DESCRIPTION OF THE PLANTOCONTUROGRAMS SURFACES OF FEET AMONG CHILDREN AND YOUTH AGED 4–18 IN CONDITIONS OF BURDENING WITH THEIR BODY MASS, IN THE LIGHT OF THE PROJECTION MOIRÉ

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ABSTRACT

Human feet fulfill a locomotor and static function throughout the whole human life – in our civilization; they are characterized by the restricted possibilities of muscle work and joint movements resulting from wearing of shoes and walking on a flat surface, and also due to the technological advancement lowering the need for physical activity. This may lead to insufficiency, static deformations and the problems of pain in the feet. Aim. The description of the differences in plantoconturograms of feet in women and men in in conditions of burdening with their body mass. Materials and methods. The study encompassed the population of 9804 females and 8699 males, aged 4–18 from randomly chosen kindergartens and schools of Warmia-Mazury region. For the evaluation, a computer stand for posture evaluation was used by the technique of projection moiré with Posture-meter M. Results. The results were elaborated on graphically. In Fig.1 and 3 the course of the changes of the mean differences of plantoconturograms of left and right foot respectively for male and female sex, and in Fig 2 and 4 in the percentage perspective are all presented. Conclusions. 1. In the studied age range of the children and youth, in case of a larger surface of the plantoconturograms of the left foot, the differences are bigger than in the situation when the right foot has a greater surface. The values of differences in the population of both sexes are approximate. 2. In female and male populations, the differences in left and right surface of the foot have a symmetrical distribution. In the percentage perspective, the differences are intensified

from 9–14 and in the male population they grow abruptly starting from 17 year of age.

INTRODUCTION

Contemporary existence conditions – apart from life facilities- carry on numerous threats to a normal posture-genesis. The intended changes in the natural environment and lifestyle, restricting of natural needs determine changes not only in the psychological dimension but also in somatic dimension. Fragmentary selection of stressors allows to some extent conscious formation of shaping up individual physical attitudes. These attitudes condition the efficiency of many organs and systems. The substantial element of the proper posture is the quality of the lower extremities with the formation of their most dynamic part-the feet.

Human feet, fulfill the locomotor and static function through all human life – in our civilization; they are characterized by the restricted possibilities of muscle work and joint movements resulting from wearing shoes and walking on a flat surface, and also due to the technological advancement lowering the need for physical activity. This may lead to insufficiency, static deformations and the problems of pain in the feet [Zeyland-Malawka, Nowakowski 2002].

A foot as an important static-dynamic element of the lower extremity is especially susceptible to factors causing deviations from the standard. Disregarding genetic conditioning and the consequences of the suffered diseases, the foot may be deformed by: inadequate shoes, a long stay in stato-dynamic standing position, overburdening, and improper nutrition, walking on a hard and barely differentiated surface. The consequence is numerous deformations and pain problems intensified with time and workload.

A major role in the upkeep of the arch of the foot is played by the posterior tibial muscle, which contains the talonavicular joint. It preserves to maintain adequate anatomical conditions and the distribution of the pressure forces. The insufficiency of the muscle leads to relaxation of the joint, in the effect of which the head of the talus bone loses support on navicular bone and it slides medially and plantar way, in this way increasing the plantoconturogram surface of the foot. All the architecture deteriorates. The effect of that is the disturbance of the distribution of the pressure forces. The morphological differentiation pertaining to the male and female foot, during individual's development, does not intensify in the equal rate; it is most distinct after the sexual maturation period. The age of the radical change, in which the development of the

foot growth is fats, is only similar in the terms of surface, and is at the 10th year of life, and the time of development completion comes at 20 year of life and comes 3 years later than in girls development. Boys' foot is generally bigger than the foot of girls and the difference depends on age. When we speak about the surface at the age of 3, it is 200mm^2. In the years of 4–7, substantial differences are not confirmed; however since the age of 7, the dimorphism in this range is already statistically significant. At the age of 20, man's foot is characterized by a larger surface of about 300 mm^2 [Demczuk-Włodarczyk 2003].

