

## PREVALENCE OF FLAT FEET AMONG SCHOOL CHILDREN

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**Abstract:** Abnormal flatness of the sole and the arch of foot is called as Flat foot, if the inner longitudinal and anterior transverse metatarsal arches are depressed. This condition may be acute, subacute or chronic. Also called as Pes Planus. Splay Foot. For this study 159 children ( 81 male and 78 female) aged between 5 – 9 yrs who are studying in different school's in Kanchipuram town were chosen. Foot print of these 159 children were obtained and Staheli's plantar arch index was calculated as per Staheli's arch index.

**Keywords:** Normal foot, Flat foot, High arch foot, Plantar arch Index, Types of feet.

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**Introduction** In bipeds, the foot takes on the important responsibility of receiving the weight of the whole body and at the same time stabilizing the individual in changing postural and environmental conditions. A normal foot must be plantigrade, have normal anatomical disposition and biomechanics, be resilient with proper springiness to provide a rhythmic normal gait.

Three main arches are recognized in the foot. They are the medial longitudinal, the lateral longitudinal and the transverse.

**Medial longitudinal arch:** The medial margin of the foot arches up between the heel and the first metatarsophalangeal joint to form a visible arch. It is made up of calcaneus, talus, navicular, the three cuniforms and their three metatarsals. The pillars are the posterior aspect of the calcaneus and the three metatarsal heads. The bones themselves contribute little to the stability of the arch, whereas the ligaments contribute significantly. The most important ligamentous structure is the plantar aponeurosis, which acts as a tie beam between the supporting pillars.

Muscles also have a role in the maintenance of the medial longitudinal arch. Flexor hallucis longus is important in this regard and acts as a bowstring. Flexor digitorum longus, abductor hallucis and medial half of

flexor digitorum brevis also contribute, but to a lesser extent. Tibialis posterior and anterior are important in maintenance of the arch. The importance of tibialis posterior is manifest by the collapse of medial longitudinal arch that accompanies failure of the tibialis tendon.

**Lateral longitudinal arch:** The bones making up the lateral longitudinal arch are the calcaneus, the cuboid and the fourth and fifth metatarsals. The pillars are the calcaneus and the lateral two metatarsal heads. The most significant ligaments are plantar aponeurosis and the long and short plantar ligaments. The most important contribution to the maintenance of the lateral arch is made by the peroneus longus tendon. The lateral two tendons of flexor digitorum longus and lateral half of flexor digitorum brevis and abductor digiti minimi also assist by preventing separation of the pillars of the arch.

**Transverse arch:** The bones involved in the transverse arch are the bases of five metatarsals, the cuboid and the cuneiforms. The intermediate and lateral cuneiforms are wedge shaped thus adapted to maintenance of the transverse arch. The stability of the arch is mainly provided by the ligaments, which bind the cuneiforms and metatarsal bases of the foot. A shallow arch is maintained at the metatarsal heads by the deep transverse ligaments, transverse fibres that bind together the digital slips of the plantar aponeurosis, and to a lesser extent, by the transverse head of adductor hallucis.

Any deviation from the anatomical plantigrade foot is a deformed foot. Some of the deformities of the foot can be grouped under the following headings.

**Flat Foot (Pes Planus):** Collapse of medial longitudinal arch leads to Flat Foot. The normal concavity due to the medial longitudinal arch is absent and instead, the medial side of the foot bugles as a medial convexity, particularly on weight bearing.

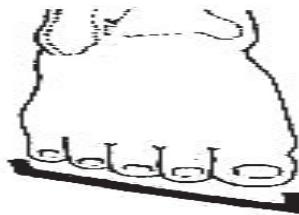
**High Arch Foot (Pes Cavus):** A normal foot has a medial longitudinal arch which is higher than the lateral one. When this normal portion is accentuated, the medial side of the foot tends to assume the shape of a high arch.

In broad-spectrum of classification of feet, three types of feet have been recognized.

