ORIGINAL RESEARCH PAPER

Volume-7 | Issue-10 | October-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# PREVALENCE STUDY OF FLATFOOT IN PRIMARY SCHOOL CHILDREN AGED BETWEEN 6 TO 11 YEARS IN TRIBAL AND RURAL POPULATIONS IN COIMBATORE, SOUTH INDIA.

Anatomy

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## ABSTRACT

**Aim:** The aim of this study was to determine the prevalence of flatfoot in primary school children in tribal and rural populations in Coimbatore district, south India.

**Materials and Methods:** This is a cross sectional study made on primary school children between 6 to 11 years of age, from many schools in tribal and rural population in Coimbatore. From 982 total children 65.5% from rural and 34.5% from tribal populations. Flatfoot diagnosis was made by foot print method using Staheli Index.

**Results:** We found a global prevalence of 25.1%, distributed 28.6% in rural and 18.3% tribal population. The children from 6 to 7 years had prevalence of 29.3%, decreasing significantly after this age. It was found that children 6 to 7 years old from rural population had prevalence of flatfoot 35.4% while children from tribal population only 23% , decreases significantly in children older than 6 years. In the chi square analysis we found association between flatfoot with population and body mass index (BMI).

**Discussion:** we found a higher prevalence of flatfoot in rural children compared to the tribal children suggesting an influence of social and cultural factors role in the development of flatfoot. The diminished prevalence of flatfoot after six years suggest that treatment of flatfoot before this age wasn't necessary.

## KEYWORDS

Prevalence, Tribal, Rural, Flatfoot, Primary, Children.

## INTRODUCTION:

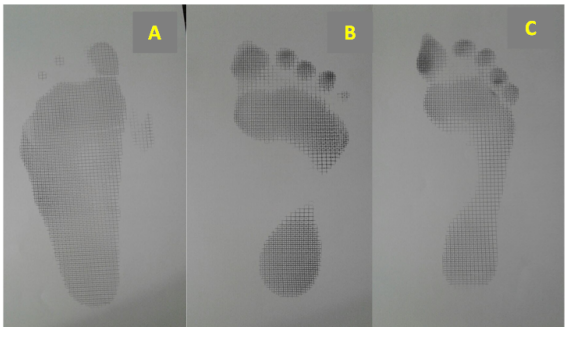
Flatfoot (Pes planus) is a common problem frequently encountered in pediatric and orthopaedic practice (1, 2). The occurrence of flatfoot is unknown, although some authors suggested that the majority of flatfeet are asymptomatic during adulthood (3). Flatfootness may exist as an isolated condition or it may be associated with broad clinical spectrum of conditions which may include neuro muscular disorders, ligament laxity, genetic and collagen disorders (4).

Flat foot is classified as physiological or pathological flatfoot. The pathological or rigid flatfoot is characterized by collapse of medial longitudinal arch during weight bearing or non weight bearing. It has multifactorial aetiology and it leads to pain and disability which requires treatment for underlying pathology (4). The physiological or flexible flatfoot, characterized by disappearance of medial longitudinal arch during weight bearing but arch appears during non weight bearing. It usually appears during the first decade of life and maybe symptomatic or asymptomatic. Risk factors like obesity, ligament laxity contribute to its persistence (5).

The prevalence of flatfoot decreases as the age of the child increases. A study in Nigeria reported prevalence of flatfoot in primary school children was 22.4% (2). Sadeghi et al reported prevalence of flatfoot in children aged 7 to 14 years is 17.1% (6). In two studies in Taiwan demonstrated that the prevalence of flatfoot in elementary school children was 59% and 28% (7, 8). Kendic et al reported that prevalence of flatfoot in primary school children in Bosnia as 22.83% (9). Pfeiffer et al reported 44% prevalence of flatfeet in preschool aged children (5). In the normal feet, 61% of the weight distributed in the posterior zone and 35% weight in the anterior zone and only 4% in the middle zone of the feet. But in the flatfeet 20 to 30% of weight distribution occurs in the middle zone of the feet (3). The change in the weight distribution from the lateral column to the medial column in children with flatfeet children leads to the abnormal gait pattern. Flatfeet in obese children may be due to the presence of fat pad under the sole of the foot, which diminishes during the formation of arches between two to five years of age (10). Other causes for flatfeet in obese may be due to collapse of the medial longitudinal arch due to over and continuous loading on the foot by excessive body mass. In another study flatfoot is more common among obese children than with normal weight children, as a result of changes which alter the structure of the foot, especially of medial longitudinal arch.