The purposefulness of shaping up the feet and the soil surface, sticking to the background in the early period of ontogenesis has been a subject of research of many authors [Godunow 1981, Niedzielski 1992, Zeyland-Malawka, Nowakowski 2002]. One cannot, however, uniformly indentify the size of the foot surface adhering to the background with the degree f its shaping up. The purpose of the study was the description of the d ferences in plantoconturograms of feet in women and men in in co tions of burdening with their body mass.

Tab. 1 Human material, age, weight and body height

	W			M		
Age	No	M.B.W	M.B.H.	No	M.B.W	M.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
Sum	9804			8699		

Source: self-research. Legend: M.B.W – mean body weight; M.B.H. – mean body height; W – women; M – men

MATERIALS AND METHODS

The study encompassed the population of 9804 women and 8699 men aged 4–18 from randomly chosen kindergartens and schools of Warmia-Mazury region. Statistical analysis encompassed only the study results of those in whose case the doctor did not confirm the significant defects in posture. Methodology of the study relied on the measurement of the foot plantoconturogram. For the evaluation, a computer stand for posture evaluation was used by the technique of projection moiré with Posturemeter M. The methodology and technique of the study was consistent with generally accepted norms [Mrozkowiak 2008]. Obtained results in the form of the spatial, graphic image allowed to describe using numbers the following parameters: Diff left-the value of the difference of feet surface in case of a larger surface of the left foot, Diff right- the value of the difference of feet surface in case of a larger surface of the right foot, Diff left% – the percentage of the difference values of feet surface in case of a larger surface of the left foot, Diff right% – the percentage of the difference values of feet surface in case of a larger surface of the right foot. Letter F- female population, letter M- male population. The obtained results were elaborated on statistically. The variables distribution is normal.

RESULTS

The difference in plantoconturograms surface was confirmed both in the male and female population. In female population, the greatest differences in the case of the bigger surface of the left foot occurred at the age ranges of 7–10 and 12–17 and they are in the ranges of 170 to 210 mm^2, while the right one at 11–12 year of life in the ranges of 70 – 80 mm^2. Considering the biggest percentage differences, the prevalence of the surface of the left foot occurs in 10 iand13 year of life in the ranges of 60–80%, when speaking about right foot-the differences are negligible , in the ranges of 5%. In male population, the greatest differences in case of the left foot surface occur in age ranges of 7–10 and 13–18 and range as from 150 to 460 mm^2, while the right foot at 10–12 in the ranges of 60–90 mm^2. Considering the biggest percentage differences, the prevalence of the surface of the left foot occurs in 16 and 18 year of life and with 60–150%, range when speaking about right foot-the differences are negligible , in the ranges of 5%.

GIRLS

The study results were elaborated on graphically. In Fig.1, the course of the changes of the mean differences of plantoconturograms of left and right foot and in Fig 2 – the differences in the percentage perspective are presented.

The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), starts with the value of 17,56 mm^2 and grows up to 62,18 mm^2 at 6 years of age, then it lowers to 14,53 mm^2 at 8, consecutively it grows up to 93,32 mm^2 at 12 and again it slides down to 32,11 mm^2 at 14, and finally it increases to 61,85 mm^2 at 18. The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), for both sexes, the curve of the same foot of thee women has a similar course. A statistically significant difference only occurs at 18 years and it is 19,95 mm^2. The course of the difference of plantoconturogram in situation when the surface of the left foot is bigger (left) starts with the value of 126,39 mm^2 and slides to 104,81 mm^2 at 6, next it grows to 172, 33 mm^2 at 8then it goes down to 122,7 mm^2 at 11., to rise to 204,99 mm^2 at 14 to definitely reach the lowest value of 82,85 mm^2 at 18 years of age.

The course of the difference of plantoconturogram in situation when the surface of the left foot is bigger (left), for both sexes, the curve of the same foot of thee women has a similar course. A statistically significant difference only occurs at 6, 12, 14, 17 and 18 year of life and is respectively: 20, 47, 23, 34, 20, 5, 33, 3 and 249, 65 mm^2.

The course of the percentage difference of plantoconturogram in situation when the surface of the left foot is bigger (left) starts with the value of 12,01%, two years later it falls to 11,84%, next it successively grows up to 64,31% at 10next it lowers to 30,58 at 11 year of life and again it grows up to 77,77% in the course of the next two years. At 14, it goes down to12, 17%, it grows again at 16 up to 40,54% and in the last year it slides to the lowest level of 3, 8%.

