**Original article:**

# Prevalence of flat foot among 18 -25 years old physiotherapy students: cross sectional study

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**Abstract**

**Background:** Pes-planus ('flat foot') is one of the most common conditions observed in adult health practice. The objective of our study wasto find out prevalence of flat foot in a population of 18 to 25 year old physiotherapy students and to find out correlation of BMI with arch index

**Methodology:** A cross sectional study was conducted with sample of 80 physiotherapy students fitting in inclusion criteria. Different outcome of the study that is navicular drop test, arch index, foot posture index were assessed for each subject.

**Result :** Prevalence of flat foot in a population of 18 to 25 years old physiotherapy students was 11.25% for all subject affected with bilateral flat foot.  According to theage, 18 years were having 2.5% of flat foot bilaterally, 19 years were having 3.75% flat foot bilaterally, 22 years were having 3.75 % flat foot bilaterally, 24 years were having 1.24% flat foot bilaterally. The mean Navicular drop test value was 11.11 for all subject affected with bilateral flat foot and 6.66 for normal subjects & pronation score (FPI) for flat foot subjects mean was 7.44 (+6 to +11) bilaterally.

**Conclusion:** From our study we concluded that, prevalence of flat foot in a population of 18 to 25 years old physiotherapy students was 11.25% and all subject affected with bilateral flat foot. There was no significant difference according to gender & there is no correlation of BMI with arch index.

**Key Words:** Flat Foot,Arch Index,Navicular Drop test,Foot Posture Index.

## Introduction

Pesplanus ('flat foot') is one of the most common conditions observed in adult health practice.[1] The true prevalence of flatfoot is unknown, primarily because there is no consensus on the strict clinical or radiographic criteria for defining a flatfoot.[1] But some authors reported that the prevalence of flexible flatfoot in children, (2 to 6 years of age) is between 21% and 57%, and the percentage has decreased to 13.4% and 27.6% in primary school children.[2] Literature on the incidence and symptomatology of adult flatfoot is limited . Ferciotestimated a 5% incidence of flatfoot in all children and adults.[3] Harris and Beath studied 3,619 Royal Canadian Army recruits and found that 15% had a simple hypermobile flatfoot, 6% had simple hypermobile flatfoot with a tight heel cord, and 2% had a tarsal coalition.[4]

The development of foot arch is rapid between 2 and 6 years of age and becomes structurally matured around 12 or 13 years of age. A flexible flat foot has an arch that is present in open kinetic chain (non-weight bearing) and lost in closed kinetic chain (weight bearing). A rigid flatfoot has loss of the longitudinal arch height in open and closed kinetic chain, generic classification of flat foot deformities that differentiated between flat feet due to physiological and pathological etiologies. Causes of flat foot can be Congenital flat foot, adult flexible flat foot, posteriortibial tendon dysfunction, tarsal coalition,peroneal spastic flat foot, latrogenic, post traumatic arthritis, charcot foot,neuromuscular flat foot.[5]

Foot and ankle specialists agree that flatfoot is a frequently encountered pathology in the adult population. Adult flatfoot is defined as a foot condition that persists or

develops after skeletal maturity and is characterized by partial or complete loss (collapse) of the medial longitudinal arch. [6]

Adult flatfoot may present as an incidental finding or as a symptomatic condition with clinical consequences ranging from mild limitations to severe disability and pain causing major life impediments. The adult flatfoot is often a complex disorder with adiversity of symptoms and various degrees of deformity. Pathology and symptoms are caused by structural loading changes along the medial foot and plantar arch, as well as by collapse through the midfoot and impingement along the lateral column andrearfoot. Muscles in the leg and foot tend to fatigue and cramp because of overuse.[8]

Till date majority of studies on prevalence of flat foot are conducted on Children below 10 years of on the adults, but minimal literature is available with studies on 18-25 years age group. Arch index, Navicular drop test and FPI are the common method for assessing prevalence of flat foot.Hence this study was undertaken to find out Prevalence of flat foot in 18 -25 years old physiotherapy students and to find out co relation of BMI with arch index.

