.

The research methodology covered the measurement of the percentage of differences in the length and width between homonymous feet: R.dł.lw%K- the difference in the foot lengths when the left one is longer in females, M – in males, R.dł.pw%K- the difference in the foot lengths when the right one is longer, R.sz.lw%K- the difference in the foot widths when the left one is wider, R.sz.pw%K- the difference in the foot widths when the right one is wider.

For the purpose of the assessment of the selected parameters, the attitude towards a computer assessment of posture, with the application of projection moiré technique- Posturemeter M, was used. The methodology and technique of research are in agreement with the generally adopted and described rules [Mrozkowiak 2008]. The measuring position consists of a computer, graphic card, program, monitor and printer, projection and receiving device with a camera for measuring feet. Procuring a spatial image is possible only thanks to projecting a line with precisely specified parameters on a child's feet. The lines falling on feet become subject to distortions depending on the surface configuration. Thanks to the application of object glass, the image of a person subject to research can be received through a special optical system with a camera, and then transmitted to the computer monitor. The distortions of the line image are entered in the computer memory, and then they are processed by a numerical algorithm into a layered map of the researched surface [Świerc 2006].

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The obtained image of the foot surface enables the interpretation of body posture in many respects. The accuracy of measurement and the analysis of the registered spatial parameters account for the possibility that the drawn conclusions may differ from the ones which have been published so far. The most significant factor in this method is the simultaneity of measurement of all real values of the spatial positioning of particular foot segments.

The achieved results were prepared statistically, determining the average value, standard deviation, variation coefficient, minimum and maximum value. All the researched features were statistically described. The distribution of variables was normal.

ACHIEVED RESULTS

The research results have been presented graphically. Diagram 1 presents the course of changes in the percentage of differences in the length and width between the left and right foot of females, diagram 3 refers to males. Diagram 2 presents average values of the percentage of differences in the length and width of feet of both sexes.

Females

The curve of the percentage of length differences in feet when the right foot is longer (R.d.l.pw%K) is not highly diversified. It starts from the value of 1%, it increases to 2.18% in the 12th year of life, and it reaches its minimum in the 18th year, i.e. 2.4%, after the decrease of the difference to 1.53% in the 17th year of life. In the period from the 4th to 12th year of life it shows a constant growing tendency, and then the difference value falls to the 17th year, and it increases in the 18th year.

The curve of the length differences in feet when the left foot is longer (R.d.l.lw%K) is not highly diversified either. It starts from the value of 0.34% taking lower and lower values up to the 13th year of life (0.05%), and then they increase up to the 17th year (0.32%), and next they drop to 0 in the 18th year of life. The greatest percentage of difference in the foot length occurs in the 14th year of life (2.18%).

The curve of the width differences in feet when the right one is wider (R.sz.pw%K) is diversified. It starts from the value of 1.42%, and it reaches its maximum in the 12th year of life, i.e. 4.77%, and it finishes with the difference of 4.24%. In the period from the 4th to 6th year of life the width difference in feet increases, up to the 8th year it decreases to grow gradually to the 12th year, and next it falls up to the 14th year of life, and it grows to the 16th year, and it finally takes the value of 4.24% in the 18th year of life.

The curve of the width differences in feet when the left one is wider (R.sz.lw%K) is also diversified. It starts from the value of 2.67 mm, and it reaches its minimum in the 12th year of life, i.e. 1.14%, and it finishes with the difference of 1.71%. In the period from the 4th to 6th year of life the width difference in feet decreases, up to the 8th year of life it increases to reach its lowest value in the 12th year, and next it rises up to the 14th year, and it drops to the 16th year, and it finally takes the value of 1.71% in the 18th year of life.

Males

The curve of length differences in feet when the right foot is longer (R.dł.pw%M) is little diversified. It starts from the value of 1.44%, and it increases to 2.28% in the 12th year of life, and reaches its final value in the 18th year, i.e. 2.18%, after the decrease of difference to 1.57% in the 17th year of life. In the period from the 4th to 12th year of life it shows a constant growing tendency, and then the difference value falls up to the 17th year, and it increases in the 18th year.

