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# *Description of foot longitudinal arch burdened with its weight on the basis of female population at the age between 4 and 18 in the light of projection moiré*

Aches in lower limbs during walking are already felt by preschool children. They are manifested by ailments in feet and calves. One of the reasons may be flatness and valgity of feet. Along with the development of this defect, the efficiency of lower limbs decreases, ache and fatigability appear which often result in changes in knee and hip joints, and in spine. The efficiency of feet may influence a body posture and quality of walking, and any deviations from the foot optimal arch may be reflected in pathogenesis of chronic illnesses in other parts of body.

All the components of the longitudinal arch in individual development show a similar tendency. The longitudinal arch emerges at the pre-school age. The height of its construction increases in the direction of medial margin of foot and despite the fact it is burdened with its own body weight, this system is usually prominent. An exception are the youngest children whose foot sole is lined with fatty tissue, and people with defects of the longitudinal arch. In the period of progressive development of human the height of the arch increases, and the intensity of the development is diversified and depends on static-dynamic conditions, lateralization, age, sex, and the arches being taken into consideration (Demczuk-Włodarczyk 2003).

The research carried out by Więcław (2003) showed the correlation between a general degree of physical development, constitution type and sex of the research subjects, and indexes determining the state of the foot arches.

The research aims at the determination of the course of changes in the foot longitudinal arch on the basis of female population at the age between 4 and 18 of the Warmińsko-Mazurski region.

## SUBJECTS AND RESEARCH METHODOLOGY

The research covered the population of 9804 females at the age between 4 and 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 did not diagnose any considerable posture defects.

The research methodology covered the measurement of the foot longitudinal arches by means of Clarke's angle and Ky coefficient. However, Clarke's angle was regarded as more reliable. For the purpose of the assessment, the attitude towards a computer assessment of posture, with the application of projection moire technique - Posturometer M, was used. The research methodology and technique were in agreement with generally adopted rules (Mrozkowiak 2008). The obtained results in the form of dimensional, graphic image allowed describing in numbers the parameters subject to research. The obtained research results were prepared statistically, determining the average value, standard deviation, variability coefficient, minimum and maximum value. The distribution of variables was normal.

## ACHIEVED RESULTS

The research results have been presented graphically. Diagram 1 presents the course of changes in average values of Clarke's coefficient with reference to longitudinal arch of the left and right foot for female sex and for both sexes, diagram 2 – Ky coefficient.

The curve reflecting average values of Clarke's angle of the left foot shows a constant growing tendency from the 5th year of life: 28.86 degrees up to the 12th year of life: 37.57 degrees, then up to the 14th year of life its value starts decreasing: 31.26 degrees, and in the 18th year of life it takes the maximum value of 39.02 degrees. The average values of the right foot in the 5th year of life show a value which is very similar to the one of the left foot: 28.59 degrees, and next up to the 12th year of life it increases taking the value of 34.29 degrees. In the 14th year of life it lowers its level to 28.53 degrees, and next up to the 18th year of life it increases taking the maximum value of 37.74 degrees.

The curve reflecting the average values of Clarke's angle in the population of both sexes is very similar to the curve of respective female population in the age bracket subject to the analysis.

The curve reflecting the average values of Ky coefficient for the left foot shows a constant fall of arch from the 4th year of life: 0.52 to 0.33 in the 12th year of life, next in the 14th year of life it reaches a higher value: 0.39, and then it falls to 0.37 in the 16th year of life, and in the 18th year of life it increases to the level of 0.42. The average values for the right foot from the 4th to the 7th year of life are at the following level: about 0.5, and then they lower their value up to the 10th year of life: 0.33, and next they increase to 0.44 in the 14th year of life and fall in the 16th year of life to 0.41, reaching the maximum value in the 18th year of life: 0.51.

The curve reflecting the average values of Ky coefficient in the population of both sexes is very similar to the curve of respective male population in the age bracket subject to the analysis.

## DISCUSSION

The research carried out by Lizis and collaborators (1996) showed that the average Clarke's angle measured with the plantographic method in 6-year-old girls was at the level of 35.8 degrees for the right foot, and 36.5 degrees for the left one. In the group of 7-9-year-old girls Hagel (2006) noted Clarke's angle of the right foot at the level from 55 in 18.75%, from 54 to 42 degrees in the case of 25.0% of the children subject to research, and from 41 to 20 degrees in the case of 56.25% of the subjects, as regards the left foot respectively 12.5%, 18.75%, 68.75%. In the group of 10-12-year-old girls in the right foot respec-

tively: 0%, 17.85%, 82.15%, in the left one 0%, 14.28%, and 85.72%. Matuszewska (2001) noted in the population of 10-year-old girls Ky coefficient of the right foot within the standard range in the case of 12% of the subjects, in accord with the standard in the case of 52%, above the standard in 36%. In the left foot respectively: 16%, 46%, 38% of the subjects.

