Prevalence of Flat Foot and Correlation between BMI and Planter Arch Index in Obese School Children

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Abstract

Aims: To find out the prevalence and correlation between the BMI and plantar arch index in obese school children.

Method: 50 participants (26 Girls and 24 Boys) of mean age 9.960 ± 0.925 were recruited based on inclusion and exclusion criteria. It was a cross sectional study among the school children. The data was obtained by using means of the footprint and the plantar arch index, which establishes the ratio between central and posterior regions of this footprint, determining a mean PAI and a limit to the flat-foot.

Result: Among the 26 girls, 42%had flat foot and 58%did not have flat foot and among the 24 boys, 45%had flat foot and 55%did not have flat foot. The result shows that there was no significant correlation(r = 0.02773) of BMI and planter arch index.

Conclusion: This Study concluded that there was no significant correlation between planter arch index and BMI in obese school children (P=0.6324) as indicated by correlation values (for right foot A =0.1413 B=0.1137and left foot A=0.1410 B=0.1066).

Keywords: *Flat foot, Planter arch index.*

Introduction

In bipeds, the foot takes on the important responsibility of receiving the weight of the whole body and at the same time stabilizing the individual in changing postural and environmental conditions.[2]Children with flexible flatfoot often do not begin to develop an arch until the age of 5 years or older. Some children never develop an arch. If flexible flatfoot continues into adolescence, a child may experience aching pain along the bottom of the foot4.The arches present right from birth, although they are masked by excessive amount of fat in their sole, an apparent flat foot (fat foot) is present in many children up to the age of 2 years.[3]

Most children are born with very little arch in the feet. As they grow and walk, the soft tissues along the bottom of the feet tighten, which gradually shapes the arches of the feet.[4] These arches maintain proportional distribution of the body weight. Concavity of the arches protects the plantar vessels and nerves from compression.[3]

The concept of Arch Index was first described by Cavanaugh et al. as the ratio of the area of the middle third of the foot to the entire foot area excluding the toes[5]. Importance of "arch-index" as a sensitive podographic indicator was later on confirmed in different studies1. Later it has been established the Arch Index, derived from footprint to show a significant negative correlation with the navicular height[5].

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Arch index also varies with age, falling into the normal adult range by age 5.[11] Whether among obese or non-obese people, school-aged children or adults, or men or women from different countries,arch index values fall into the different ranges of arch index values suggested and used as a potential method to classify high-arched, normal, and low-arched foot types.[6]

An arch index of less than 0.21 has been said to be indicative of a cavus foot, while it greater than 0.26 is indicative of planus foot whereas Arch Index between 0.21~0.26 corroborates normal arch height.[5]A ''gold standard'' method for determining foot type has yet to be established, and clinical observation remains the method most often relied upon.[6]

Procurement of, and processing the footprint being easier and cheaper, is more acceptable for the patient than radiography. Hence, in spite of the fact that radiography is still important in establishing the arch height, footprint procedures are preferred to it.[5]

This can be conveniently taken on a graph paper and the Arch Index can be calculated thereafter to ascertain the height of the arch of foot.[5] Measures of navicular drop, arch height, dorsal foot height, longitudinal arch angle, and hind foot angle have demonstrated poor to good reliability in supporting clinical determinations of foot type[6]. But unfortunately almost no studies have inter-related mathematically the foot-print derived arch-index values with the radio graphically evaluated standing arch-height measurements with an acceptable equation, by which one can interpret directly the standing navicular or talar height with the help of arch index without proceeding through actual maneuver. Especially such information lacks in pertinent literature so far in Indian population is concerned[5].But the reliability of these measurements in classifying foot type has not been investigated.[6] Arch index values, based on the contact area of the middle section of the plantar footprint, have been used to determine foot type. Arch index values calculated by footprint analysis have been obtained from force plate6.A moderate correlation between BMI and occurrence of pes planus exists; [9]differences have been found between children with and without obesity.[6]High BMI some time may be a cause of flat foot. The assessment of plantar arch development, by the relationship between arch region width and heel region width obtained on a footprint, is proposed by Engel and Staheli.[7]

Methodology

Source of Data: Santaniketan school , Rankuva.

Study Design: Cross sectional observational study.

Sample size: 50 Participants.

Participants: Preschool children (age between 8 to 11 years).

Sampling Method: Random sampling method.

