

PREVALENCE OF FLAT FEET AMONG STUDENTS OF "ANGEL KANCHEV" UNIVERSITY IN RUSE, BULGARIA

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Abstract: *In the present study we have investigated the distribution of flat feet among students of "Angel Kanchev" University. Analysis is being made of flat feet distribution according to the BMI of the students.*

Key words: *Flat feet, BMI, students, Kinesitherapy.*

1. Introduction

Foot problems are reported by approximately 70% to 80% of adults and 30% of children. One of the most important characteristics affecting its incidence is medial longitudinal arch [3].

The shape of the foot depends on normal tarsal bones, normal articulation and ligamentous support between the tarsal bones, normal neuromuscular function, and finally, a normal weight distribution from above – this, a normally aligned leg. This is a lot of normal, each of which may be late to develop, and apparent foot abnormalities such as flat feet may occur at any time during growth [5].

In a range of our investigations we have studied the distribution of children's low arched feet and flat feet. Having in mind the possibilities for growth and interaction of the mentioned factors hereinabove, we are interested in disclosing the magnitude of the problem for already grown up children.

Tendency is established in literature related to the flat feet and overweight

interrelation. Umar M.B., Tafida R.U. (2013) [6] established that from a total of 1,222 children (59%) has been documented with flatfoot: 67% of males; 49% of females; and 75%, 65%, 57%, and 48% of obese, overweight, normal-weight, and underweight children, respectively.

According to Riddiford-Harland (2011) [4] obese children had significantly fatter and flatter feet compared to normal weight children. The functional and clinical relevance of the increased fatness and flatness values for the obese children remains unknown. Flat feet and overweight interrelations for grown up individuals are not well studied.

2. Purpose

The purpose of the study is to establish prevalence of Low Arched Feet and Flat Feet among students of "Angel Kanchev" University and the interrelation between the Low Arched Feet and Flat Feet and overweight.

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3. The Problems

Investigated are 136 students of "Angel Kanchev" University at an average age of 20, 58 years - 66 men and 70 women. 39,4% of the men practice some sports activity while most of them go to a fitness hall. Football, basketball, volleyball, cycling, track and field, judo, kick box are mainly the sports practice by the men. The percentage of sport practicing women is much smaller - 11, 4% and the sports practiced by them are track and field, table tennis, basketball, handball, taekwondo.

We have used the plantograph of G. Kaymakchiev and B. Sokolov for diagnostician Low Arched Feet and Flat Feet. The device is a rectangular wooden frame of the following dimensions - 35 - 40 x 18 - 20 sm. The frame is covered by tightened nylon and smooth cloth is tightened over the nylon. The cloth is coated by inkpad ink well spread all over the surface. A list of paper is put on a smooth surface on the floor and the plantograph is put over the list with the inked surface downwards to the list. The investigated person steps by bare foot on the inner side of the plantograph (the nylon) and transfers his/her weight on the leg under study. The investigator presses by his finger the basic phalanx of the second finger of the person under study and after that the foot is energetically lifted up from the plantograph. A plantogram is made for the other foot in the same way.

The plantogram is then drawn (fig. 1). **AB** tangent is drawn along the inner side of the foot. Then the middle of the II finger is connected to the middle of the heel edge (**CD**). The exact place of the middle of the heel is found by the additional line **EF** which is perpendicular to the **AB** tangent. The **dh** distance is measured and from its central point **f** the perpendicular line **CD** is drawn. The point of intersection of this perpendicular with the imprint of the

outside edge of the foot is marked by point **a**; where it crosses the imprint of the inside edge of the foot - by point **b**; and the place where it crosses the **AB** tangent - by point **c**. The **ab** and **bc** distances are measured and Chijin's Index is found according to the **ab/bc** relation - dark to lightened part. If the index is 1, 0 - the feet are normal (NF); if it is 1,0-2,0 - there is a Low Arched Feet (LAF) and if above 2,0 - Flat Feet (FF).



Fig. 1. Outline of the foot imprint according to the method described by G. Kymakchiev and B. Sokolov

In order to establish the availability of overweight or obesity, we have calculated the Body Mass Index (BMI) according to the classical formula. The BMI Categories are: Underweight = <18.5; Normal weight = 18.5-24.9; Overweight = 25-29.9; Obesity = BMI of 30 or greater.

