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Prevalence of Flatfoot among Adolescents by Using Navicular Drop Test.

V. Senthil Prabhu[*1], D.Kesavi[2] and E. Kayalvizhi[3]

[1*]Meenakshi Academy of Higher Education & Research (MAHER), Chennai. TN
[2]Sri Ramachandra Medical College & Research Institute, Chennai. TN
[3]Dept of Physiology, Meenakshi Medical College Hospital & Research Institute, Kanchipuram. TN

ABSTRACT:

Flatfoot is one of the commonly observed foot deformities in the clinical practice. Medial longitudinal arch height determines the extent of flatfoot. Most of the prevalence studies in India on prevalence of flatfoot were done in adults. Aim of the study – to establish prevalence of flat foot in urban school adolescents between 14 to 16 years of age in Coimbatore, Tamilnadu. This cross sectional study involved 333 urban school adolescents (175 boys and 158girls) between the ages of 14 to 16 years. The flatfoot diagnosis was made using Navicular Drop Test, Where values ≥ 10mm were indicative of flatfoot. Statistical analysis was done using SPSS version 15.0. The prevalence of flatfoot was 20.1% (for boys- 22.3%; for girls -17.7%). The median Inter Quaterile range (IQR) for ND among boys was 7.7 mm (6.3 -10.2) and 7.6 mm (6.3 -10.3) for right and left respectively. The correlation of Navicular Drop with weight and BMI was significant, but insignificant correlation with was found between Navicular drop and height. The difference between the Navicular Drop of boys and girls group was statistically not significant. The present study established the prevalence of flexible flatfoot and gender wise normative values of Navicular Drop among 14 – 16 years old urban school adolescents and a positive correlation between Navicular Drop and BMI. The data collected in the study will be useful in the field of Orthopaedics and physiotherapy.

KEY WORDS: Flatfoot, adolescents, urban, medial longitudinal arch, Navicular Drop.

*Corresponding author

V.SenthilPrabhu

PhD scholar

Meenakshi Academy of Higher Education & Research (MAHER),

Chennai. Tamil Nadu

INTRODUCTION :

The foot arch is one of the most dynamic structure in the human body and it has essential functions like shock absorption, transmission of body weight and acts as a lever for propulsion of the body during locomotion[1,2,3].Medial longitudinal arch is an important factor determining the flatfoot[3]. Flatfoot (pesplanus) is a common clinical condition in the paediatric population in abroad. In developing countries like India, it's frequently ignored.Flatfoot may exist as isolated condition or it may be associated with broad clinical condition which includes – ligament laxity, muscular, collagen, neurological and genetic disorders[3].

The flatfoot classified as pathological or physiological flatfoot [4]. The pathological or rigid flatfoot is characterized by the loss of medial longitudinal arch even during non weight bearing. It has multiple etiologies and leads to pain disability which requires treatment for underlying pathology includes idiopathic short achiles tendon, congenital vertical talus and accessory scaphoid bone[5, 6].The physiological or flexible flatfoot is characterized by the flattening of medial longitudinal arch during weight bearing and it appears during non weight bearing. It may be symptomatic or asymptomatic. It may be associated with factors like ligament laxity and body weight. The risk factors include younger age, male gender, over weight and obesity[5].

The feet of children at birth appear to be flat due to presence of fat under the sole. The arches become visible only when child starts walking and during weight bearing [7]. The arches of foot begin to develop between two to five years and completely mature around the age of twelve to fifteen years [8]. Prevalence of flatfeet is more among children mainly due to ligament laxity and early shoe wearing habit affects the development of medial longitudinal arch [9].

The prevalence of flatfoot decreases significantly with increasing age [9]. Higher prevalence is reported among children between two to six years of age (21 to 57%) which decreases to (13.4% to 27.6%) in primary school children [1]. Pfeiffer et al reported 44% in a study conducted in USA aged between 3 to 6 years [5]. Bordin et al found that the prevalence 16.4 % among children aged between 8 to 10 years in Italy [10]. Though, many studies regarding prevalence of flatfoot had been done in many countries. Prevalence studies in south India is limited and methods employed to diagnose the flatfoot are not reliable [11, 12]. So the present study aimed to determine the flatfoot using more reliable and valid clinical assessment Navicular Drop Test (NDT).