The curve of length differences in feet when the left foot is longer (R.dł.lw%) is the least diversified. It starts from the value of 0.19% taking lower and lower values up to the 12th year of life (0.2%), and then they increase up to the 17th year of life (0.32%), and next they drop to 0 in the 18th year of life.

The greatest difference in the foot lengths occurs in the 12th year.

The curve of the width differences in feet when the right one is wider (R.sz.pw%) is diversified. It starts from the value of 1.64%, and it reaches its maximum in the 12th year of life, i.e. 4.1%, and it finishes with the difference of 2.36%. In the period from the 4th to 5th year of life the width difference in feet increases, up to the 7th year it decreases to grow gradually to the 12th year, and next it falls up to the 14th year, and it grows to the 15th year, and it finally takes the value of 2.36% in the 18th year of life.

The curve of the width differences in feet when the left one is wider (R.sz.lw%) is also diversified. It starts from the value of 3.17 mm, and it reaches its minimum in the 12th year of life, i.e. 1.06%, and it finishes with the difference of 2.06%. In the period from the 4th to 5th year of life the difference of the width percentage in feet decreases, up to the 7th year of life it increases to reach its lowest value in the 12th year, and next it rises up to the 14th year, and it drops to the 18th year and finally takes the value of 2.06%.

The curves of differences in the length and width of feet in the population of both sexes have a similar course to the changes occurring within the analysed sex.

The curve of length differences in feet when the right foot is longer (R.dł.pw%) is diversified. It starts from the value of 1.52%, and it reaches a high value in the 12th year of life, i.e. 2.15%, then it falls to 1.55% in the 17th year and finishes with the difference of 2.26%. In the period from the 4th to 12th year of life it shows a constant growing tendency, and then the difference value falls up to the 17th year, and it finishes with the maximum value of 2.26% in the 18th year of life.

The curve of length differences in feet when the left foot is longer (R.dł.lw%) is little diversified. It starts from the value of 0.27% taking lower and lower values up to the 13th year of life (0.09%), and then they increase up to the 17th year of life (0.32%), and next they drop to 0 in the 18th year of life.

The curve of the width differences in feet when the right one is wider (R.sz.pw%) is diversified. It starts from the value of 1.53%, and it reaches its maximum in the 12th year of life, i.e. 4.45%, and it finishes with the difference of 3.02%. In the period from the 4th to 6th year of life the difference of the width percentage in feet increases, up to the 8th year it decreases to grow gradually to the 12th year. Next it drops to the 14th year of life, increases up to the 16th year, and it finally reaches the value of 3.02% in the 18th year.

The curve of the width differences in feet when the left one is wider (R.sz.lw%) is also diversified. It starts from the value of 2.92%, and it reaches its minimum in the 12th year of life, i.e. 1.1%, and it finishes with the difference of 1.94%. In the period from the 4th to 6th

year of life the width difference in feet decreases, up to the 7th year it increases to reach its lowest value in the 12th year. Next it grows to the 14th year of life, decreases up to the 16th year, and it finally reaches the value of 1.94% in the 18th year.

DISCUSSION

On the basis of available scholarly publications no material presenting the analysis of the foot parameters achieved from the assessment with the application of projection moiré and percentages has been found.