4. Results

Men with Low Arched Feet Flat Feet and Normal Feet (n=66)

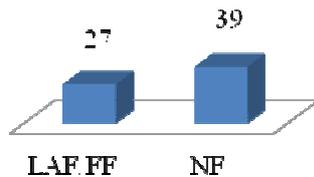


Fig. 2. Distribution of Low Arched Feet and Flat Feet among the investigated men students

Twenty seven of the investigated men students (40, 9 %) have Low Arched Feet and Flat Feet. Thirty nine men students (59, 1%) have Normal feet. The high percentage of distribution of the Low Arched Feet and Flat Feet demonstrate persistence of the problem after child age too.

Women with Low Arched Feet Flat Feet and Normal Feet (n=70)

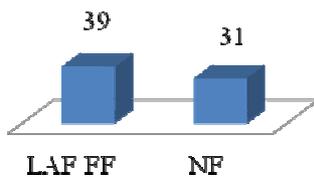


Fig. 3. Distribution of Low Arched Feet and Flat Feet among the investigated women students

The percentage of distribution of the Low Arched Feet and Flat Feet among the investigated women students (55,7%) is higher than the one for the men and even more, in practice the women having Low Arched Feet and Flat Feet are more than those having Normal Feet (44,3%).

Men with Low Arched Feet and Flat Feet (n=27)

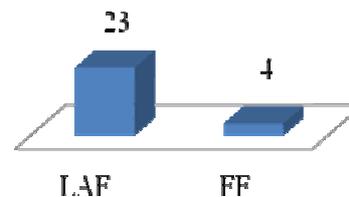


Fig. 4. Distribution of Low Arched Feet and Flat Feet among the men having deviations from the Normal Feet

Twenty seven of the investigated men have got deviations from the Normal Feet. Twenty three (85, 2%) have Low Arched Feet, while 4 (14,8%) have Flat Feet. Juxtaposed to all investigated 66 men these 4 men students present 6, 1% of them.

Women with Low Arched Feet and Flat Feet (n=39)

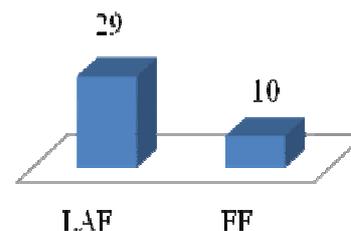


Fig. 5. Distribution of Low Arched Feet and Flat Feet among women having deviations from the Normal Feet

From all 39 women having deviations from the normal feet, 74, 4% have Low Arched Feet and 25, 6% have Flat Feet. Juxtaposed to all investigated women students – 70 in number, the Flat Feet percentage of distribution is 14, 3%.

Low Arched Feet and Flat Feet distribution - men (n=27)

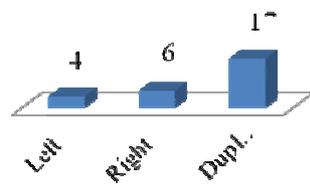


Fig. 6. *Unilateral and bilateral distribution of Low Arched Feet and Flat Feet among the men under study*

The presence of not a small percent of one sided Low Arched Feet requires additional study about the possible reasons. Probably the one sided manifestation of the problem is related not only to local deformations but with changes of the kinematics of the supporting locomotorium. These changes might be caused by muscle dysfunctions, muscle disbalance, differences in the length of the limbs, problems in the domain of the lower back, incorrect posture, scoliosis, etc.

The presence of Low Arched Feet and Flat Feet is two sided for 62, 96% of the men with deviations from the Normal Feet (n=27). 14,81% have deviation from the norm in the left foot, while 22,22% have deviations in the right foot.

Low Arched Feet and Flat Feet distribution - women (n=39)

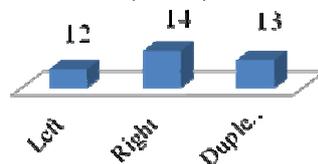


Fig. 7. *Unilateral and bilateral presence of Low Arched Feet and Flat Feet among the women under study*

Not a small distribution is observed among women too of unilateral presence of

Low Arched Feet and Flat Feet - total 66, 7% (30,8% in the right and 35,9% in the left). The interrelation looked for down here between the Low Arched Feet and Flat Feet and the overweight and obesity is logically to refer most of all to people having bilateral manifestation of the problem.

BMI men (n=66)

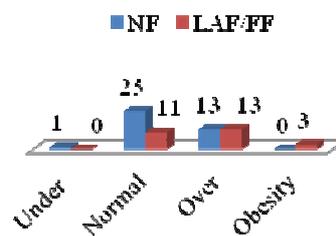


Fig. 8. *Distribution of Low Arched Feet and Flat Feet presence among men according to the BMI Categories*

For the greatest percentage (37, 9%) of the investigated men, the normal foot corresponds to the BMI normal values.