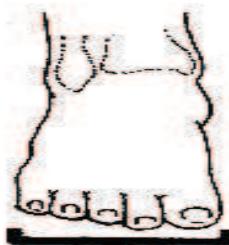
#### **Types of feet:**

**1. Egyptian Type of foot:** The great toe is longer than the 2<sup>nd</sup> toe, the

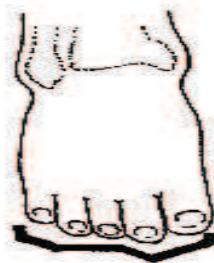
second toe is longer than the 3<sup>rd</sup> toe and so on.



2. **Square / Intermediate Rectangular type of foot :** The great and second toes are equal. However the 2<sup>nd</sup> toe may be equal or longer than 3<sup>rd</sup> toe. The 3<sup>rd</sup> toe may be equal or longer than the 4<sup>th</sup> toe. The 4<sup>th</sup> toe may be equal or longer than the 5<sup>th</sup> toe.



3. **Grecian (Greek) Type of foot:** The great toe is smaller than the 2<sup>nd</sup> toe. The 2<sup>nd</sup> toe is bigger than the 3<sup>rd</sup> toe. The 3<sup>rd</sup> toe is bigger than the 4<sup>th</sup> toe. The 4<sup>th</sup> toe is bigger than the 5<sup>th</sup> toe.



#### **Aim & Objectives:**

1. Identifying the Normal foot and other types of deformities i.e Flat and High Arch foot.
2. Calculating Staheli's Plantar Arch Index (PI)\* for the whole population.

3. To determine the prevalence rate of Flat foot and High Arch foot along with Normal foot.

**Materials & Methods :**

1. Foot Impression gaining kit with Ink Pad Ink.
2. Standard Measuring tools like Inch Scale etc.,
3. White sheets and stationary needs.

$$* PI = \frac{\text{Support width of central region}}{\text{Support width of heel region}}$$

**Data Collection:**

1. A total population of 159, in age ranging from 5 year to 9 years in Kanchipuram district was chosen.
2. Each individual was made to sit and the foot was brought in contact with the Foot Impression gaining Kit (Picture 1), without any loss of image each individual foot impression was pressed on white sheets in standing posture (Picture 2 & Picture 3).

**PICTURE - 1**



**PICTURE - 2**



**PICTURE - 3**

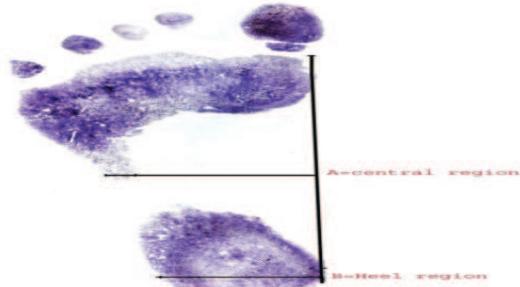


3. Later, on every sheet a line was drawn tangent to the medial forefoot edge and the heel region. The Mean point of this line was calculated. From this point a perpendicular line was drawn crossing the foot print and same procedure repeated for heel tangency point (Picture 4 & Pictures5)

**PICTURE - 4**



**PICTURE - 5**



4. Plantar Arch Index was calculated by obtaining ratio

$$\text{PI} = \frac{\text{Support width of central region}}{\text{Support width of heel region}}$$

#### Inclusion Criteria

- ❖ Age 5 to 9 years.
- ❖ Both Genders male and female.

#### Exclusion Criteria

- ❖ Burns.
- ❖ Fractured foot.
- ❖ Boils.
- ❖ Congenital deformities.
- ❖ Obese Children.

#### Observations:

	RIGHT FOOT			LEFT FOOT		
	A	B	PI	A	B	PI
<b>Average</b>	<b>24.16</b>	<b>33.45</b>	<b>0.73</b>	<b>23.95</b>	<b>33.39</b>	<b>0.72</b>
<b>SD</b>	<b>10.33</b>	<b>4.18</b>	<b>0.32</b>	<b>10.77</b>	<b>3.65</b>	<b>0.34</b>
<b>Minimum</b>	<b>2</b>	<b>21</b>	<b>0.06</b>	<b>0</b>	<b>23</b>	<b>0.00</b>
<b>Maximum</b>	<b>60</b>	<b>45</b>	<b>1.58</b>	<b>60</b>	<b>42</b>	<b>1.77</b>