**Material and Method**

This cross sectional study was conducted in PDVVPF's,College of Physiotherapy, Vilad, Ahmednagar between April – 2013 to May 2013 which included 80 physiotherapy students. Convenience sampling method was followed for the study.The Ethical clearance was obtained for the study from Institutional Ethical Committee(IEC).Written informed consent was obtained from all the subject fitting in inclusion criteria .Initially the demographic data that is Name, Age, Gender, Height, Weight & BMI was assessed. After that subjects were assessed for navicular drop test, arch index, foot posture index

**ARCH INDEX**: [7]Each subject asked to deep the both the foot in the foot tray containing blue ink.Than he was asked to walk on the white floor or on the white paper strips.

Using foot print method a foot axis was drawn from the centre of the heel to the tip of the second toe & the foot print will be divided into equal thirds by constructing lines tangential to the foot axis. AI was calculated as the ratio of area of the middle third of the foot print into the entire foot print area.The lower the arch the higher the AI.(**Photo no 1**)

**NAVICULAR DROP TEST:** [9],[10],[12]For checking navicular drop test, the subject was first positioned in standing i.e. weight bearing position. Using a small rigid ruler, the height of the navicular bone was measured from the floor to the most prominent part of navicular tuberosity when in the neutral talar position. Again the height of the navicular bone was measured in relaxed sitting position i.e. non weight bearing .The difference in measurement is the navicular drop and drop>10mm will be regarded as pesplanus**.(Photo no.2)**

**FOOT POSTURE INDEX:**[11]For checking the FPI, the subject was positioned in standing & the foot was in observed 3 direction by the physiotherapist i.e. anterior, medial, posterior directions. FPI was assessed using following six criteria: 1) Palpation of the head of the talus **,**2) Observation of the curves above and below the lateral malleoli,3) The extent of the inversion/eversion of the calcaneus ,4) The bulge in the region of the talo-navicular joint , 5) The congruence of the medial longitudinal arch and 6) The extent of abduction/adduction of the forefoot on the rearfoot**.**The master chart was prepared using scores of all three outcome.

**Result**

Gender wise distribution of subject in which 17% subject include in males& 83% include in females.

Subject according to BMI: 27 subjects were underweight i.e. <18, 44 subjects were having normal weight i.e. 18-24.9, 8 subject were overweight i.e. 25-29.9, 1 subject having grade I obesity i.e. 30- 34.9.
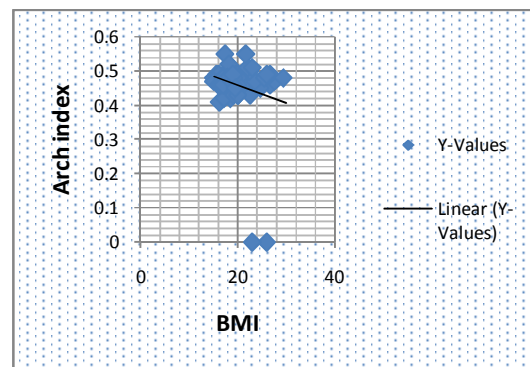
**Table No. 1- Distribution of arch index according to BMI**.

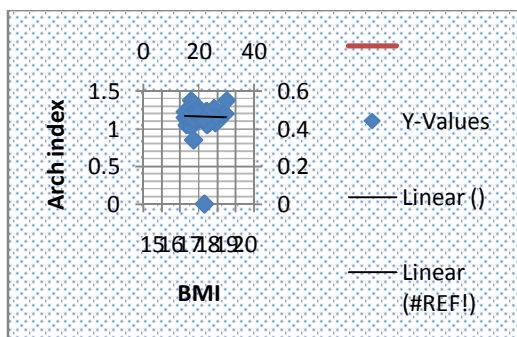| Subject no | BMI | | Arch index | |
|---|---|---|---|---|
| | | | RIGHT | LEFT |
| 27 | <18 | Underweight | 0.47 | 0.47 |
| 44 | 18-24.9 | Normal | 0.44 | 0.44 |
| 8 | 25-29.9 | Overweight | 0.53 | 0.53 |
| 1 | 30-34.9 | Grade-I obesity | 0.55 | 0.55 |