The primary objective of the study was to determine the prevalence of flatfoot in primary school children aged between 6 to 11 years in tribal and rural populations in Coimbatore, south India.

Figure 1: A) Flat Foot B) High Arch Foot C) Normal Foot




## MATERIALS AND METHODS:

A descriptive cross sectional study design was employed for this study. The study samples were selected using random sampling method. A total of 982 subjects from the study area were selected, their age ranged from 6 to 10 years from the rural and tribal schools. The Inclusion criteria were: age between 6 to 11 years, students in Coimbatore district in selected schools and having informed consent from their parents or guardians. Exclusion criteria included those with congenital or acquired neuromuscular disorder, lower limb deformity, children prior foot surgery, parents not willing to participate in the study and children who did not attend the school on the day of examination.

The samples were taken from many schools including government, private and tribal schools from Coimbatore district. Ethical clearance was obtained from Richmond Orthopedic Hospital, Coimbatore. The following were variables considered: Age, height, weight, body mass index, gender and dominance and family antecedents of foot pathology.

The height of the individuals (cm) was measured with Stadiometer (Indosurigcals) and their weight (kg) was measured using weighing scale (prestige). The flatfoot was measured using Harris foot print mat

(Diabetic foot care). The foot were cleaned thoroughly. The participant was made to walk over the foot print mat with normal weight distribution of the body. The above procedure is repeated for the other foot. The foot prints were then used to calculate the Staheli arch index. Using lead pencil, two lines were drawn one at the minimal distance of the midfoot region (A) and one at the maximal distance of the rearfoot region (B). The Staheli index was then calculated by the ratio of the minimal distance in the midfoot region to the maximal distance in the rearfoot region. An individual was considered to have flatfoot, if Staheli index value was > 1.15. This validated method of measuring Staheli Idex.

**TABLE 1: Characteristics Of Population**

| VARIABLE | TRIBAL | RURAL |
|---|---|---|
| | (n= 338) | (n= 644) |
| **GENDER - n (%)** | | |
| BOYS | 209 (61.8) | 354 (55) |
| GIRLS | 129 (38.2) | 290 (45) |
| **AGE - YEARS** | | |
| MEDIAN | 8.5 | 8.5 |
| INTER QUARTILE RANGE | 6.75-10.25 | 6.75- 10.25 |
| **AGE GROUP** | | |
| 6 TO 7 | 113 (33.4) | 192 (29.9) |
| 8 TO 9 | 116 (34.3) | 236 (36.6) |
| 10 T0 11 | 109 (32.3) | 216 (33.5) |
| **BODY MASS INDEX** | | |
| MEDIAN | 16.82 | 17.79 |
| INTER QUARTILE RANGE | 14.60-19.23 | 15.61-20.39 |
| **DOMINANCE** | | |
| RIGHT | 304 (89.4) | 597 (92.7) |
| LEFT | 31 (9.2) | 39 (6.1) |
| AMBIDEXTROUS | 3 (1.6) | 8 (1.3) |

**STATISTICS:**

The data collected were stored in a data base Microsoft Excel 2007. The qualitative variables were described in proportions and quantitative variables by mean and standard deviation if they had normal distribution or median and inter quartile range if didn't had normal distribution. The criteria to determine the flatfoot was Staheli Index (P.1.15). The participants were classified into four weight categories as follows: underweight, normal weight, overweight and obese according to growth chart by Indian Association of Pediatrics (20). Finally, a Chi square analysis was done to evaluate association of flatfoot with variables studied. Data analysis was done using SPSS software version 15. The level of significance was at $p \leq 0.01$.