Gender Wise Study : Right Side

GENDER		
	MALE RIGHT	FEMALE RIGHT
<b>Average</b>	<b>0.75</b>	<b>0.70</b>
<b>SD</b>	<b>0.34</b>	<b>0.30</b>
<b>n</b>	<b>81</b>	<b>78</b>

Gender Wise Study : Left Side

GENDER		
	MALE LEFT	FEMALE LEFT
<b>Average</b>	<b>0.76</b>	<b>0.68</b>
<b>SD</b>	<b>0.37</b>	<b>0.29</b>
<b>n</b>	<b>81</b>	<b>78</b>

Age Wise Study : Right Side

RIGHT					
	5	6	7	8	9
<b>Avg</b>	<b>0.88</b>	<b>0.74</b>	<b>0.68</b>	<b>0.70</b>	<b>0.55</b>
<b>SD</b>	<b>0.30</b>	<b>0.27</b>	<b>0.27</b>	<b>0.33</b>	<b>0.31</b>
<b>n</b>	<b>36</b>	<b>33</b>	<b>30</b>	<b>29</b>	<b>31</b>

Age Wise Study : Left Side

LEFT					
	5	6	7	8	9
<b>Avg</b>	<b>0.89</b>	<b>0.74</b>	<b>0.67</b>	<b>0.69</b>	<b>0.58</b>
<b>SD</b>	<b>0.33</b>	<b>0.31</b>	<b>0.27</b>	<b>0.37</b>	<b>0.32</b>
<b>n</b>	<b>36</b>	<b>33</b>	<b>30</b>	<b>29</b>	<b>31</b>

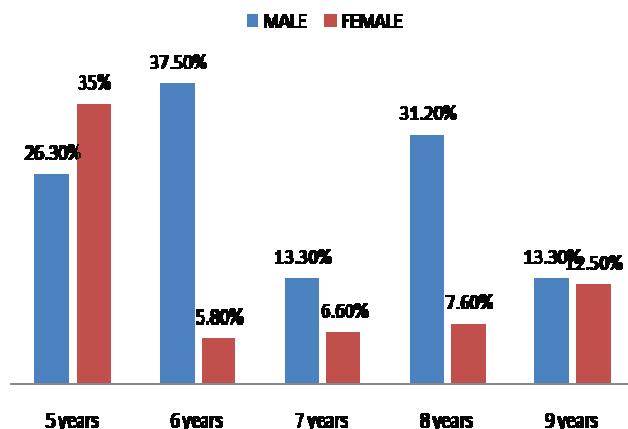
Comparison of Both Sides :

	RIGHT SIDE	LEFT SIDE
<b>Average</b>	<b>0.73</b>	<b>0.72</b>
<b>SD</b>	<b>0.32</b>	<b>0.34</b>
<b>Number(n)</b>	<b>159</b>	<b>159</b>

Average plantar indexes being 0.73 for right side and 0.72 for left side in our group of study.

## Percentage Prevalency ;

Age	MALE	FEMALE
<b>5 years</b>	<b>26.3%</b>	<b>35%</b>
<b>6 years</b>	<b>37.5%</b>	<b>5.8%</b>
<b>7 years</b>	<b>13.3%</b>	<b>6.6%</b>
<b>8 years</b>	<b>31.2%</b>	<b>7.6%</b>
<b>9 years</b>	<b>13.3%</b>	<b>12.5%</b>



**Discussion:** The normal human foot has medial and lateral longitudinal arches and the transverse half arch at the level of the mid tarsal joints . There is also anterior transverse arch at the level of the heads of the metatarsal bones.

Foot has two functions to perform static and dynamic functions. In standing, it performs static function by forming a stable weight bearing support to the body. During walking, it functions as an efficient lever to propel the body weight forward.

Arches of foot are held together by the strong ligaments especially the spring ligament, long plantar ligament, short plantar ligament, interosseous ligaments and plantar aponeurosis. Of the muscles, tibialis anterior, posterior and peroneus longus help in integrity and maintenance of the arches and help in efficient posture.