MATERIALS AND METHODS :

This was prevalence, cross sectional study in which (708 boys and 604 girls) urban adolescents studying in private and government school aged between 14 to 16 years in Coimbatore, Tamilnadu. Subjects were selected using random sampling method. Informed consent obtained from

their parents or guardian. Ethical clearance for the study was obtained from the Richmond Orthopaedic Hospital Ethical Committee, Coimbatore.Inclusion criteria: aged between 5 to 16 years, school children from selected schools and informed consent from their parents or guardian.Exclusion criteria: included those with congenital disorder, gait deformity, neuromuscular disorder. Parents refused to participate in the study and who didn't sign the informed consent and the children who didn't attend the school on the day of evaluation.

The demographic data such as age, gender, height and weight of each child were recorded. The Navicular Drop Test was measured by Brody Method [13]. Each participant was made to sit relaxed in chair with hip and knee flexed at 90 degree and the foot was placed flat on firm surface. The examiner ensured that the ankle and subtalar joints were placed in neutral position. The height of the navicular tuberosity is marked in the sitting position with the index card. The children were made to stand with equal weight bearing on both the feet. Now the new point of the navicular tuberosity is marked on the index card. The difference between the two lines on the index card was measured with digital (Baker's) verniercalliper. The navicular drop was measured for both feet in each child.

STATISTICAL ANALYSIS:

SPSS 15 version was used to analyse the data. The normality of the data was tested using Shapiro – Wilk test. Median and Inter Quartile Range (IQR) were calculated for demographic data and ND since the data was normally distributed. The Navicular Drop among boys and girls was compared using Mann Whitney U test. The criteria to determine flatfoot was ND $\geq$ 10 mm. Using this criteria, the prevalence was calculated separately for boys and girls and also for whole population. The level of significance was set at $p \leq 0.05$.

TABLE 1: Prevalence of flatfoot in high school adolescents.

	TOTAL SAMPLE	RIGHT SIDE	LEFT SIDE	BILATERAL
BOYS	175	4(2.3%)	9(5.1%)	39 (22.3%)
GIRLS	158	4(2.5%)	6(3.8%)	28(17.7%)
TOTAL	333	8(2.4%)	15(4.5%)	67(20.1%)

RESULTS:

Subjects in the present were high school adolescents, in the age group of 15 to 16 years. The height, weight, BMI, right and left side navicular drop distribution among the study population calculated. The normality of the distribution was estimated with Shapiro Wilk test. The data distribution was not normally distributed. So, Median and Inter Quartile Range (IQR) were expressed for descriptive statistics.

The right and left side navicular drop was compared using Mann Whitney U test. The difference was not statistically significant. The entire study sample for right and left side navicular

drop was also compared using Mann Whitney U test. The difference between the right and left side was not statistically significant.

Spearman's correlation was used to compare navicular drop with height, weight and BMI. The correlation of navicular drop with height was not statistically significant. Butwith weight and BMI the correlation was statistically significant.

TABLE 2: Distribution of height, weight, BMI and Navicular drop (ND) among high school adolescents.

		HEIGHT (CM)	WEIGHT (KG)	BMI (KG/M2)	RND(MM)	LND(MM)
BOYS (N=175)	MEAN (±SD)	155 (±9.6)	51 (±10.5)	21 (±3.2)	8 (±2.1)	8 (±2.2)
	MEDIAN (IQR)		51 (44.8 to 56.3)	20.4(19.2 to 23.5)	7.7(6.3 to 10.2)	7.6 (6.3 to 10.3)
	RANGE	135-173	31-84	15.31-28.70	5.08-12.65	5.04-13.08
GIRLS (N=158)	MEAN (±SD)	152 (±9.97)	51 (±11.70)	22 (±3.63)	8 (±2.06)	8 (±2.20)
	MEDIAN (IQR)	153(143 to 160)	51(42 to 59)	21.5(19.5 to 24.3)	7.9(6.6 to 10.2)	7.7(6.2 to 10.3)
	RANGE	134-173	29-80	15.24- 28.93	5.09-13.08	5.39-11.09
TOTAL (N=333)	MEAN (±SD)	153 (±9.8)	51.3 (±11.1)	21.6 (±3.5)	8.3 (±2.1)	8.2 (±2.2)
	MEDIAN (IQR)	155 (143 to 161)	51 (43 to 68)	20.8(19.3 to 26.7)	7.8 (6.5 to 10.2)	7.6 (6.2 to 10.2)
	RANGE	134-173	29-84	15.24-28.93	1.08-13.08	5.4-13.08

