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Original Article

SCREENING OF BODY MASS INDEX AND FUNCTIONAL FLATFOOT IN ADULT: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: There is a relation between flatfoot and increased Body Mass Index (BMI). Increased weight leads to increase plantar pressure causing reduced distance between ground and arches of the foot. The purpose of the present study is to estimate the prevalence of flat feet in college going students, to determine the relationship between flat foot and Body Mass Index (BMI), and to compare prevalence of flat foot among college boys and girls.
Materials and Method: Samples were taken according to willingness for participation; informed consent was given and signed from them. Height and weight of subjects were measured by using standard apparatus. Total numbers of males screened were 46 and females were 182. BMI was considered as the index of obesity .The international BMI cut–off values were used to determine obesity (BMI> 95th percentile), and foot structure assessment was performed with Denis Method. Significant relationship between obesity and flatfoot was observed.
Result: A significant relationship (Pd"0.01) was found between the prevalence of flatfoot and BMI. Also males were found to have higher prevalence of flatfoot than women in the age group of 18-25 years.
Conclusion: The results of this study suggest that there is relationship between increased weight of person and structure of the foot. Males are more prone to flatfoot than females in the age group of 18-25 years.
KEY WORDS: Flat foot, Body Mass Index, Obesity.

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INTRODUCTION

Flatfoot is also called as pes planus or fallen arches. Flatfoot i.e. acquired flatfoot develops due to injury , prolonged stress to the foot, obesity, illness, faulty biomechanics [1]. It is a postural deformity in which the arch of the foot collapses. Flatfoot is often a complex disorder with symptoms and varying degrees of deformity and disability. There are several types of flatfoot in which one of them have a common i.e. partial or total collapse of the arch [2]. Flexible flatfoot is one of the most common types of flatfoot. Flatfeet can sometimes contribute to problems in ankles and knees because the condition can alter optimal alignment of legs. Acquired flat foot most often arises from a combination of too much force flattening the arch in the face of too little support for the arch. Treatment of the adult acquired flat foot is often difficult. The clinician should remember

the biomechanics of the normal arch and respond with a treatment that strengthens the supporting structures of the arch or weakens the arch-flattening effects on the arch [2].

Flatfoot i.e. acquired flatfoot develops due to injury, prolonged stress to the foot, obesity, illness, faulty biomechanics [3]. It is that recognized posterior tibia tendon dysfunction as a common cause of acquired adult flatfoot [4].

It was reported that the incidence of flat foot in the population studied was found to be 16.4%, of which 18.1% were males and 14.6% females. Fifty percent showed slight flat-footedness (1st degree), 28% moderate (2nd degree) and 22% showed very marked flat - footedness (3rd degree). The frequency of obesity and overweight in the same population was found to be 27.3% (Cole index>120). Analysis of the variance showed a significant difference between the Cole Index in subjects with flat feet (121.77 +/- 19.2) and the rest of the population examined (110.12 +/- 15.3). In this study, the children suffering from this dysmorphism were also found to be obese or overweight [4]. BMI categories - Normal = 18.5 - 24.9, Overweight = 25 - 29.9, Obesity = BMI of 30 or greater. Main contributing factors for the increase in body mass index is sedentary lifestyle, foods in high fat and calories. Stress is also an important factor for obesity. Growing older, this can lead to less muscle mass and a lower metabolism making it easier to gain weight.

The BMI is generally used as a mean of correlation between groups related by genera mass and can serve as a vague means of estimating adiposity. The duality of the BMI is that, whilst easy to use as a general calculation, it is limited in how accurate and pertinent the data obtained from it can be. Generally, the index is suitable for recognizing trends within sedentary or overweight individuals because there is a smaller margin for errors [5]. BMI is used differently for children. It is calculated the same way as for adults, but then compared to typical values for other children of the same age. Instead of set thresholds for underweight and overweight, then, the BMI percentile allows comparison with children of the same sex and age. BMI can be calculated quickly and without expensive equipment. However, BMI categories do not take into account many factors such as frame size and muscularity [6].

METERIALS AND METHODS

Ethical clearance was obtained from Institutional Ethical Committee. Patients were screened based on the inclusion and exclusion criteria.