Tendon of the tibialis posterior, on its way to its final insertion in the internal cuneiform and metatarsals, attaches to it, instead of to the under surface of the scaphoid tubercle. This relationship is the cause of its influence on flat-foot.

The longitudinal arch consists of medial and lateral components resting on a common pillar posteriorly the tuberosity of the calcaneum. Talus is the key stone of the arches. It receives the body weight and transmits it to the arches below. Through the arches weight is transmitted to calcaneus and the heads of first and fifth metatarsals.

Any deviation from the anatomical plantigrade foot is a deformed foot. Some of the deformities of the foot can be grouped under the following as Flat foot/ (pes planus), High arch foot/ (pes cavus).

**Flat Foot:** Collapse of medial longitudinal arch leads to flat foot.

The following are types of flat foot :

- ❖ Congenital flat foot: Appears in all new born babies as the postural muscles have not yet developed. In some, foot is not only flat but the undersurface is convex and whole foot is in valgus position or everted position due to congenital abnormality of talus in which it lies in vertical talus position.
- ❖ Infantile flat foot: Infantile flat foot is physiological flat foot of children. Arches become obviously flat and flatfoot disappears as the postural muscles start developing. There is a possibility of flat foot with the poor development of postural muscles.
- ❖ Compensatory flat foot: In children genu valgum at knee can cause a compensatory flat foot. In some cases of paralytic equines due to polio or cerebral palsy, it is compensated at the tarsal joint by flattening of the arch.
- ❖ Acquired flat foot: The causes of flat foot in adults are muscle weakness, rapid increase of body weight, post-traumatic flat foot with injury to the calcaneus or metatarsal bones.
- ❖ Spasmodic flat foot: Spasmodic flat foot is seen due to spasm of peroneal muscles due to unaccustomed strain in adolescents,

subtaloid arthritis or congenital calcaneo navicular anomalies.

Medial arch is obliterated, navicular bone is prominent, area of weight bearing increases and may cause increased callosity.

Flat foot can be further classified as

- ❖ Flexible flat foot: Non-weight bearing, Normal development of arch.
- ❖ Rigid flat foot: During non-weight bearing also, Medial arch does not develop.
- ❖ Static flat foot : Faulty postural activity of muscles

In many cases it probably has a congenital basis, but it may be caused by selective muscle weakness or paralysis. All infants have flat feet for an year or two till they begin to stand, or even up to age four ( Others authors describe major variations on plantar arch can occur until age six and seven.

Using sophisticated methodology such as strength platforms, graded scales increases accuracy of measurements. In our study group flat foot is most prevalent up to age nine. In normal feet with presence of an arch, the stress will be distributed in an even manner so that the person will not experience any kind of pain. Under an abnormal condition that occurs due to lack of stretching of muscles, bones and tendons, there will be absence of arch among these people. In this condition, all the weight will be concentrated in a smaller area on the feet and generates a lot more pain than normal. This condition might occur in both children and adults. In some people both feet will be flat and in some only one foot will be flat. To find whether the foot is flat or not, a simple test using plantar arch index can be performed and categorized into unilateral flat foot and bilateral flat foot. The children with flat feet will not be able to undertake various activities like in an easy manner. They will experience more pain when they are subjected to high impact activities such as running and jumping. There will be more amount of stress in the calf and ankle regions. Foot pain is fairly common even in children. Heel pain is common in very active children, when high-impact exercise can irritate growth centers of the heel.

**Summary:** Plantar arch study on a population of 159 ranging from 5 year to 9 years done in a wider sense adding feathers to the first assessment of plantar study done by Engel and Staheli. The flat feet and high arch feet evaluation was obtained by means of foot prints and the plantar arch index was established. The mean values of plantar arch index within the age group were stable and ranges from 0.72 to 0.73. With plantar arch

indices greater than 1.15 was regarded as flatfeet and less than 0.10 was regarded as High arch feet. **Conclusion:** Flat foot is highly prevalent in the ages between 5-9. The average values for plantar arch indices are stable and ranges from 0.72 to 0.73 in our sample regarded as Normal foot. Plantar arch index  $> 1.15$  is regarded as Flat foot. Plantar arch index  $< 0.10$  is regarded as High arch foot.

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