The prevalence of pes planus is highly variable globally and locally. The objective of the present study was to investigate the prevalence of pes planus in children between the age of 5 to 10 years in Belagavi city.

**Materials and methods:** 590 children from the different schools in Belagavi city were selected randomly and screened. Demographic data and footprints were collected. Footprints were analysed using Chippaux-Smirak-Index.

**Results:** The overall prevalence of pes planus was 29.83%. The prevalence of pes planus was high in overweight children (60%). In males, prevalence was higher than females (M-52.84%; F-47.16%).

**Conclusion:** The present study states that there is significant association between the pes planus and BMI (p<0.05). Prevalence of pes planus is higher in overweight children than healthy and underweight children.

**ABSTRACT**

The prevalence of pes planus is highly variable globally and locally. The objective of the present study was to investigate the prevalence of pes planus in children between the age of 5 to 10 years in Belagavi city.

Materials and methods: 590 children from the different schools in Belagavi city were selected randomly and screened. Demographic data and footprints were collected. Footprints were analysed using Chippaux-Smirak-Index.

Results: The overall prevalence of pes planus was 29.83%. The prevalence of pes planus was high in overweight children (60%). In males, prevalence was higher than females (M-52.84%; F-47.16%).

Conclusion: The present study states that there is significant association between the pes planus and BMI (p<0.05). Prevalence of pes planus is higher in overweight children than healthy and underweight children.

**INTRODUCTION**

The lower limb and foot structure has been a distinguishing component for humans from other mammals since the period of evolution. The foot allows humans to attain an upright posture and is responsible for unique bipedal gait pattern. The foot is an important factor in determining the functions of lower limb. Hence it has a role to play in occurrence of repetitive lower limb injuries. It has been estimated that more than 90% of clinical visits regarding the foot problems are because of pes planus. Pes planus is a commonly discussed topic in orthopaedics and also in paediatric age groups.

The foot acts a flexible platform, which supports the body weight in upright posture and also acts as a lever to propel the body forward during walking, running and jumping. To meet these necessities, the human foot is designed in the form of elastic arches. The 3 main arches in the foot are medial longitudinal, lateral longitudinal and transverse arches. These arches passively add elasticity and flexibility to foot by allowing midfoot to spread and close. They help the foot to absorb shock, produce strength to push off, balance the body and walk. They evenly distribute the weight around the foot and act as an energy store.

These arches are present in human foot since birth but are masked in infants by excessive fat in their soles. As the child grows and starts walking, the soft tissues under the foot tighten and sharpens the arches. By the age of 2-5 years, the fat pad resolves and arches are developed as part of normal bone, ligament, muscles and tendon growth. Any abnormality in the supporting structures of medial longitudinal arch leads to deformed arch formation. The commonest deformity is the flat foot. Adequate growth and development of the arches passively add elasticity and flexibility to foot by allowing midfoot to spread and close. They help the foot to absorb shock, produce strength to push off, balance the body and walk. They evenly distribute the weight around the foot and act as an energy store.

The causes of flat foot can be congenital or acquired, the most common form being the congenital flatfoot.

**Congenital flatfoot:**
- Infantile or physiological
- Congenital vertical talus

**Acquired flatfoot:**
- Occupational
- Obesity
- Postural
- Secondary to anatomical defect elsewhere
  - Genu valgum
  - Equinus deformity of the ankle
  - Varus deformity of the foot

There are two types of pes planus: Rigid and Flexible. A rigid pes planus is structural where the medial longitudinal arch is absent in weight bearing and in non-weight bearing. In flexible pes planus, the arch is reduced during normal weight bearing but reappears during toe standing or non-weight bearing position of the foot.

In pes planus, the forces created during walking, running and jumping are transmitted to the metatarsals, then to upper parts of the body and may result in different problems of foot, ankle, knee and spine. This condition if not diagnosed and treated early, may result in bony changes and may persist in adulthood.

There are various methods available to diagnose pes planus some of which are foot printing X-ray, laser scanning measurement, plantar pressure measurement, MRI scanning, Plantar Arch Index (PAI), Navicular Height Test, Chippaux-Smirak-Index and Clarke's Angle of which Chippaux-Smirak-Index was found to be the most reliable method.

