ORIGINAL RESEARCH PAPER

Paediatrics

Volume - 7 | Issue - 4 | April-2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

PREVALENCE OF PES PLANUS IN CHILDREN BETWEEN THE AGE OF 5 TO 10 YEARS IN BELAGAVI CITY: A CROSS SECTIONAL STUDY

KEYWORDS: pes planus, chippaux-smirak-index, BMI

Vinuta Deshpande | Aditi Swami

Tanaya Prabhu | Vivekanand Neelgund

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 Chipaux-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 mammalians since the period of evolution. The foot allows human 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.[1] 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.[2] 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.[3] 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 tightens and sharpens the arches.[1] 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, also known as pes planus. The pronated posture of hind foot and decreased medial longitudinal arch is termed as pes planus. The reported prevalence of pes planus in SriLanka was 16.06% in age group of 6-10 years.[4] Another study reports prevalence of 25% in Yoruba ethnic group of Nigeria.[5]

The causes of flatfoot can be congenital or acquired, the most common form being the congenital flatfoot.[3]

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.[6]

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.[3]

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.[7]

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

Volume - 7 | Issue - 4 | April-2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

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 taken 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).
CSI=B/A*100

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.
BMI=weight(kgs)/height^2(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 out of the total population screened. [Table no.1].

Table I Distribution Of Pes Planus By Gender, Side and type

	Male	Female	Total
Pes Planus	92 (52.27%)	84 (47.73%)	176/590 (29.83%)
Normal	237(57%)	177 (43%)	414/590 (70.17%)
Right (By CSI)	81 (53.29%)	71 (46.71%)	152/590 (25.76%)
Left (By CSI)	74 (54.41%)	62 (45.59%)	136/590 (23.05%)
Flexible type unilateral	-	-	63/176 (35.79%)
Flexible type bilateral	-	-	106/176 (60.22%)
Rigid bilateral	-	-	7/176 (3.97%)

Table no. II gives the prevalence of pes planus according to BMI. 7 out of 67 underweight (10.44%), 160 out of 508 normal weight (31.49%) and 9 out of 15 overweight (60%) children had pes planus.

Table II. Prevalence of pes planus according to BMI

Category according to BMI	No. of children	No. of Children with Pes Planus	% Of Pes Planus
Underweight	67	7	10.44
Normal weight	508	160	31.49
Overweight	15	9	60%

Using karl Pearson's correlation coefficient method, the BMI was compared with CSI of right and left side as shown in table no.III The obtained p value was 0.0001 which is less than 0.05 which says that the correlation is highly significant. When values of CSI on right side were compared with the values of CSI on left side, the calculated p value was less than 0.05, and thus it states that the results are highly significant.

Table III. Correlation between BMI with CSI on right and left side by Karl Pearson's method

Variables	Correlation among		
	r-value	t-value	p-level
BMI=Kg/m with CSI right	0.3540	9.1775	0.0001
BMI=Kg/m with CSI left	0.3280	8.4196	0.0001
CSI right with CSI left	0.7927	31.5314	0.0001

DISCUSSION

Prevalence of pes planus is highly variable globally and locally. Variability is influenced by many factors such as age, gender, genetic composition, developmental milestones, environmental conditions, physical activity and footwear. According to review of literature, studies done in Taiwan showed a prevalence rate of pes planus as 59%[8] and 29%[9]. The overall documented prevalence of pes planus in Sri Lanka was 16.06%.[4] A study done in India recorded the prevalence of pes planus in children aged 6-10 years as 8.2% in the year 1992.[10] In the present study the total participants screened were 590 school-going children between the age group of 5-10 years, among them 329 were males and 261 were females. The participants' foot prints were analysed using Chippaux-Smirak-Index and the overall prevalence calculated was 29.83%.

A study conducted in Nigeria stated that the prevalence of bilateral pes planus is more than unilateral pes planus.[6] In the present study bilateral pes planus was more frequent than unilateral pes planus, the prevalence was 19.15% and 10.68% respectively. When the data was analysed to find the prevalence of pes planus on right foot and left foot, it was found that the occurrence of pes planus was more on the right side. In males the prevalence rate was more on the right side and the same was noted in females.