Inclusion criteria included students from KLE university campus, age group of 18-25 years. Exclusion criteria included any congenital deformities, callus or corn, unwillingness for participation. Participants were briefed about the nature of the study and intervention and only those participants willing to take part were recruited for the study and informed consent was obtained. Following requirements were taken from each subject: Name, Age, Gender, Height, Weight, Date of birth, Sporting activities and its time per week in hours. Height and weight was measured on each individual in light clothes and without footwear using standard apparatus. Height was measured from nearest 0.5 cm, with the help of measuring tape. And to measure the height measuring tape was fixed to the wall. Height was measured while the subject stands with heel, shoulder and occiput touching the vertical tape. Head was held erect with the external auditory meatus and the lower border of the orbit in horizontal plane. All measurements were taken by one of the investigators. BMI was calculated as weight (kg) divided by square of the height in meter. Subjects were classified according to WHO classification according to their BMI and were classified as underweight, normal weight, over weight and obesity groups. Also, foot structure assessment was performed with Denis method prior to testing, college students feet were screened by one of the investigator to identify and exclude subjects with any external factors that may have contributed to variations in plantar pressures, such as calluses. All subjects underwent footprint screening.

The plantar foot print was classified according to Denis into three grades of flatfeet:

Grade 1: The support of lateral edge of the foot is half of that of metatarsal support.

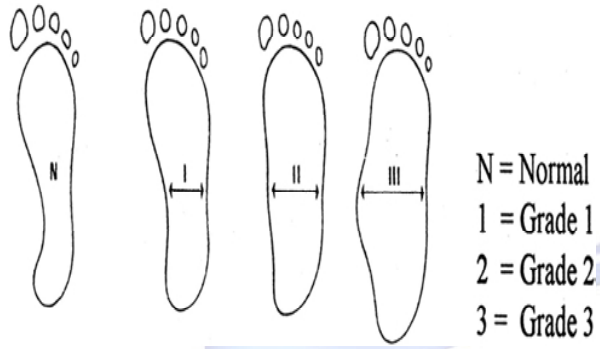
Grade 2: In which the support of central zone

and forefoot are equal.

Grade 3: Support in the central zone of the foot is greater than the width of the metatarsal support.

These obtained results will be statistically calculated for arch index.

Fig.1. Classification of plantar footprint according to Denis Method [11,14].



Statistical Analysis: Statistical analysis for the present study was done manually as well as using the statistic software SPSS 16.0 version so as to verify the results obtained. For this purpose data was entered in an excel spread sheet, tabulated and subjected to statistical analysis. Statistical test used was Fisher Exact test which was utilized calculation of 'p-value', chi-square and degree of freedom were calculated, significant difference in grades of BMI and DENIS method grading was also calculated. 'p-value' was also calculated for comparison between males and females to find out the prevalence of flat foot. Probability value less than or equal to 0.05 were statistically significant.

RESULTS

The result of final study was analyzed by DENIS METHOD and components like height, weight and BMI were calculated so as to screen the correlation between BMI and flat foot.

DEMOGRAPHIC PROFILE

Table 1: Represents number of people included in each grade of DENIS method and their percentage.

DENIS GRADES	NUMBERS	PERCENTAGE (%)
GRADE 0	127	55.7
GRADE 1	47	20.5
GRADE 2	27	11.8
GRADE 3	27	11.8

Level of significance, p = 0.001. This table represents number of subject having flat foot according to DENIS grading . Grade 2 and Grade 3, which represents people flatfoot. It accounts to total of 23.6 %. 11.8% both in Grade 2 and Grade 3. Here the p value was found to be 0.001, which is statistically significant.

Table 2: According to gender.

DENIS GRADES	FEMALE	MALE
GRADE 0	112	15
GRADE 1	37	10
GRADE 2	17	10
GRADE 3	16	11

Total numbers of subjects screened were 228. Out of the 228 subjects screened 182 subjects were females, of them 33 females had flatfoot. 46 males were screened and out of which 21 had flatfoot. These values were statically analyzed and p-value was found to be 0.001 which is highly significant. Also chi-square value was calculated, it was 13.410. Degree of freedom was found to be 3.