The research carried out by Makarczuk and Dudkiewicz (2004) shows that longitudinal arch of the left foot, measured by Ky coefficient, more often holds lower values than in the case of the right foot, and Clarke's angle clearly increases with age. Also, a significant increase in the frequency of occurrence of lowered and flat feet was noticed (in accord with Ky) between the 10th and 11th year of life. The research carried out by Ignasiak (1995) and Lizis (2000) shows that between the 12th and 14th year of life occurs a temporary, puberal arrest of the foot arch development.

The research carried out by Makarczuk and collaborators (2003) shows that in the case of girls the left feet display lowered longitudinal arches more often than the right feet. The research carried out by Nowicki G. and Nowicki R. (2004) showed that in the case of female nurses and officials the most frequently occurring foot defect is platypodia, and deviations in the construction of feet of the women subject to research concern the left limb to a greater extent than the right one. The research carried out by Kasperczyk and collaborators (1999) confirms the hypothesis that the intensive development of medial longitudinal arch of foot falls in the period short after assuming of erect position and in the following years. Annual average increments of Clarke's angle showing the lifting of longitudinal arch for children at the age from 3 to 6 are over 5 degrees, for the age from 7 to 10 only a little over 1 degree. The research does not confirm the belief that platypodia is a common phenomenon. 129 persons, 20%, were regarded in danger of platypodia, and about 10% of persons had flat feet.

The research carried out by Więcław B. (2004) showed that longitudinal foot arch of village children described by Clarke's angle coefficient and Ky coefficient presented with average values fell in the range of values regarded as physiological in contrast to children from Szczecin where average values were lower in relation to the range of correct values. Moreover, among village children there was a higher percentage of correctly arched feet than in the case of children living in towns. The research also showed sexual dimorphism confirmed by Student's t-test with reference to the average values of Ky coefficient.

The measurements of the foot longitudinal arches, Clarke's angle and Ky coefficient do not fully confirm the research results of other authors.

## CONCLUSIONS

1. Foot longitudinal arch in the case of girls measured by means of Clarke's angle increases from the 5th to the 12th and from the 14th to the 18th year of life. In the period of sexual maturation from the 12th to the 14th year of life the foot arch is subject to lowering.
2. The longitudinal arch of the right foot in the case of girls measured by means of Ky coefficient increases to the 12th year of life; then, up to the 18th year of life it shows a steady falling tendency.

3. The right foot arch measured by means of Clarke's angle and Ky coefficient is greater than the left foot arch.

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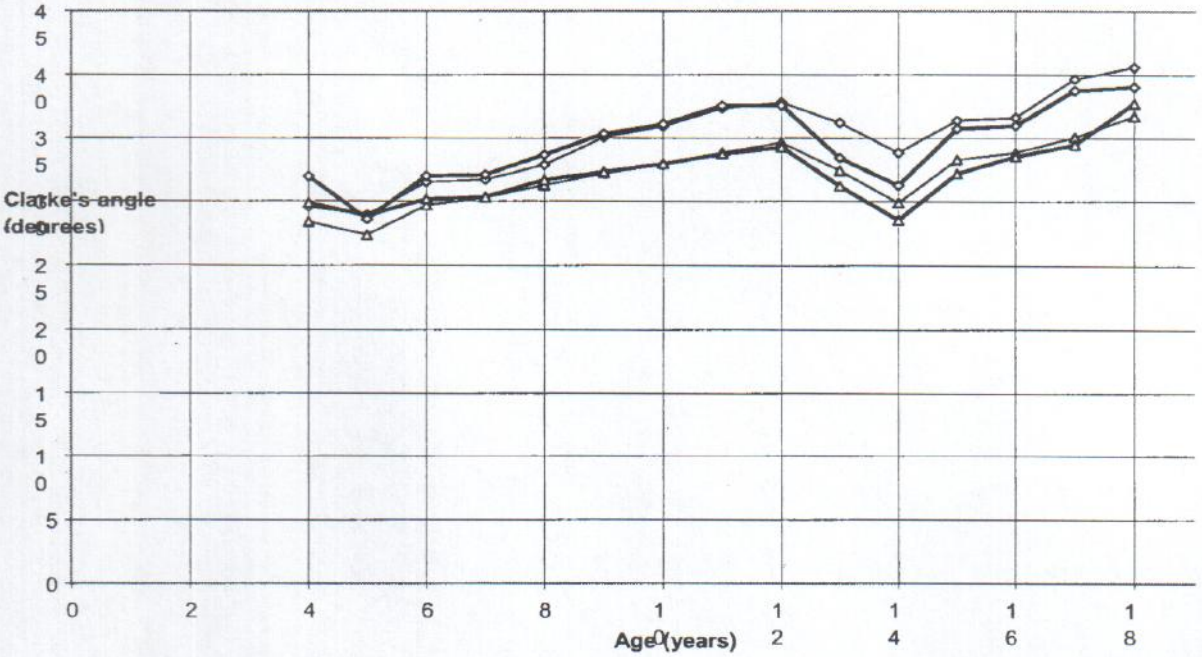
**Diag.1 Course of changes in average values of Clarke's angle of feet in female population and both at the age from 4 to 18 lat (n) K=9804, 18503**