The course of the percentage difference of plantoconturogram in situation when the surface of the left foot is bigger (left), for both sexes, the curve of the same foot of thee women has a similar course. However, at 10, 12, 13 it takes significantly higher values, respectively: 12,78%, 11,39%, 16,19%, and at 17 and 18 year of life- smaller, respectively of: 12, 91% and 93,77%.

The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), for both sexes, and in the population of women is uniform and oscillates in the ranges of1,04 do 5,37%.

BOYS

The study results were elaborated on graphically. In Fig. 3 the course of the changes of the mean differences of plantoconturograms of left and right foot and in Fig 4 – the differences in the percentage perspective can be seen.

The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), starts with the value of 15,64 mm^2 and grows up to 38,75 mm^2 at 6 years of age, then it slides to 18,73 mm^2 at 7., next it goes up to 89,95 mm^2 at 12., then it goes down to 32,11 mm^2 at 14, and then it again goes up to 59,28 mm^2 at 15. Finally, the difference decreases to 31,15 mm^2 at 18.

The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), for both sexes, the curve of the same foot of the men has a similar course. A statistically significant difference only occurs at 6 and 18 years and it is 50,72 and 41,9 mm^2, respectively.

The course of the difference of plantoconturogram in situation when the surface of the left foot is bigger (left) starts with the value of 138, 8 mm^2 and goes down to 115,08 mm^2 at 5, next it grows up to 168,95 mm^2 at 7., to decrease to 109,14 mm^2 at 12., then it grows again to 204,99 mm^2 at 14, and lowers to 176,19 mm^2 at 16, to definitely reach the highest value of 460,92 mm^2 at 18 years of age.

The course of the difference of plantoconturogram in situation when the surface of the left foot is bigger (left), for both sexes; the curve of the same foot of the men has a similar course. A statistically significant difference only occurs at 6, 7, 12, 14, 17 and 18. The differences are, respectively: 125,28, 156,59, 134,91, 225,49, 209,83 and 332,5 mm^2.

The course of the percentage difference of plantoconturogram in situation when the surface of the left foot is bigger (left)starts with the value of 12,28%, then it successively grows to 44,83% at 11 ., next it lowers to 31,45 at 12. and again it rises to 42,66%. At 14 it again goes down to 12,17%, to grow up at 16 to 58,8%, it slides to 46,42% and in the last year it reaches the lowest 148,06%.

The course of the percentage difference of plantoconturogram in situation when the surface of the left foot is bigger (left), for both sexes; the curve of the same foot of men has a similar course. Only at 10, 12 and 13 it takes statistically lower values,: 13,95%, 12,56, 18,92%, at16, 17 and 18 respectively , which are higher of: 11,25%, 17,68% and 50,49%.

The course of the difference of plantoconturogram in situation when the surface of the right foot is bigger (right), for both sexes, is uniform and oscillates in the ranges of from1,2 to 5,18%.