Table 3: According to BMI classification.

DENIS GRADES	UNDER WEIGHT	NORMAL WEIGHT	OVER WEIGHT	OBESE	TOTAL
GRADE 0	26(83%)	80(65%)	15(29.4%)	5(23.8%)	127
GRADE 1	4(12.90%)	25(20.30%)	15(29.4%)	3(14.3%)	47
GRADE 2	0	11(8.9%)	10(19.60%)	6(28.6%)	27
GRADE 3	1(3.2%)	7(5.7%)	11(21.60%)	7(33.3%)	27
TOTAL	31(100%)	123(100%)	51(100%)	21(100%)	22

This table represents total number of both males and females in relation to DENIS method, where total number of subjects who fall under grade 0 is 127. Grade 1 consisted of 47 subjects. Grade 2 and grade 3 who have flat foot have, total number of subject are 27 and 27 each. Statistical analysis was done and p-value found was 0.001 which is statistically significant. Chi-square value found was 17.410. Degree of freedom was 3.

DISCUSSION

Flatfoot also called as pes planus or fallen arches. It is a postural deformity in which the arch of the foot collapses. There is a functional relationship between the structure of the arch

of the foot and the biomechanics of the lower limb.This study compares the prevalence between flatfoot and gender. It also states the comparison between different grades of BMI and flatfoot. This will help us in giving a clear cut idea whether the weight and gender of a person is responsible for the arch of the foot.

It has been proven that there is a vast variation in the prevalence of flexible flat feet reported by various authors [7, 8]. According to our study, these differences could be explained by the theorem that the authors used different age groups or perhaps only made their findings at the end of the usual evolutionary period when extra evolution toward healthy feet was improbable. But in our study we used only one age group where all the maturity is attained and so these differences in age groups are nullified and results can be proven reliable. Our study studied adults between the ages 18-25 years. A body of higher mass with weak musculature exerts extra forces on the arch of the foot causing weakness of the respective muscles causing collapsed arches. It significantly alters the contact surface of the arch and the ground.

In our study, static weight-bearing footprints for the right and the left foot were taken by dipping both the foot one by one inside container of colored water. As the study included the population of age group 18-25 years they had already matured and also attained puberty. Obesity was permanent factor in our study that may cause significant relationship between flat foot and obesity. Because mass increases resulted in increased static and dynamic plantar pressures, causing significant change to the structure of the feet. However, long-term mass increases associated with obesity appeared to flatten the medial longitudinal arch of the subjects as confirmed by an increased area of foot contact with the ground [9].

Our study showed that the BMI was associated with flat foot. This can be associated with excessive belly fat causing weak abdominals and in turn causing excessive lordotic posture. This causes change in passing of line of gravity and transfer of force through foot. As a result the weight bearing areas are changed. Along with this increased fat and decreased muscle strength due to decreased muscle fibers causes collapse arches.

Our study showed that males were more prone to flat foot than females. This results are consistence with relationship of flatfoot and high arch with main anthropological variables which is a study based on BMI. The higher incidence of males more prone to flat foot can be given by the foot-ware they use. If the foot-ware is harder then it may cause flat foot [10].

Although obesity and overweight is a temporary, but it can be the cause of flatfoot. Therefore subjects should pay attention to increasing weight that may cause flatfoot and also other problems in the future.

The foot adapts itself under loading condition by maintaining the medial longitudinal arch. Increasing the loading further activates compensatory mechanisms which maintain the longitudinal arch and shifts he loads to the central and medial forefoot.[11] But treatment and prevention of flatfoot may have an effect on an individual's overall health and occurrence of other foot and ankle pathologies [12].

We also found that the presence or absence of flatfoot does not modify quality of life. Activities of daily living are not affected by flatfoot and also there are no hurdles for performing it . Studies also states that there is no problem or shortcoming in performance in physical functioning and also participation in sternous physical work were foot pathology is included recent. Quality of life has been used as a tool of results for surgical treatment of the feet. Some authors have not found any differences in quality of life based on the abnormalities found [13].

Conflicts of interest: None

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