**Diag. 2 Course of chan ges in average values of Ky coefficient of feet in female population and at the age from 4 to 18 lat (n) K=9804, 18503**

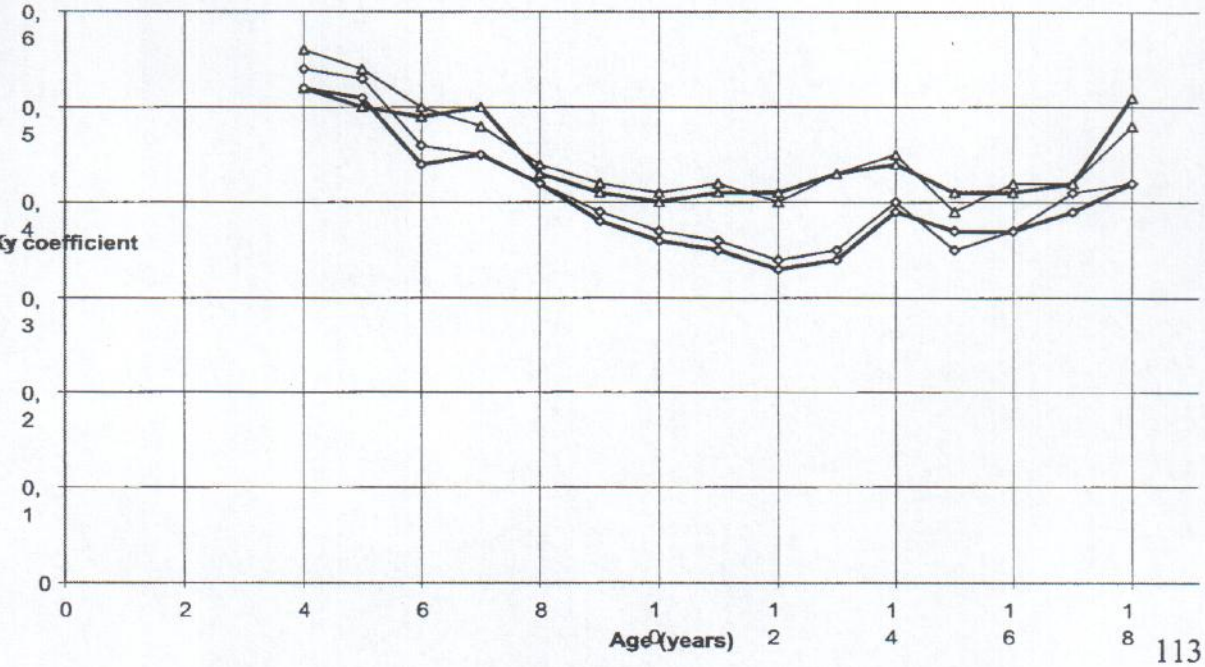


**Table 1 Human material, age, body weight and height**

| Age | Quantity | B.W. | B.H. |
|---|---|---|---|
| 4 | 95 | 19,1 | 111,0 |
| 5 | 196 | 21,0 | 113,8 |
| 6 | 269 | 22,5 | 117,3 |
| 7 | 610 | 26,42 | 121,0 |
| 8 | 1341 | 26,42 | 128,28 |
| 9 | 1839 | 30,14 | 132,87 |
| 10 | 1752 | 35,11 | 138,26 |
| 11 | 1047 | 41,95 | 145,0 |
| 12 | 670 | 44,77 | 151,84 |
| 13 | 569 | 46,47 | 157,2 |
| 14 | 582 | 52,56 | 162,24 |
| 15 | 424 | 55,25 | 165,18 |
| 16 | 108 | 55,4 | 162,4 |
| 17 | 134 | 57,0 | 164,7 |
| 18 | 168 | 61,3 | 166,7 |
| In total | 9804 | | |

Source: own research

Legend: B.W. – average value of body weight; B.H. – average value of body height.


## ABSTRACT

The efficiency of feet may influence a posture and quality of walking, and any deviations from the foot optimal arch may be reflected in pathogenesis of chronic illnesses in other parts of body. Determination of the course of changes in the foot longitudinal arch on the basis of female population at the age between 4 and 18 of the Warmińsko-Mazurski region. The research covered the population of 9804 females at the age between 4 and 18 from randomly selected nursery and other schools in the Warmińsko-Mazurski region. The research results have been presented graphically. Diagram 1 presents a course of changes in average values of Clarke's coefficient with reference to longitudinal arch of the left and right foot for female sex and for both sexes, diagram 2 – Ky coefficient. 1. Foot longitudinal arch in the case of girls measured by means of Clarke's angle increases from the 5th to the 12th and from the 14th to the 18th year of life In the period of sexual maturation from the 12th to the 14th year of life the foot arch is subject to lowering. 2. The longitudinal arch of the right foot in the case of girls measured by means of Ky coefficient increases to the 12th year of life; then, up to the 18th year of life shows a steady falling tendency. 3. The right foot arch measured by means of Clarke's angle and Ky coefficient is greater than the left foot arch.