**FIGURE 2: Analysis of foot print to determine the Staheli Arch Index:**

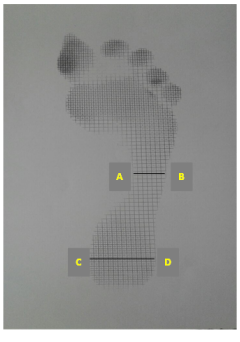



**FIG 2:** An image of Harris Mat foot print on plain paper is shown. Line AB indicates the width of narrowest part of the mid foot & CD indicates the width of widest part of the rear foot. Staheli index was calculated by dividing AB & CD.

**RESULTS:**

A total of 948 children were examined in two populations; 338 in tribal (34.4%) and 644 in rural population (65.6%). After analyzing the presence of flat footedness in tribal and rural population, rural reported a prevalence of 28.6% and tribal population of 18.3%. If we observe the age groups in each population, we find in the group from 6 to 7 years of age prevalence of flatfeet of 35.4% in rural population and 23% in tribal population and for those older than 10 years of age 27.3% in rural and 12.8% in tribal population. Regarding gender, boys had greater prevalence of flatfeet at 25.4% than girls 24.6%. The prevalence of flatfeet was highest 29.3% among 6 years old and lowest among 11 years 21.5%. The association between the age, gender and flatfoot was not statistically significant. The association between the population, body mass index and flatfoot was significant ($p < 0.001$).

**TABLE 2: Results By Population For Normal Foot And Flatfoot**

| VARIABLE | TRIBAL | | RURAL | |
|---|---|---|---|---|
| | NORMAL FOOT | FLATFOOT | NORMAL FOOT | FLATFOOT |
| | (n= 276) | (n=62) | (n=460) | (n= 184) |
| **GENDER** | | | | |
| BOYS | 169 (80.9) | 40 (19.1) | 251 (70.9) | 103 (29.1) |
| GIRLS | 107 (83) | 22 (17) | 209 (72.1) | 81 (27.9) |
| **AGE GROUP** | | | | |
| 6 TO 7 YEARS | 87 (77) | 26 (23) | 124 (64.6) | 68 (35.4) |
| 8 TO 9 YEARS | 94 (81) | 22 (19) | 179 (75.8) | 57 (24.2) |
| 10 TO 11 YEARS | 95 (87.2) | 14 (12.8) | 157 (72.7) | 59 (27.3) |
| **BMI** | | | | |
| UNDERWEIGHT | 17 (70.8) | 7 (29.2) | 25 (71.4) | 10 (28.6) |
| NORMAL WEIGHT | 206 (87.7) | 29 (12.3) | 349 (75.1) | 116 (24.9) |
| OVERWEIGHT | 29 (70.7) | 12 (29.3) | 57 (64) | 32 (36) |
| OBESE | 24 (63.2) | 14 (36.8) | 29 (52.7) | 26 (47.3) |
| **DOMINANCE** | | | | |
| RIGHT | 226 (82.8) | 47 (17.2) | 543 (91) | 54 (9) |
| LEFT | 22 (78.6) | 6 (21.4) | 22 (56.4) | 17 (43.6) |
| AMBIDEXTROUS | 2 (66.7) | 1 (33.3) | 5 (62.5) | 3 (37.5) |

**DISCUSSION:**

This study found a global prevalence of 22.3% for the rural and tribal population analyzed, compared to other studies in different world populations. The prevalence of flatfoot maybe influenced by various factors was age, gender, footwear, physical activity. According to Ezema et al, prevalence of flatfoot in the primary school children in Nigeria was 22.4% (2). In another study conducted in primary school in Bosnia by Kendic et al showed prevalence of 23.8% (9). The difference of our study outcome with the 44% prevalence reported by Pfeiffer et al and 57% by Lin et al, seems explainable given that the study by these author included population of age less than six years in which arch development was not complete. The critical period for the development of the arch is completed by six years (5,12,13).