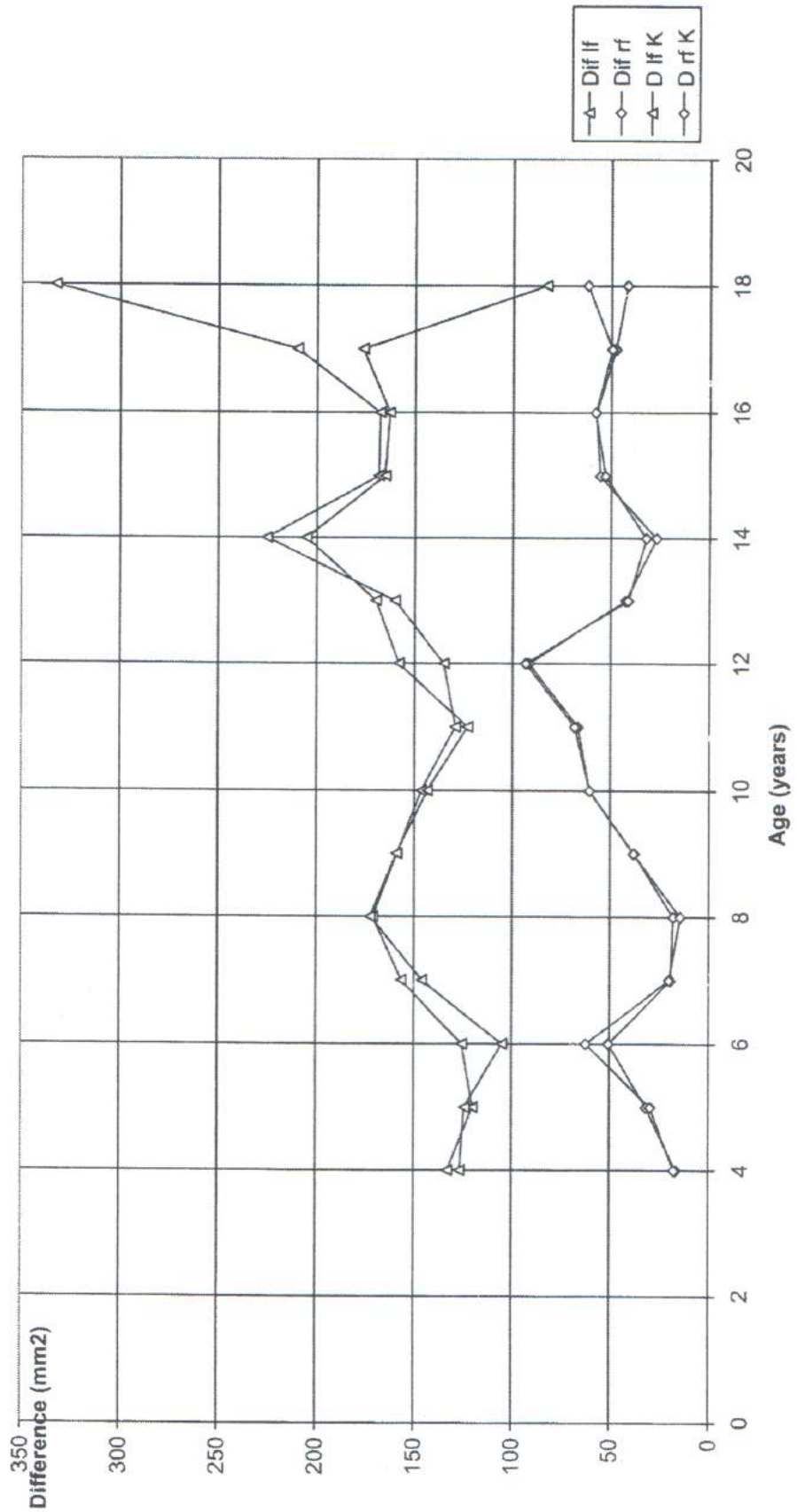

Figure 1. The course of changes of mean differences of plantoconturogram surface between left and right foot of female population and for both sexes (n) K=9804, 18503