**Graph No.1-Distribution of arch index according to BMI**
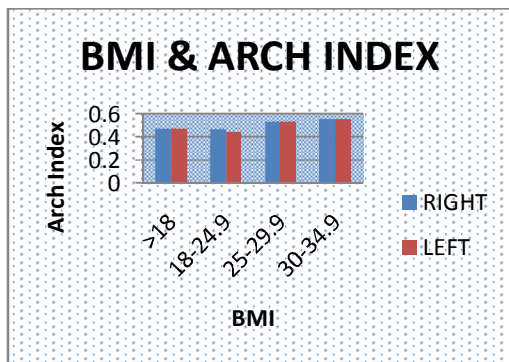


**Graph No.-3 Correlation between BMI & arch index (Left foot)**



**Graph No.2- Correlation between BMI & arch index (Right foot)**



**Graph 2 and Graph 3 shows that there is no corelation of BMI and Arch index in Right and Left Foot.**

**Table No.2- Distribution of subject according to navicular drop test score.**

| | NO. of subject with score >10mm | No. of subject with score <10mm |
|---|---|---|
| **No. of subject** | 9 | 71 |
| **Percentage (%)** | 11% | 89% |

**Graph No.4- Distribution of subject according to navicular drop test score.**

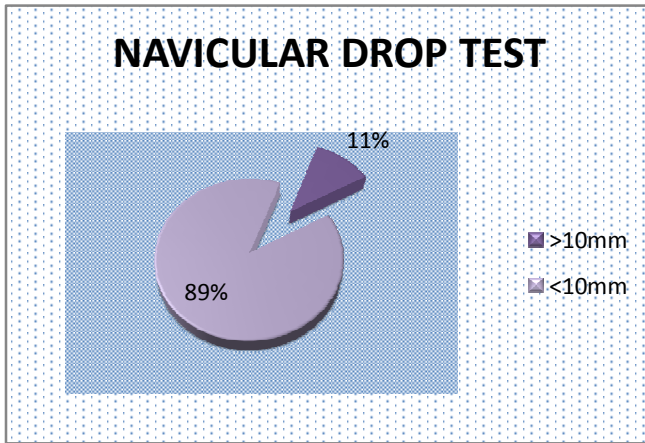## NAVICULAR DROP TEST

11%

89%

>10mm

<10mm

Table No. 2 shows distribution of subject with navicular drop test score < 10mm,> 10mm base on navicular drop test in that 9(11%) of subject were having score > 10mm (flatfoot)& 71(89%) of subject were having score <10mm (normal).

**Table No.3- Distribution of subject according to Foot posture index.**

| | No.of subject with score 0 to +5 (Normal) | No.of subject with score +6 to +9 (Pronated) | No.of subject with score -1 to -4 (supinated) | No.of subject with score -5 to -12 (Highly supinated) |
|---|---|---|---|---|
| No. of subject | 61 | 9 | 8 | 0 |
| Percentage(%) | 79 | 11 | 10 | 0 |

**Graph No.5- Distribution of subject according to Foot posture index.**
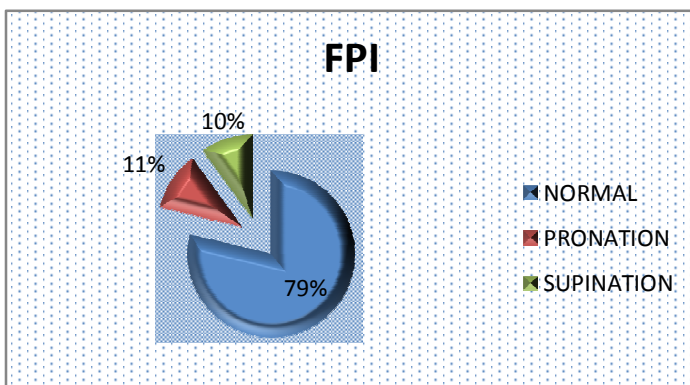
### FPI

10%

11%

79%

NORMAL

PRONATION

SUPINATION

Table No.3 shows distribution of subject according to foot posture index, in that 79% subject were having normal FPI,11% subject were having

pronated FPI, 10% subject were having supinated FPI, no one was having highly supinated FPI.