TABLE 3: Comparison of Navicular Drop (ND)

	RND(BOYS VS GIRLS)	LND (BOYS VS GIRLS)	RND VS LND (TOTAL SAMPLE)
MANN WHITNEY TEST	12397.5	13106.5	51361.5
P- VALUE	0.31	0.85	0.45 NS

NS – statistically not significant

TABLE 4: Correlation between Navicular Drop with BMI, weight and height.

	CORRELATION WITH	SPEARMAN' S RHO	P- VALUE
RIGHT NAVICULAR DROP	HEIGHT	-0.022034	0.70 NS
	WEIGHT	0.16064	0.005*
	BMI	0.27148	0*
LEFT NAVICULAR DROP	HEIGHT	-0.006674	0.90 NS
	WEIGHT	0.12033	0.03*
	BMI	0.21246	0.00024*

*Indicates statistical significance ($p < 0.01$)

NS – statistically not significant.

DISCUSSION:

Flatfoot is a common condition found in children usually less than 8 to 10 years old and differs among age groups (5, 16). As the age increases the prevalence of flatfoot decreases because the maturation of the arch completes by 12 to 13 years of age. Medial longitudinal arch rapidly

develops up to 6 years and gradually up to 10 years without any changes thereafter (17). Majority of the authors studied prevalence of flatfoot in children. The purpose of our study is to determine the prevalence of flatfoot among adolescents aged 14-16 years of age group through Navicular Drop Test and its correlation with demographic variables.

The Navicular Drop is defined as the change in the navicular bone height when the foot moves from subtalar neutral or non weight bearing position to weight bearing position (14). Brody and Muller et al. reported normal value for Navicula Drop was less than 10mm (13, 15). So, in our study we considered a Navicular Drop of ≥ 10mm as Flexible Flatfoot.

The prevalence of bilateral flatfoot was found to be 20% in our study. In consistent values for flat foot prevalence among adolescents has been reported by many researchers. This is due to the different methods used to measure the flatfoot. The present study applied Navicular Drop Test to diagnose the flatfoot. The Navicular Drop method has proved to be valid and reliable compared to the footprint and visual assessment methods used by the other authors to assess the flatfoot (11, 12). Very few flatfoot prevalence studies reported boys and girls group separately. Present study reported prevalence of flexible flatfoot among boys and girls to be 22.3% and 17.7% respectively.

There is no consensus over normal values of Navicular Drop Test among different authors. Also, the authors have used different methods to measure the Navicular Drop. Brody and Muller et al have observed 15mm, 10mm as the upper limit of the Navicular Drop in their study (18). Only few studies reported gender wise separate values for right and left foot. In our study, we found the median values with Inter Quaterlie Range for Navicular Drop among boys as 7.7(6.3 to 10.2) and 7.6 (6.3 to 10.3) for right and left sides respectively.

Fukano et al found that normal values for Navicular Drop are difficult to estimate as it's influenced many factors like age, gender and BMI (19). We also evaluated correlartion of Navicular Drop with height, weight and BMI. The correlation of Navicular Drop with height is not statiscally significant. However, correlation with weight and BMI with Navicular Drop was statiscally significant.

CONCLUSION:

The present study concludes that the prevalence of flatfoot in urban school adolescents aged between 14-16 years was 22.3%. The study has estimated that gender wise normative values for Navicular Drop and also the influence of height, weight and BMI on Navicular Drop. The information obtained from this study will be useful in the field of orthopaedics and physiotherapy.

CONFLICT OF INTEREST:

The authors have no conflict of interest relevant to this article

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