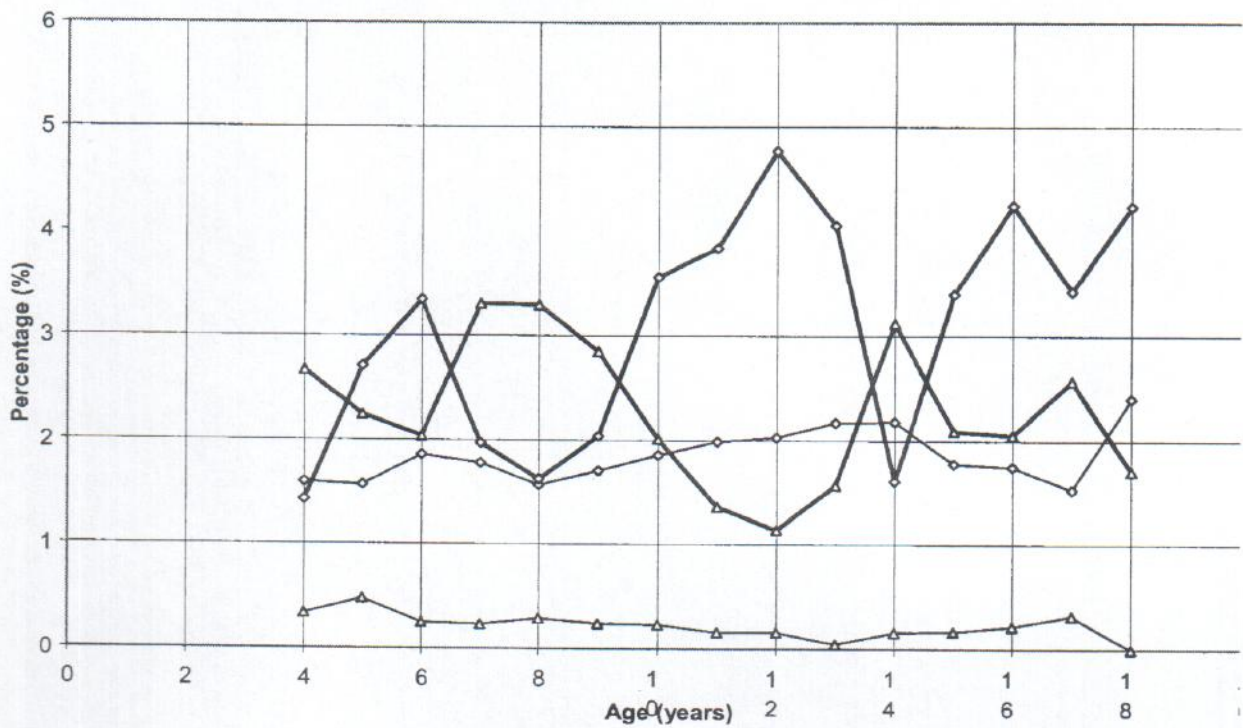
CONCLUSIONS

1. In the population of males and females the changes in the percentage of differences in the width and length of feet are as if reflected in a mirror.
2. If the left foot is wider and longer, the percentage of the asymmetry of both measurements is smaller than in the situation when the right foot is wider and longer.

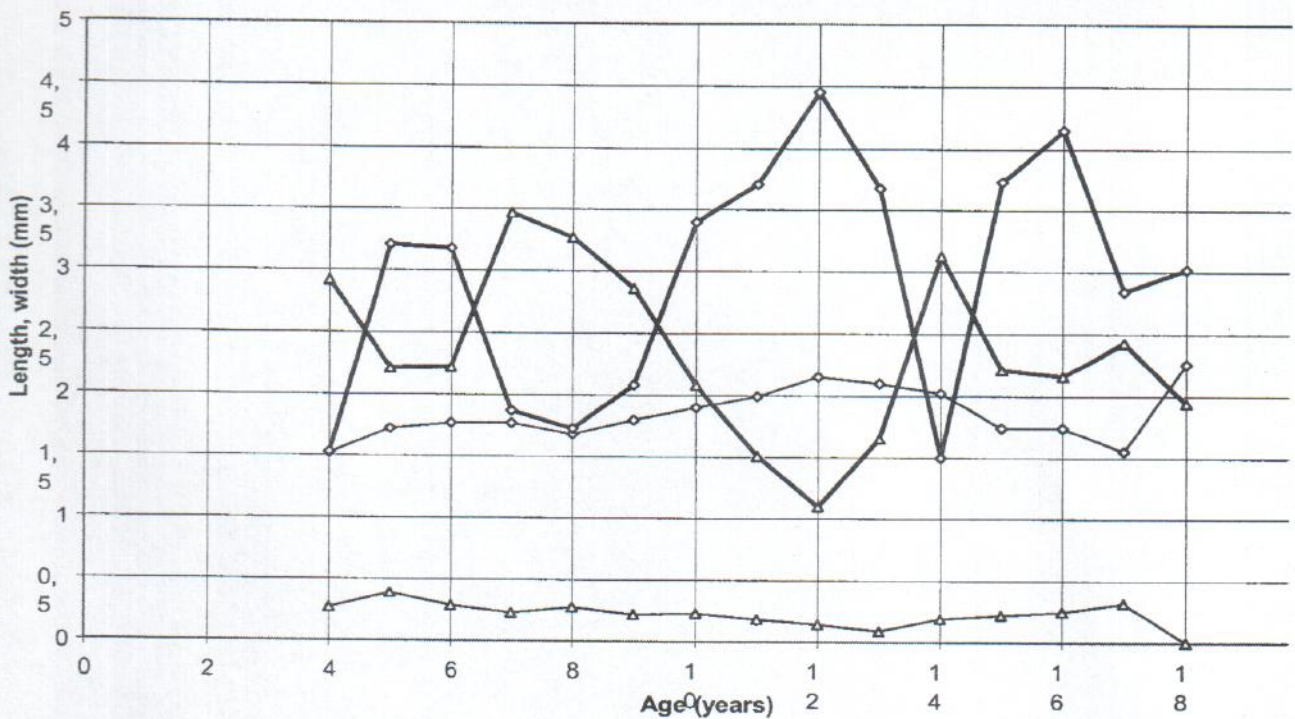
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Diag. 1 Course of changes in the percentage of differences in the length and width between the left and right fc in female population at the age from 4 to 18 (n) 9804