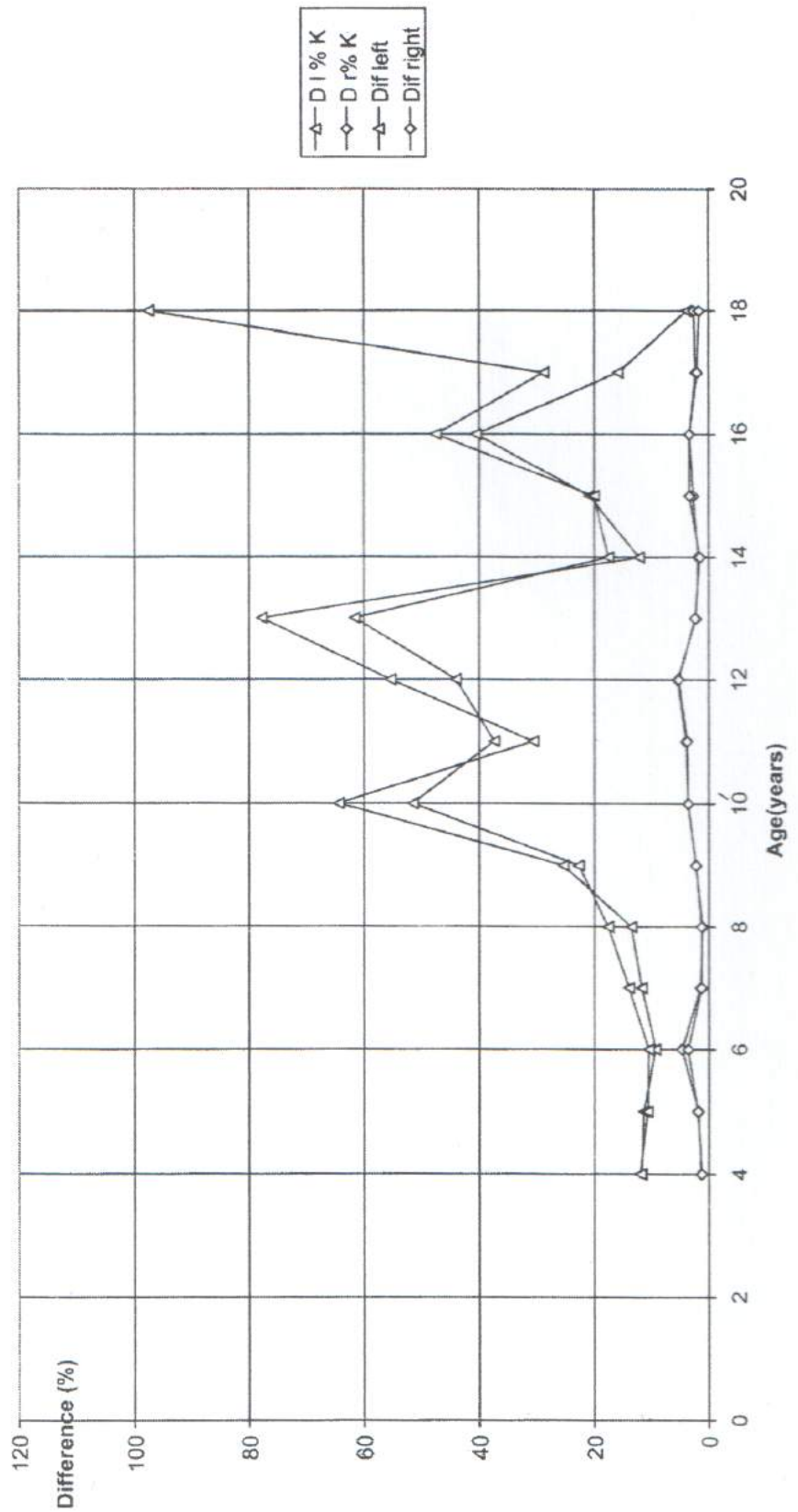

Figure 2. The course of changes of the percentage of differences of plantoconturogram surface between left and right foot in female population and for both sexes in the age range of 4 -18 years(n) 9804, 18503