**Discussion**

Our study was to find out the prevalence of flat foot in a population of 18 to 25 year old Physiotherapy students. By the careful examination of the foot prints of 80 subjects, the presence of bilateral flat foot was determine in 9 subjects (11.25%), vs. 71 subjects (88.75%) with normal arch. According to age 18 years were having 2.5% of bilateral flat foot, 19 years were having 3.75% bilateral flat foot, 22 years were having 3.75% bilateral flat foot, 24 years were having 1.25% bilateral flat foot.Result shows no significant difference according to gender & there was no correlation of BMI with arch index.FeridunÇilli, M.D.,

ÖzcanPehlivan, M.D., KenanKeklikçi, M.D.,et al in their study on prevalence of flatfoot reported in the literature[13,14,15] is usually for children younger than 8-10 years old and differs among age groups. As the age of the group increases, prevalence of the flatfoot decreases due to its benign nature of spontaneous correction. It was reported that[15] 43% of children had moderate and 14% had severe flatfoot in the age group of 2-3 years. The prevalencedropped to 31% for moderate and 9% for severe flatfoot in the age group of 3-4 years, 24% for moderate and 4% severe at age group of 4-5 years, and 19% for moderate and 2% for severe in the age group of 5-6 years. In a different study,[16] it was also reported that the prevalence of flatfoot was 16.4% in the age group of 8-10 years. Our study group includes boys and girls of 18 and 25 years old. Prevalence of the bilateral flatfoot in our group was 11.25%. Considering our result and spontaneous resolution after the first decade, it can be said that real prevalence of symptomatic flatfoot is not very high in adolescents.SašaMilenković et al in their study found that in adults, the flexible flat foot may be regarded as the normal contour of a strong and stable foot, rather than the result of weakness in foot structure or weakness of the muscles in the foot. No associated complaints were reported among studied cases.[8]In our study pronation score (FPI) for flat foot subjects mean was 7.44(+6-+11) bilaterally. In previous study by Martin Pfeiffer et al the average valgus varied significantly with age: the 3-year old children had a mean valgus of 6.4° (range: 2–24°),but the valgus was reduced to 4.5° (range: 2–13°) in the 6-year-old children.[17]Medial arch improves with increasing age, very quickly up to 6 years, slowly up to 10 years, and without significant change thereafter.[18-22]Hassan Daneshmandi et al found that obese children have a greater tendency for flat foot than normal-weight children.[23] Our results disagree with those found elsewhere. But the reason for this may be the minimal number of obese subjects in our study.From our study the Navicular drop test mean value was 11.11mm for all subject affected with bilateral flat foot and 6.66 for normal subjects. Rasmus G Nielsen et al in from their studyconcluded that measurement of the static ND might be the most appropriate technique for the clinical assessment of foot pronation.[9,24] Therefore simple and reliable methods to measure dynamic ND are highly warranted.

**Conclusion**

From our study we concluded that, prevalence of flat foot in a population of 18 to 25 years old physiotherapy students was 11.25% for all subject affected with bilateral flat. According to age 18 years were having 2.5% of flat foot bilaterally, 19 years were having 3.75% flat foot bilaterally, 22 years were having 3.75 % flat foot bilaterally, 24 years were having 1.24% flat foot bilaterally.There was no significant difference according to gender & there was no correlation of BMI with arch index.

**References**

1  Shih YF, Chen CY, Chen WY, Lin HC. Lower extremity kinematics in children with and without flexible flatfoot: a comparative study. BMC MusculoskeletalDisord. 2012;13:31.