Chippaux-Smirak-Index: CSI is calculated by dividing the value of the narrower zone of the midfoot by the value of parallel line on wider zone of the forefoot and multiplying by 100.

According to Chippaux-Smirak Criteria, more than 45% is considered as the flatfoot.

**MATERIALS AND METHOD**

Before the commencement of the descriptive cross-sectional study, an ethical clearance was obtained from the institution. The list of the schools in Belagavi city was obtained from the block education officer and computer based randomization was done. 590 children including 329 males and 261 females, between the age of 5 to 10 years were randomly selected from these schools. Children with burns, fractures or boils over the foot, congenital deformities of lower extremities and who had underwent corrective surgical management were excluded. An informed assent was taken from the guardians and enrolment in.
the study was done. A brief demographic data including weight and height was noted. The children were asked to wash and dry their feet and were made to sit. After that they were asked to dip their right foot in a tray with red ink and were made to place it on a blank sheet and were asked to stand. Same procedure was repeated for left foot using a tray with blue ink. 2-3 prints were repeated and the best one was selected and analysed using Chippaux-Smirak-Index for pes planus.

CSI was calculated by drawing a tangential line connecting the first metatarsal head and the heel. Another two lines were drawn to know the maximum width of the metatarsals (A) and narrowest portion of the arch (B).

$$\text{CSI} = \frac{B}{A}$$

According to Chippaux-Smirak criteria, CSI more than 45% was taken as pes planus.

Weight and height of the children were measured in kilograms and centimetres and body mass index was calculated.

$$\text{BMI} = \frac{\text{weight (kgs)}}{\text{height (m)}}$$

RELIABILITY OF MEASUREMENTS

Analysis of all the footprints were done by only one investigator in order to minimize the inter examiner error. Also weight and height were measured by one investigator.

DATA ANALYSIS

All collected data was entered in the excel sheet and was analysed statistically using SPSS version 21. Participants were categorised in 6 groups according to their age-5,6,7,8,9 and 10 years. Depending upon BMI scores, participants were grouped into 4 categories as underweight, normal weight, overweight and obese as per the WHO classification. In the present study we found no participant belonging to obese category. Overall prevalence, prevalence of unilateral and bilateral pes planus was calculated. By One Way ANOVA method, comparison of pes planus with BMI scores was done. Correlation between BMI and pes planus was found out by using Karl Pearson’s correlation coefficient method.

RESULTS

The overall prevalence of pes planus in the present study was 29.83% (176 out of 590). 92 males (52.27%) and 84 females (47.72%) presented with pes planus. 152 children had right sided and 136 children had left sided pes planus. When categorised by CSI, 81 males and 71 females showed pes planus on right side while 74 males and 62 females on left side. 63 children had unilateral and 113 had bilateral pes planus. Flexible type was seen in 169 (28.64%) and rigid type was seen in 7 (1.19%) children. 177 (43%) of pes planus were with normal BMI and 60 % of overweight subjects had pes planus. According to WHO classification of BMI, in the present study bilateral pes planus was more common than unilateral pes planus. According to a research conducted in Nigeria flexible type of pes planus was more common than rigid type. Above mentioned studies are consistent with the result of the present study where flexible type of pes planus was more common than the rigid type.

According to WHO classification of BMI, in the present study it was found that 10.44 % of children were underweight, 31.49 % were with normal BMI and 60 % of overweight subjects had pes planus. In the previous studies they have found an association between BMI and flatfoot. A study carried out in Nigeria (2014) and Taiwan (2010) and in (2011) found that as the BMI increases the prevalence of pes planus also increases. In Germany showed that pes planus is more common in overweight children.
CONCLUSION

The present study concludes that the prevalence of pes planus in 5-10 years aged children in Belagavi city of Karnataka state is 29.83%. The study further suggests that there is significant association between BMI and pes planus (p<0.05). The prevalence was high in overweight children. The study also states that Right side was more involved but was not statistically significant. In our study the bilateral flatfoot was more prevalent than unilateral which was statistically significant. Another significant factor is flexible type of pes planus is more prevalent than rigid type. There is no significant influence of gender on pes planus, even though it is more prevalent in males than females.

ABBREVIATIONS

BMI: Body Mass Index
CSI: Chippaux-Smirak-Index
SPSS: Statistical Package for the Social Sciences
WHO: World Health Organization

REFERENCES