

# Assessment of Plantar Arch Index and Prevalence of Flat Feet among South Indian Adolescent Population.

Pranati .T<sup>1</sup>, K. Yuvraj Babu<sup>2</sup>, Karthik Ganesh<sup>3</sup>.

1. BDS 1st year, Saveetha Dental college & Hospitals, Chennai – 600 077.
2. Assistant Professor, Anatomy department, Saveetha Dental College & Hospitals, Chennai – 600 077.
3. Senior Lecturer, Anatomy department, Saveetha Dental College & Hospitals, Chennai – 600 077.

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## Abstract:

### Aim :

To assess the prevalence of flat feet deformity by evaluating plantar arch index among the South Indian adolescent population.

### Objective :

Flat feet disorder is quite common and this study shows the prevalence of flat feet deformity among South Indian adolescent population using plantar arch index.

### Background :

Flat feet, also known as acquired flat foot disorder, result from collapsed arch. When standing, the sole of the foot should not touch the ground completely. However, a fallen arch causes the foot to roll inwards and the entire sole comes close to touching the ground. Because feet are the foundation for body, flat feet can cause problems throughout the skeletal structure and can even bring the joints out of alignment.

### Reasons :

To know the ratio of people feet with normal plantar arch and people with flat feet disorder among South Indian population.

### Results :

16% of the subjects had flat feet disorder among which 6% had unilateral flat feet and 8% had bilateral flat feet.

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**Keywords:** Plantar arch, Flat feet, Pes planus, Plantar arch index.

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## INTRODUCTION:

The term flat foot is commonly used to describe a nebulous mixture of anatomical variations as well as a small core of pathological conditions [1]. Flat feet or pes planus is a postural deformity in which the arches of the foot collapses, with the entire sole of the foot coming into complete or near-complete contact with the ground. There is a functional relationship between the structure of the arch of the foot and the biomechanics of the lower leg. The arch provides an elastic, springy connection between the forefoot and the hind foot. This association safeguards so that a majority of the forces incurred during weight bearing of the foot can be dissipated before the force reaches the long bones of the leg and thigh.[2]

In pes planus, the head of the talus bone is displaced medially and distal from the navicular. As a result, the spring ligament and the tendon of the tibialis posterior muscle are stretched, so much so that the individual with pes planus loses the function of the medial longitudinal arch (MLA). If the MLA is absent or non functional in both the seated and standing positions, the individual has “rigid” flatfoot. If the MLA is present and functional while the individual is sitting or standing up on their toes, but this arch disappears when assuming a foot-flat stance, the individual has supple / flexible flatfoot. This latter condition can be correctable with well-fitting arch supports.[3]

The appearance of flat feet is normal and common in infants, partly due to "baby fat" which masks the developing arch and partly because the arch has not yet fully developed. The human arch develops in infancy and early childhood as part of normal muscle, tendon, ligament and bone growth [4]. Training of the feet, especially by foot gymnastics and going barefoot on varying terrain, can facilitate the formation of arches during childhood, with a developed arch occurring for most by the age of four to six years. Flat arches in children usually become proper arches and high arches while the child progresses through adolescence and into adulthood.

In Europe and America flat foot is a common reason for attendance at a children's orthopaedic clinic, but in India children are seldom brought for treatment for flat foot. The few children who complain are from rich families. Children from farming community or from the family of a labourer never come to clinics complaining flat foot. [5] This shows that there is lack of awareness about flat foot among the illiterate and economically backward people.

## MATERIALS AND METHODS:

This study was conducted on 50 adolescents (12 boys and 38 girls) aged between 14-20 years. Footprints of all the 50 subjects were taken using simple ink print method. A thin, large piece of sponge (larger than the size of foot) is placed on a tray and diluted ink is poured. The sponge absorbs all the ink and when foot is placed, the ink sticks on the surface of the foot. The foot is then immediately placed on

a paper to obtain the print and hence to diagnose the presence of flat feet. This is done by calculating the plantar arch index.

For calculating plantar arch index, a tangential line is drawn connecting the medial forefoot edge and heel region. The mean point of this line is calculated. From this point, a perpendicular line is drawn crossing the footprint. The same procedure is repeated for heel tangency point. The width of the central region of the foot print is considered as A and the width of the heel region is considered as B. The plantar arch index (PAI) is obtained by dividing the A value by B value (PAI = A/B). If PAI is greater than 1.15, then it is considered as flat foot. [6]

Plantar arch index = A/B

A – width of central region of footprint (in cm)

B – width of heel region of footprint (in cm)

#### RESULTS:

The plantar arch index values ranged from 0.24 to 1.62 . Among 50 subjects, 8 members (5 girls, 3 boys) i.e. 16% had flat feet disorder i.e. PAI > 1.15 among which 3 (6%) members had unilateral left flat foot and 1 person (2%) had unilateral right flat foot and the remaining 4 subjects had bilateral flat feet (8%). All the 8 members have flexible flat feet i.e. When the foot is placed on the ground i.e. in

standing position, the foot will be flat and when the foot is raised it regains its original arch shape. People with flexible flat foot may or may not experience pain in the heel, arch, angle or outside of the foot. All the subjects had no history of pain.