Diag. 2 Course of changes in the percentage of differences in the length and width between the left and right in the population of both sexes at the age from 4 to 18 (n) 18503



Description of differences in the length and width of the left and right foot burdened with its weight with reference to males and females at the age from 4 to 18 presented in percentages in the light of projection moiré

Table 1 Human material, age, body weight and height

Age	F			M		
	Quantity	B.W.	B.H.	Quantity	B.W.	B.H.
4	95	19.1	111.0	104	19.5	109.5
5	196	21.0	113.8	206	20.1	113.0
6	269	22.5	117.3	263	21.7	118.4
7	610	26.42	121.0	597	23.21	127.93
8	1341	26.42	128.28	1255	28.0	130.23
9	1839	30.14	132.87	1677	31.34	134.47
10	1752	35.11	138.26	1542	35.11	139.84
11	1047	41.95	145.0	901	42.48	145.37
12	670	44.77	151.84	549	43.61	151.7
13	569	46.47	157.2	462	48.45	157.52
14	582	52.56	162.24	436	54.25	165.42
15	424	55.25	165.18	355	59.82	169.81
16	108	55.4	162.4	83	58.8	167.7
17	134	57.0	164.7	123	64.0	171.0
18	168	61.3	166.7	146	70.0	175.4
Total	9804			8699		

Source: own research

Legend:

B.W. – average value of body weight; B.H. – average value of body height; F – females; M – males

ABSTRACT

The foot shape is subject to lengthening at the age of 8, and afterwards it becomes wider. At the age of 7-8 the coefficient of the foot width quickly increases, which is connected with its firmer arch. After the 8th year of life, a certain lowering of arch takes place; however, after the puberal peak the foot rises again. The analysis of the percentage of differences in the length and width of feet burdened with their weight in the male and female population at the age from 4 to 18 in the light of projection moiré. The research covered the population of 9804 females and 8699 males at the age from 4 to 18 from randomly selected nursery and other schools in the Warmińsko-Mazurski region. The research methodology covered the measurement of the percentage of differences in the length and width between homonymous feet. For the purpose of the assessment, the attitude towards a computer assessment of posture, with the application of projection moiré technique- Posturemeter M, was used. The research results have been presented graphically. Diagram 1 presents the course of changes in the percentage of differences in the length and width between the left and right foot of females, diagram 3 refers to males. Diagram 2 presents average values of the percentage of differences in the length and width of feet of both sexes. 1. In the re-

Education vs. wellness

searched population of males and females the changes in the percentage of differences in the width and length of feet are as if reflected in a mirror. 2. If the left foot is wider and longer, the percentage of the asymmetry of both measurements is smaller than in the situation when the right foot is wider and longer.