2  Vittore D, Patella V, Petrera M, Caizzi G, Ranieri M, Putignano P, et al. Extensor deficiency: first cause of childhood flexible flat foot. Orthopedics. 2009;32(1):28.

3  Menz HB. Foot Problems in Older People: Assessment and Management. Churchill Livingstone/Elsevier; 2008.ISBN 9780080450322.

4  Bonnet WL, Baker DR. Diagnosis of pesplanus by x-ray. Radiology. 1946;**46**:36-45.]

5  Riccio I, Gimigliano F, Gimigliano R, Porpora G, Iolascon G. Rehabilitative treatment in flexible flatfoot: a perspective cohort study. ChirOrganiMov. 2009;93(3):101-7.

6  Volpon JB. Footprint analysis during the growth period. JPediatrOrthop. 1994;14:83–85.

7    Hironmoy Roy, Kalyan Bhattacharya, Samar Deb and Kuntala Ray et al Arch Index: An Easier Approach for Arch Height (A Regression Analysis)  Al Ame en J Med S c i (2 0l2 )5 (2 ) :1 3 7 -1 4 6  I S SN 0 9 7 4 - 1 1 4 3.

8    Saša Milenković, Mladen Živković, Saša Bubanj,Dobrica Živković, Ratko Stanković, Radoslav Bubanj, Tijana Purenović, Dejan Stojiljković, Borislav Obradović,incidence of flat foot in high shool student Series: Physical Education and Sport Vol. 9, No 3, 2011, pp. 275 – 281.

9    Rasmus G Nielsen, Michael S Rathleff, Ole H Simonsen and Henning Langberg et al Determination of normal values for navicular drop during walking: a new model correcting for foot length and gender Journal of Foot and Ankle Research 2009, 2:12 doi:10.1186/1757-1146-2-12.

10   MetteKjærgaard Nilsson, Rikke Friis, Maria Skjoldahl Michaelsen, Patrick Abildgaard Jakobsen and Rasmus Oestergaard Nielsen et al Classification of the height and flexibility of the medial longitudinal arch of the foot Nilsson et al. Journal of Foot and Ankle Research 2012, 5:3

11   Edwin J. Harris, DPM, John V. Vanore, DPM,James L. Thomas, DPM, Steven R. Kravitz,et al in their study on Diagnosis and Treatment of Pediatric Flatfoot.Journal of ankle & foot surgery.VOLUME 43, NUMBER 6, NOVEMBER/DECEMBER 2004

12    Picciano AM, Rowland MS, worrel Reliabilty of open & close kinetic chain subtalar joint neutral position & navicular drop test. Jorthop sport phys. Ther, 1993;18:553-558.

13   Pfeiffer M, Kotz R, Ledl T, Hauser G, Sluga M. Prevalence of flat foot in preschool-aged children. Pediatrics 2006;118:634-9.

14   Chen JP, Chung MJ, Wang MJ. Flatfoot prevalence and foot dimensions of 5- to 13-year-old children in Taiwan. Foot Ankle Int 2009;30:326-32.

15   Lin CJ, Lai KA, Kuan TS, Chou YL. Correlating factors and clinical significance of flexible flatfoot in preschool children. J Pediatr Orthop 2001;21:378-82.

16   Bordin D, De Giorgi G, Mazzocco G, Rigon F. Flat and cavus foot, indexes of obesity and overweight in a population of primary-school children. Minerva Pediatr 2001;53:7-13.

17   Martin Pfeiffer, MDa, Rainer Kotz, Prof MDa, Thomas Ledl, MScb, Gertrude Hauser, Prof MDc, Maria Sluga, Prof MDa et al   Prevalence of Flat Foot in Preschool-Aged Children.www.pediatrics.org/cgi/doi/10.1542/peds.2005-2126 doi:10.1542/peds.2005-2126.