#### DISCUSSION:

The prevalence of flat feet in this study is 16% which is comparatively less compared to a study done by Martin Pfeiffer et al where the prevalence of flat feet was 44% in a group of 3-6 year old children [7]. From this study it is found that the average PAI value of right foot among teens aged from 14 to 17 years is and the average PAI value of left foot is 0.74 and right foot is 0.711. This is similar to the study made by Arnoldo Jose Hernandez et al where the average PAI values of children aged between 5 and 9 is ranged from 0.61 to 0.67 [6]. In studies done by Singrolay et al [8] and Kanatli Ulunav et al [9], it has been found that there is a Correlation between Talo-first metatarsal angle (TFM angle) which can be obtained by radiography. Hence simple ink print method can be a cost effective and easier way of diagnosing flat feet compared to radiography. It is simple and easier to apply. This method is non-invasive and does not involve radiation. Thus it can be used clinically to diagnose flat feet.



Figure 1: Measurement of Plantar Arch Index on foot print a) normal feet b) flat feet

	PAI Right – Normal Foot		PAI Left. – Normal Foot		PAI Right – Flat foot		PAI Left – Flat Foot	
	Range	mean	Range	Mean	Range	Mean	Range	Mean
MALE	0.36-1.00	0.58	0.28-0.93	0.64	1.19-1.57	1.25	1.17-1.62	1.39
FEMALE	0.28-1.05	0.64	0.24-1.00	0.65	1.17-1.36	1.23	1.16-1.34	1.24

PAI Measurements of Bilateral Flat Foot		PAI Measurements of Unilateral Flat Foot	
<i>Left foot</i>	<i>Right foot</i>	<i>Left foot</i>	<i>Right foot</i>
1.38 (flat)	1.19 (flat)	0.7 (normal)	1.17 (flat)
1.62 (abnormally flat)	1.57 (abnormally flat)	1.16 (flat)	0.9 (normal)
1.36 (flat)	1.27 (flat)	1.18 (flat)	0.95 (normal)
1.34 (flat)	1.17 (flat)	1.17 (flat)	1 (normal)

**CONCLUSION:**

Simple ink print method is a cost effective and easier way of diagnosing flat feet clinically. In this study 16% of the subjects had flat feet disorder where 8% had unilateral flat foot and the other 8% had bilateral flat feet.

**REFERENCES:**

1. Rose, G. K., E. A. Welton, and T. Marshall. "The diagnosis of flat foot in the child." *Bone & Joint Journal* 67.1 (1985): 71-78.
2. Franco, Abby Herzog. "Pescavus and pesplanus." *PhysTher* 67 (1987): 688-694.
3. Book : "Clinical Anatomy by Regions" by Richard S. Snell
4. Book : "Textbook of Pediatric osteopathy" by Eva Moeckel, NooriMitha
5. Rao, UdayaBhaskara, and Benjamin Joseph. "The influence of footwear on the prevalence of flat foot. A survey of 2300 children." *Bone & Joint Journal* 74.4 (1992): 525-527.
6. Hernandez, Arnaldo José, Luiz Koichi Kimura, Marcos Henrique Ferreira Laraya, and Edimar Fávoro. "Calculation of staheli's plantar arch index and prevalence of flat feet: a study with 100 children aged 5-9 years." *Acta Ortopédica Brasileira* 15, no. 2 (2007): 68-71.
7. Pfeiffer, Martin, Rainer Kotz, Thomas Ledl, Gertrude Hauser, and Maria Sluga. "Prevalence of flat foot in preschool-aged children." *Pediatrics* 118, no. 2 (2006): 634-639.
8. SINGROLAY, RAJENDRA, and RAJENDRA SINGH KUSHWAH. "Stahelis plantar arch index measured by simple footprint method is an effective diagnostic tool for flat foot as other radiological methods-A comparative study." *International Journal of Scientific Research* 4.9 (2016).
9. Kanatli, Ulunay, HalukYetkin, and Erdal Cila. "Footprint and radiographic analysis of the feet." *Journal of Pediatric Orthopaedics* 21.2 (2001): 225-228.