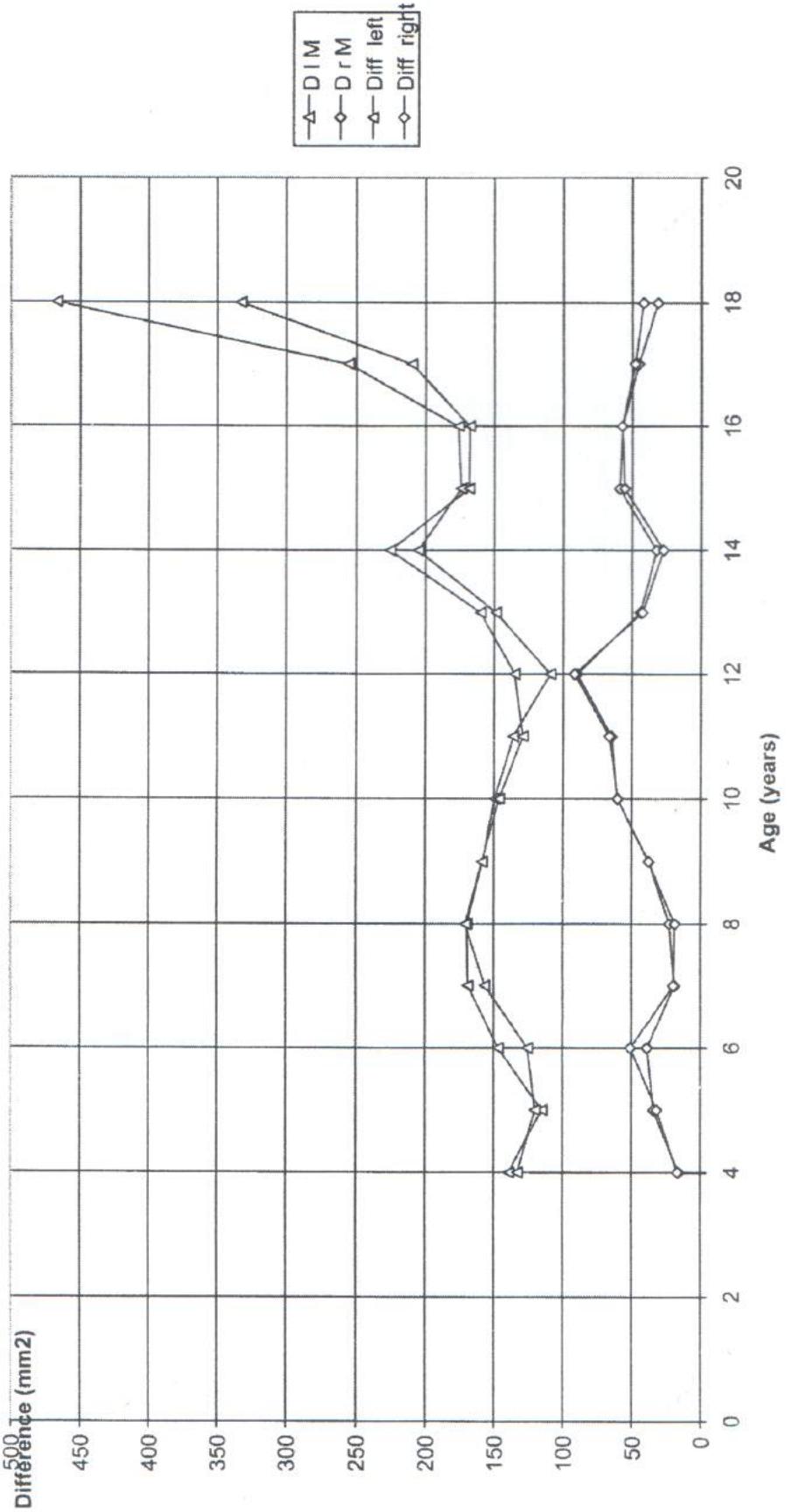

Figure 3. The course of changes of mean differences in plantoconturogram surface between left and right foot of the male population and for both sexes , in the age range 4-18 years (n) 8699, 18503