In a study conducted in Bogota and Barranquilla, Colombia in two different populations with different social, cultural and geographical characteristics found a prevalence of 30.9% for the city of Bogota and 17.3% for the city of Barranquilla in the age group from 3 to 5 years, suggesting the influence of footwear use and its form for the development of the medial longitudinal arch (1). Joseph and Rao observed a higher prevalence of flatfoot in children using closed shoe 8.6% with respect to the children who predominantly were sandals or barefooted (14). In another study by Sachithanandam and Joseph also states an association between duration of footwear use and flatfootness(15). In our study we found prevalence of flatfoot in tribal children was 18.3% and in rural children was 28.6% maybe due to closed shoe and its use for longer duration with respect to tribal population, where the use of footwear is lower or barefooted.

**TABLE 3: Association Between Variables And Prevalence Of Flatfoot.**

| | NORMAL FOOTED | FLATFOOTED | X2 | P VALUE |
|---|---|---|---|---|
| **POPULATION** | | | 12.35 | 0.000441* |
| TRIBAL | 276 (81.7) | 62 (18.3) | | |
| RURAL | 460 (71.4) | 184 (28.6) | | |
| **GENDER** | | | 0.09 | 0.77 |
| BOYS | 420 (74.6) | 143 (25.4) | | |
| GIRLS | 316 (75.4) | 103 (24.6) | | |
| **AGE GROUP** | | | 5.54 | 0.06 |
| 6 TO 7 YEARS | 227 (70.7) | 94 (29.3) | | |
| 8 TO 9 YEARS | 252 (76.1) | 79 (23.9) | | |
| 10 TO 11 YEARS | 266 (78.5) | 73 (21.5) | | |

| | | | | |
|---|---|---|---|---|
| BMI | | | 28.79 | 0.00001 * |
| UNDERWEIGHT | 42(71.2) | 17 (28.8) | | |
| NORMAL WEIGHT | 555 (79.3) | 145 (20.7) | | |
| OVERWEIGHT | 86 (66.2) | 44 (33.8) | | |
| OBESE | 53 (57) | 40 (43) | | |

Data are presented as n (%)

*Indicates statistical significance ($p < 0.01$)

This study used Staheli index to diagnose the flatfoot and Echarri et al showed Chipaaux Simrak index and the Staheli index are more convenient method to diagnose the flatfoot and also to detect the importance of age, gender, and footwear in the formation of arch (11). But in our study difference between the age groups was not statistically significant. The prevalence of flatfoot was decreasing as the age increases. The other authors also suggested the prevalence of flatfoot was decreasing with advancing age (1, 14, 16). This may be explained by several factors like laxity of ligaments, obesity and fatty pad in the arch diminishes after six years and arch formation completes by the age of six (17).

We observed a higher prevalence of flatfoot in males than girls in both rural and tribal population. Boys had 25.4% of flatfoot compared to the girls with only 24.6% which was not statistically significant. Chen et al had that increased flatfootness in boys compared to females of same age (8). Mickel et al also found higher prevalence in boys and it was caused by thicker plantar fat in medial part of foot in males than that of females (10).

Our study also showed that the weight status was significantly associated with flatfoot. Obese and overweight children were three times more likely to have flatfoot compared with the normal weight children. A similar association has been reported by other researchers in various countries (2, 14,18). Higher prevalence of flatfoot in obese children may be related to continuous pressure applied over the medial longitudinal arch during walking (19).

The prevalence reported for rural population is significantly greater with respect to the population studied in tribal and it remains so when analysing age groups, suggesting the presence of cultural and social conditions that would affect the flatfeet.

## CONCLUSION:

The statistical data show significant difference in the prevalence of flatfoot in the populations studied. This study suggests that male gender and obesity are the risk factors of the flatfoot. Age is also another important factor for the prevalence of flatfoot which decreases as the age advances in the children. In this study, we found prevalence of flatfoot 29.3% in the age group 6 to 7 years and of 21.5% in the age group of 10 to 11 years, suggesting that treatment with orthoses or shoe inserts would not be prescribed before six years of age and parents should know the importance of barefoot walking. We felt that the differences found in the prevalence of flatfeet in both population studied may be due to social and cultural factors like the type and use of footwear.

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