In order to establish the statistic reliability about the interrelation between the presence of Low Arched Feet and Flat Feet and the overweight and obesity we have used the Pierson's X^2 criterion to compare the frequency distributions.

Table 1
Pierson's X^2 criterion for comparison of the frequency distribution of Low Arched Feet/Flat Feet and overweight/obesity among the investigated men (n=66)

	NF		LAF/FF		Σ acc lines
	Ff	Ft	Ff	Ft	
O/O	13	17,14	16	11,86	19
N/U	26	21,86	11	15,14	37
Σ acc columns	39		27		66

Legend: NF (Normal Feet); LAF/FF (Low Arched Feet/Flat Feet); O/O (Overweight/Obesity); N/U (Normal /Under Weight) Ff (Factual frequency); Ft (Theoretical frequency)

The empiric value of Pierson's $X^2\alpha$ criterion (X^2 (emp.)) calculated from table 1. is 0,57. The table value of the X-criterion of Pierson ($X^2\alpha$) for level of importance 0, 05 is 3,84. It means that $X^2(\text{emp.}) < X^2\alpha$, i.e. there is no reason for rejecting the zero hypothesis although the presence of a tendency for interaction between the overweight and obesity and the presence of Low Arched Feet and Flat Feet.

The empiric value of Pierson's $X^2\alpha$ criterion (X^2 (emp.)) calculated from the table is 4, 35. The table value of Pierson's X-criterion ($X^2\alpha$) for level of importance 0, 05 is 3,84. It means that $X^2(\text{emp.}) > X^2\alpha$ i.e., there is a reason for rejecting the zero hypothesis which a prove about an interaction between overweight/obesity and the presence of Low Arched Feet/Flat Feet.

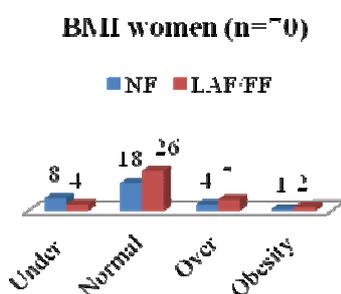


Fig. 9. Distribution of Low Arched Feet and Flat Feet presence among women according to the BMI Categories

The greatest are the percentages of the BMI normal values for the women we have investigated, both those with normal feet and those with deviations from the norm, respectively 37, 1% and 25, 7%.

Statistic checkup of the results is applied for the women too.

Table 2
Pierson's $X^2\alpha$ criterion for comparison of the frequency distribution of Low Arched Feet/Flat Feet and overweight/obesity among the investigated women (n=70)

	NF		LAF/FF		Σ acc lines
	Ff	Ft	Ff	Ft	
O/O	5	6,74	9	8,49	15
N/U	26	24,71	30	31,09	55
Σ acc columns	31		39		70

Legend: NF (Normal Feet); LAF/FF (Low Arched Feet/Flat Feet); O/O (Overweight/Obesity); N/U (Normal/Under Weight) Ff (Factual frequency); Ft (Theoretical frequency)

5. Conclusions

There is not a small distribution of Low Arched Feet and Flat Feet among the contingent we have studied – 55, 7% for the women and 40, 9% for the men. The distribution of the more serious state Flat Feet among the contingent under study is respectively 6,1 for the men and 14,3% for the women. Data show that the deviations from the norm in the height of the feet longitudinal arch persists after child age too.

The statistic checkup of the interrelations of the Low Arched Feet/Flat Feet and Overweight/Obesity among the contingent we have investigated shows presence of statistic dependency for the women. There is a tendency among the men for an interrelation between the investigated indicators which is not statistically reliable.

The presence of not a small percent of unilateral Low Arched Feet and Flat Feet impose additional study of the interrelations between the changes in the supporting locomotorium related to muscle dysfunctions, asymmetry of the body, scoliosis, etc.

It is necessary to study additionally the interrelation between the unilateral and bilateral presence of the Low Arched Feet and Flat Feet and the Overweight and Obesity.

6. Proposals

There exist a problem in the interpretation of the results and the interrelation between the Flat Feet and the Overweight. On one side the overweight could by itself claim excess requirements and load to the muscles supporting the normal longitudinal arch of the feet. On the other side the presence of greater body mass particularly in the domain of the foot is a reason for concealing the problem and it is possible an actual Low Arched Feet problem to be lacking. That problem appears namely in the screening examinations because of the nature of their methodology of study. Similar particularities may arise upon Flat Feet among pregnant women where the determining factor is the presence of characteristic edema of the feet and the Flat Feet among athletes where the working hypertrophy of the muscles may result in pseudo Flat Feet.

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