A study carried out in Iran concluded that the prevalence of pes planus in children was considerable and most of them were flexible pes planus.[3] Another study done by Mihanpor Taheri (1994) showed that flexible type was more common than rigid type of pes planus[3]. According to a research conducted in Nigeria flexible type of pes planus was more common than rigid type.[6] 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.[6,8,9] According to Ester et al.(2013) overweight and obese children had higher frequency of pes planus.[11] Another study conducted in Germany showed that pes planus is more common in overweight children.[12]

Volume - 7 | Issue - 4 | April-2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

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

1. Halabchi F, Mazaheri R, Mirshahi M, Abbasian L. Paediatric flexible flatfoot; clinical aspects and algorithmic approach (2013, June) https://tspace.library.utoronto.ca/bitstream/1807/59310/1/pe13050.pdf
2. B.D.Chaurasia, Textbook of Human Anatomy, Volume 2, 5th Edition, P.No. 169.
3. Armin Abtahian, Sina Farzan. A Study of Flatfoot in High School Children.(2016, april) http://www.alliedacademies.org/articles/a-study-of-the-prevalence-of-flatfoot-in-high-school-children.html
4. Senadheera. V., Nawagamuwa, B., Nidhya, K., Sivappriyan, S., Warnasooriya, W., Madhuranga, P., & Peiris, H. Prevalence and associated factors of flatfoot among 6-10 years aged children in central province of Sri Lanka. (2016, may). https://www.ijphy.org/articles/Vol%203%20Issue%203/11IJPHY391.pdf
5. M.B.T Umar, Adeyemi Paul. Incedence of flatfoot and anthropometric comparison between flat and normal foot of the Yoruba ethnic group of Nigeria. (2010) http://docsdrive.com/pdfs/medwelljournals/rjasci/2010/412-416.pdf
6. C.I. Ezema, MSc, MD,U.O. Abaraogu, BMR, MSc,G.O. Okafor, BMR. Flat foot and associated factors among primary school children: A cross-sectional study.(2014) https://www.researchgate.net/profile/Ukachukwu_Abaraogu2/publication/259140951_Flat_foot_and_associated_factors_among_primary_school_children_A_cross-sectional_study/links/0c960532b5fd6cfeaf000000.pdf
7. Onodera AN, Saccoa ICN, Morioka EH, Souza PS, deSa MR, madio AC: What is the best method for child longitudinal plantar arch assessment and when does arch maturation occur? (2008) https://www.researchgate.net/profile/Isabel_Sacco/publication/42388456_What_is_the_best_method_for_child_longitudinal_plantar_arch_assessment_and_when_does_arch_maturation_occur/links/00b4951ace4274ffa9000000.pdf
8. Chang, J.H.,Wang,S.H.,Kuo,C.L.,Shen,.H.C.,Hong,Y.W.,Lin,L.C. Prevalence of flexible flatfoot in taiwinese school-aged children in relation of obesity,gender and age. (2010, April) https://link.springer.com/article/10.1007/s00431-009-1050-9
9. Chen,J.P.,Chung,M.J.,Wang,M.J Flat Foot prevalence and foot dimension of 5-13 years old children in Taiwan. (2009) http://journals.sagepub.com/doi/abs/10.3113/FAI.2009.0326
10. Rao,O.B, & Joseph, B.the prevalence of foot wear on the prevalence of Flatfoot ;a survey of 2300children.(1992) http://www.bjj.boneandjoint.org.uk/content/jbjsbr/74-B/4/525.full.pdf
11. Ester, O.J.,Aguadao,Abellan,L.D., Mecerreyes,L.,Alegre L.M foot morphology in normal in normal weight, over weight and obese school children.(2013, May) http://www.uclm.es/profesoradO/xaguado/ASIGNATURAS/cursos/Paradar/3FootMorpholEurJPediatr2013.pdf
12. M Mauch, S Grau, I Krauss, C Maiwald and T Horstmann. Foot morphology of normal, underweight and overweight children. (2008) http://www.nature.com/ijo/journal/v32/n7/full/ijo200852a.html