18   Volpon JB. Footprint analysis during the growth period. J Pediatr Orthop. 1994;14:83–85.

19    Rao UB, Joseph B. The influence of footwear on the prevalence of flat foot: a survey of 2300 children. J Bone Joint Surg Br. 1992;74:525–527.

20   Forriol F, Pascual J. Footprint analysis between three and seventeen years of age. Foot Ankle. 1990;11:101–104.

21   Wenger DR, Mauldin D, Speck G, Morgan D, Lieber RL. Corrective shoes and inserts as treatment for flexible flatfoot in infants and children. J Bone Joint Surg Am. 1989;71:800–810.

22    Schilling FW. The medial longitudinal arch of the foot in young children [in German]. Z Orthop Ihre Grenzgeb. 1985;123: 296–299.

23   Hassan Daneshmandi, Nader Rahnema, and RahimehMehdizadeh Relationship between Obesity and Flatfoot in High-school Boys and Girls International Journal of Sports Science and Engineering Vol. 03 (2009) No. 01, pp. 043-049.

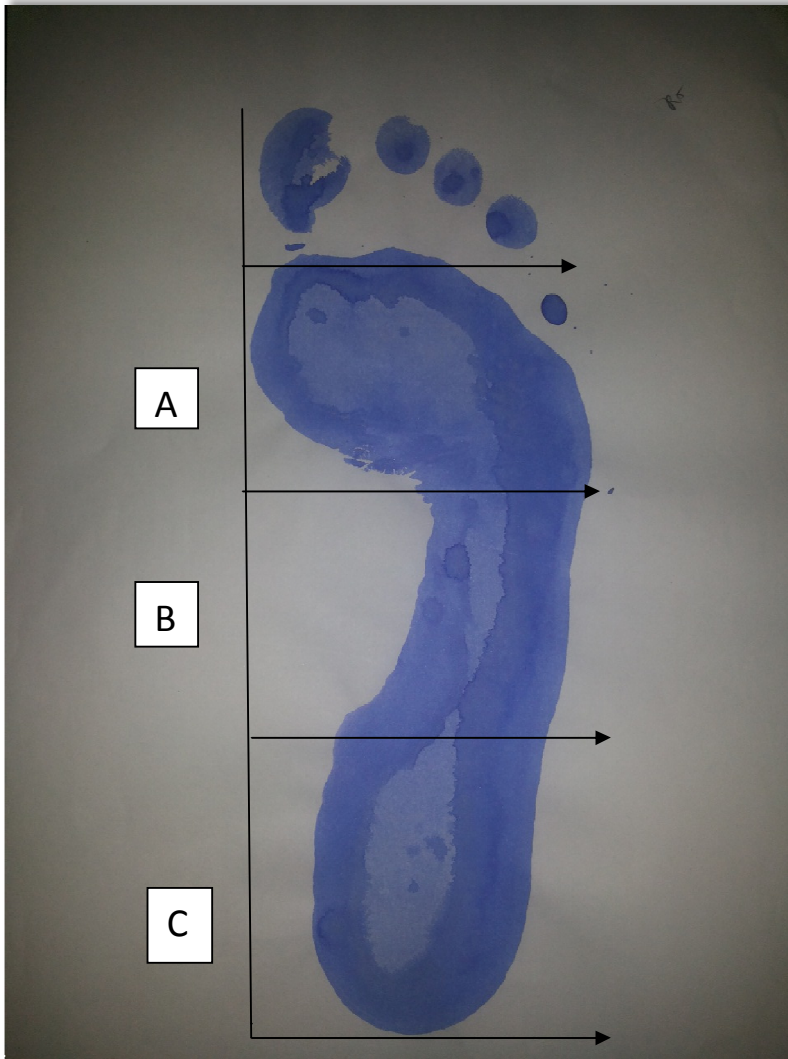24   Menz HB: Alternative techniques for the clinical assessment of foot     pronation. J Am Podiatr Med Assoc 1998, 88:119-29.

Photo No: 1 Arch Index



Photo No: 2 Navicular drop test