Materials used: Pen, paper, record sheet, weighing machine, measure tap, calculator

inclusion criteria:Children in the age group of 8 to 11 year [boys and girls] and Children with BMI(boys: > 17.7 (obese),Girls: > 18.3 (obese))

Exclusion criteria:Children beyond the age of 11 year, Congenital Talipes Equinovarus ,Polio, Cerebral palsy,Trauma fracture of lower limb and pelvic. Children with BMI(Boys: <17.7,Girls: <18.3)

Outcome measures: BMI and Planter arch index

Procedure:

The present study was initiated after the clearance obtained from the institutional committee of ethics of the Shrimad Rajchandra College of Physiotherapy, Bardoli.

A total 50 children who were in preschool of age between 8 to 11 years were found to be satisfying all the inclusion criteria.A detailed explanation regarding the complete procedure was given to each subject and as a formality towards their willingness to be a part of this study, they were asked to sign a written consent. After taking written consent, the demographic data that is age, gender, standard, weight, height and BMI were calculated. All the test was performed in quiet and proper ventilated room. Static foot print of both feet was obtained on a chart paper using ink. The calculation of the PLANTAR ARCH INDEX was carried out as follows.

A line is drawn tangent to the medial fore foot edge to the mid heel region. The mean of this line was calculated. From this point, a perpendicular is drawn, crossing the foot print [mid foot region, the arch width =A].The same is repeated for the heel tangency point [Mid heel width =B]. PAI will obtained by dividing the value of arch width [A] by the value of mid heel width [B].The equation to calculate this is: PAI= A/B. The range of normal was defined as being within 2SD from the mean.After collecting data from the subjects, all data was gathered and a master sheet was prepared.Next, for the statistical analysis, the descriptive statistical of age, gender, standard, weight, height, BMI and planter arch index was taken out. Spearman Correlation test was carried out for this study. It is the color that used for foot-print of participants on blank white paper.

Data Analysis and Results

Data Analysis

This study aimed to evaluate the prevalence of flat foot and correlation between BMI and planter arch index in obese school children.The data was collected for Flat foot in Children.

Evaluation of average, minimum, maximum and standard deviation values for central arch region (A) and heel (B) on footprint was taken. And for the plantar arch index (PAI) corresponding to right and left feet, respectively was taken. Descriptive statistics including mean, standard deviation for age and BMI was calculated using Microsoft office excel. Frequency percentages of gender were analyzed by pie chart.As all the data was not normally distributed, Non-parametric test, i.e., Spearman correlation test was used to analyze the data

The obtained result was considered significant if the value of p<0.05

Results

1 Demographic Data

Demographic data of participants (N=50)

	Mean	SD
Age	9.960	0.925
BMI	20.094	2.217
Right A	8.574	0.718
Right B	4.264	0.352
Left A	8.572	0.718
Left B	4.268	0.351

Table 1 shows the descriptive statistic of Age, BMI and arch index for right and left foot of all participants.

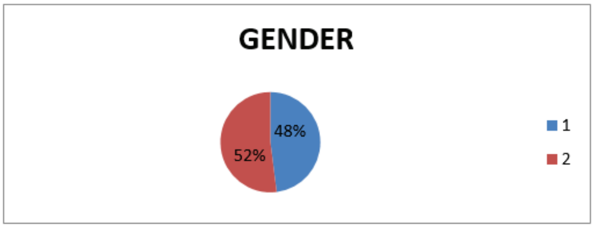
Table 2: Associations between BMI and PAI

Associations coefficient	RIGHT A	RIGHT B	LEFT A	LEFT B
p value	0.1413	0.1137	o.1410	0.1066
R value	0.2110	0.2265	0.2112	0.2310

Table 2 shows the p value of correlation between BMI and Planter arch Index of Right and left foot.

Association is significant at the 0.05 level [2-tailed]

Association is significant at the 0.01 level [2-tailed]



Graph 1Gender distribution among the school children

Series: 1 Boys Series: 2 Girls

In above pie chart there were 48% of boys and 52% of girls among the school children.

Discussion

This cross sectional study aimed to find the prevalence of flat foot and correlation between the BMI and planter arch index in obese school children.

For this study total 50 school children were selected and out of this, sample size, only 52% were girls and 48% were boys.As data was not normally distributed, nonparametric test was used to correlate BMI and planter arch index, analyzed using Spearman Correlation test.