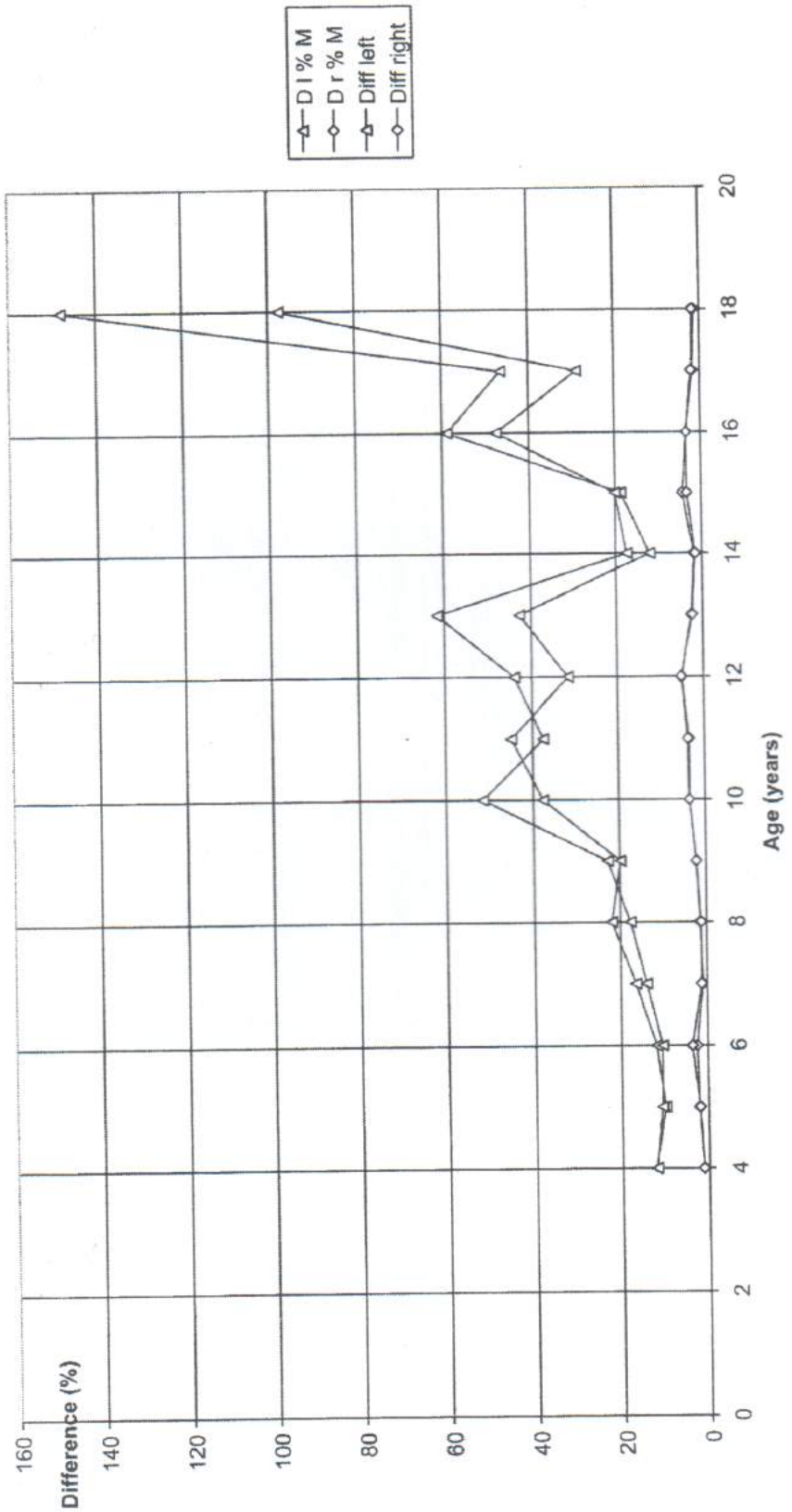

Figure 4. The course of changes of the percentage of differences of plantoconturogram surface between left and right food in male population and for both sexes in the age range of 4 -18 years (n) 8699, 18593

DISCUSSION

From the research [Demczuk-Włodarska 2003], it appears clear that the intensity of the development of the foot surface is diversified in specific periods of life. The highest differentiation of annual values is observed in the kindergarten period. However, the dynamics of this particular feature runs less intensely and the periods of rapid growth are sporadic and are much diversified. The speeding up of the surface development occurs in the kindergarten age of 100–200 mm^2 at 9–10 and it is greatest from all foot parameters. Annual growths are in the ranges of 150 mm^2. The smallest differences in growth are observed in the youth period. The evaluation of the morphological symmetry of feet points to the direction of dependences related to the age of the subjects and the characteristics. In the case of studying of particular characteristics, there occurs the left side domination, occurring since 4 and pertaining till 20.In boys, left domination of the foot from 7–16 is not really visible, but it grows after 17.In girls, the left-side asymmetry is at the fixed level. It finds its confirmation in the conducted research. The confirmed initial asymmetry of the left side changes from 8 year of life into the right-side one. Moreover, in girls, the left foot is characterised by greater values of the surface (...) than the foot of boys.

Basing on the literature available, there has been no trace of other publications presenting the differences in the surface of plantoconturograms of feet obtained using the projection moiré.

CONCLUSIONS

1. In the studied age range of the children and youth, in case of a larger surface of the plantoconturograms of the left foot, the differences are bigger than in the situation when the right foot has a greater surface. The values of differences in the population of both sexes are approximate.
2. In female and male populations, the differences in left and right surface of the foot have a symmetrical distribution. In the percentage perspective, the differences are intensified from 9–14 and in the male population they grow abruptly starting from 17 year of age.

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