The result of the present study are not consistent with previously reported findings on prevalence of flat foot in obese school children.The foot functions as strong and stable support for the body as well as the lever of ambulation[13]. During successive loading and unloading cycle of ambulation these functions of feet makes it to present a unique behaviour[13]. Feet is the region suffering highest variation in human body because of the deformation experienced by the medial longitudinal arch during stance phase[13]. Because of these features it is necessary to clinically examine this region which may be a complex one[1].The foot has following arches: medial and lateral longitudinal arch, transverse half arch at the level of mid tarsal joint and anterior transverse arch at the level of head of metatarsals[3]. The static function of foot works during stable weight bearing support whereas the dynamic functions during walking as an efficient lever to propel the body weight forward. These are the two major functions of foot [3].Decreased participation of obese students in physical activity is due to the structural changes in their foot[7].

Engel and Staheli found a strong reduction in incidence of flaccid flat feet up to the age of 4, because medial longitudinal arch development happens through this age, thus, higher plantar arch indexes are expected in younger children, while these indexes are lower in older children[1]. Other authors admit that major variations on plantar arch happen until the age of 7. The suggestion of this index having a decreasing incidence up to approximately 5 years old, remaining stable after that was responsible for our decision to study a group of children above that age; so by working with lower age groups we could reduce the usefulness of our indexes to the intended end. Some genetic pathological conditions also affect flat feet[1]. The identification of congenital problems, particularly involving the feet ; postural abnormalities of the spine, pelvis, hips and knees ; Achilles Tendon shortening, and restraint to subtalar joint movements are essential for ruling out the possibility of secondary flat feet[1]. The plantar arch index and the navicular vertical height are correlated, but the second is better, because it directly measures navicular, which is the key to medial arch, in addition it is easy to achieve[1].Using a sophisticated methodology, such as strength platforms, graded scales or "moire" photopodometry , increases measurements accuracy, but these are more difficult to apply in clinical routine[13]. The classification proposed by these authors may be used by obtaining a carton-based template of the area of plantar region of the feet , which allows for calculating the plantar index from the areas of different regions of the feet[1]. Although the two novice testers had different levels of clinical experience, our results suggest that the study methods can be learned quickly. Reliability may have been enhanced by using AutoCAD to analyze the digital photographs[5].The standing navicular height (NHSTD), talar height (THSTD) and normalized navicular height (NNHSTD) along with normalized talar height (NTHSTD) individually has been correlated with the arch-index at the margin of statistical significance[4]. The results of this study shows that without going in the unnecessary time-taking radiological procedures, it is better to have the foot-print of the subject to analyze the arch-index, from which standing arch-height values easily can be calculated [4].

A study found a global prevalence of 15.74% for the population analyzed, compared to other studies ranging between 2.7 and 44% in the Pfeiffer study[11].The difference of results with the 2.7% prevalence reported by Garcia et al.4, seems explainable given that the study by this author considered a population that included older age groups (13 to 15 years of age) in which the arch was completely developed, considering as flat footed only those subjects with at least a Denis grade 2[11]. Few studies in literature determine the prevalence of flat footedness; among them, there is the study by Echarri and Forriol who reported 70% prevalence for flat feet in children 3 to 4 years of age and of 40% between 5 and 8 years of age[11].While this study did not elaborate on any effect excess weight may have on foot development or effciency, Welton suggested that, although many footprints registered outside the normal range, they would not necessarily require intervention or treatment but rather monitoring for potential problems[7]. However, Hennig et al identified body weight as a major influence on the magnitude of the pressures under the feet of 125 children aged 6 ± 10 years[7].

Limitations:

this study included age group between 8-11 years. Another limitation of this study is that only BMI of 17.7 (boys) and 18.3 (girls) were included. Further studies can be done on under-weight children of same age that may prevail structural abnormalities in children.

Conclusion

The prevalence rate of flat foot among the obese school students of ages between 8 -11 years is, out of the 50 students, 26 were girls and 24 were boys.Among the 26 girls, 42% had flat foot and 58%did not have flat foot.Among the 24 boys, 45% had flat foot and 55%did not have flat foot.

This Study concluded that there was no significant correlation between planter arch index and BMI (P=0.6324) as indicated by correlation values (for right foot A =0.1413 B=0.1137and left foot A=0.1410 B=0.1066).

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Conflict of Interest-Nil

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