

A STUDY ON PREVALENCE OF FLAT FEET AMONG SCHOOL CHILDREN IN KANCHIPURAM POPULATION

D.Krupa Daniel ^{*1}, Chithambaram Chandrasekaran ², Ajith Mano ³.

^{*1} Associate Professor of Anatomy, Southern Medical University, Guangzhou P.R, CHINA.

² MBBS-4th Year, Southern Medical University, Guangzhou P.R, CHINA.

³ MBBS-2nd Year, Southern Medical University, Guangzhou P.R, CHINA.

ABSTRACT

Background: A flexible flatfoot is considered to be a variation of a normal foot. Any deviation from the anatomical plantigrade foot is a deformed foot. Some of the deformities of the foot are: Flat Foot. The normal concavity due to the medial longitudinal arch is absent. High Arch Foot - A normal foot has a medial longitudinal arch which is higher.

Materials and Methods: A total population of 625, in age ranging from 5 year to 9 years in Kanchipuram district was chosen. Each individual was made to sit and the foot was brought in contact with the Foot Impression gaining Kit on white sheets in standing posture.

Results: 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.

Discussion: 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 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.

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.

KEY WORDS: Normal foot, Flat foot, High arch foot, Plantar arch Index, Types of feet.

Address for Correspondence: Dr.D.Krupa Daniel, Associate Professor of Anatomy, Southern Medical University, Guangzhou P.R, China. Phone no.: +86-15626441489.

E-Mail: danielkrupa1309@gmail.com.

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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 physiomechanics, be resilient with proper springiness to provide a rhythmic normal gait [1].

A flexible flatfoot is considered to be a variation of a normal foot. The muscles and joints of a

flexible flatfoot function normally. Most children are born with very little arch in the feet. As they grow and walk, the soft tissues along the bottom of the feet tighten, which gradually shapes the arches of the feet [1].

Children with flexible flatfoot often do not begin to develop an arch until the age of 5 years or older. Some children never develop an arch. If flexible flatfoot continues into adolescence, a child may experience aching pain along the bottom of the foot. A doctor should be consulted if a child's flatfeet cause pain. Three main arches are recognized in the foot. They are the medial longitudinal, the lateral longitudinal and the transverse [2].

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 [2,3].

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 cuneiforms 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[2,3].

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 [2,3].

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 bulges 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.

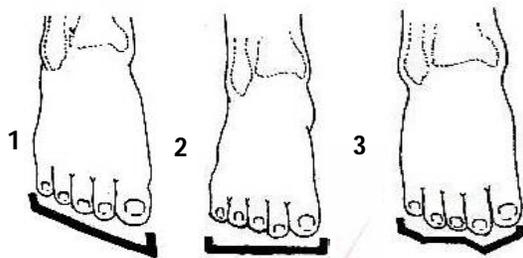
Types of feet:

1. Egyptian Type of foot: The great toe is longer than the 2nd toe, the second toe is longer than the 3rd toe and so on.

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

Grecian (Greek) Type of foot: The great toe is smaller than the 2nd toe. The 2nd toe is bigger than the 3rd toe. The 3rd toe is bigger than the 4th

toe. The 4th toe is bigger than the 5th toe.

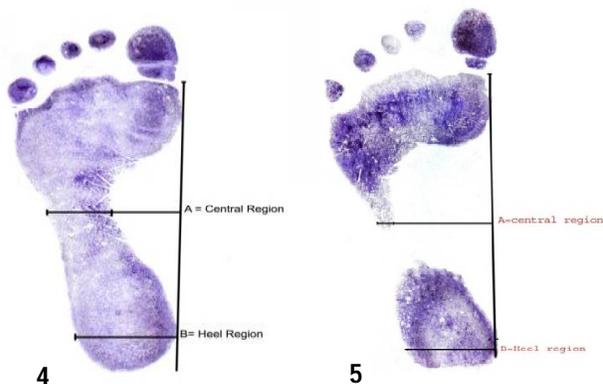


MATERIALS AND METHODS

Foot Impression gaining kit with Ink Pad Ink, Standard Measuring tools like Inch Scale etc., White sheets and stationary needs and Measuring through Plantar arch Index (PI).

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

Data Collection done with a total population of 625, in age ranging from 5 year to 9 years in Kanchipuram district was chosen. 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). 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 & Picture 5).



Inclusion Criteria for the study were Children age between 5 to 9 years, Both sexes.

Exclusion Criteria for the study were Children with burns, fractures over foot region, Boils, Congenital Deformities, Obese Children.

RESULTS

Table 1: Showing the statistical data on various parameters of the both sides.

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

Table 2: Showing the statistical data on various parameters Gender Wise Study: Right Side.

	GENDER	
	MALE RIGHT	FEMALERIGHT
Average	0.75	0.70
SD	0.34	0.30
n	402	223

Table 3: Showing the statistical data on various parameters Gender Wise Study: Left Side.

	GENDER	
	MALE LEFT	FEMALE LEFT
Average	0.76	0.68
SD	0.37	0.29
n	402	225

Table 4: Showing the statistical data on various parameters Age Wise Study: Right Side.

	RIGHT				
	5	6	7	8	9
Avg	0.88	0.68	0.74	0.70	0.55
SD	0.30	0.27	0.27	0.33	0.31
n	131	127	129	122	116

Table 5: Showing the statistical data on various parameters Age Wise Study: Left Side.

	LEFT				
	5	6	7	8	9
Avg	0.89	0.74	0.69	0.67	0.58
SD	0.33	0.31	0.27	0.37	0.32
n	131	127	129	122	126

Table 6: Showing the statistical data on various parameters While comparing both sides.

	RIGHT SIDE	LEFT SIDE
Average	0.73	0.72
SD	0.32	0.34
Number(n)	625	625

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

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 [3].

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 [2].

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 [2].

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:

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[2, 3].

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 [2,3].

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 [3].

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 [3,4]. Medial arch is obliterated, navicular bone is prominent, area of weight bearing increases and may cause increased callosity.

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[2,3].

Flat foot can be further classified as [4,5,6].

Flexible flat foot: Non-weight bearing, Normal development of arch.

Static flat foot: Faulty postural activity of muscles.

Rigid flat foot: During non-weight bearing also, Medial arch does not develop.

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[7] till they begin to stand, or even up to age four [8]. Others authors describe major variations on plantar arch can occur until age six and seven [1].

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 [5,9,10]. 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 [1,8,10] 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 [11,12].

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.

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.

Conflicts of Interests: None

REFERENCES

- [1]. Staheli LT, Chew DE, Corbett M. The longitudinal arch. *J Bone Joint Surg Am.* 1987. 69:426-8.
- [2]. J.Maheshwari. *Essential orthopaedics* (1997) 2nd edition. Page number 275-276.
- [3]. Natarajan. *Textbook of orthopaedics and Traumatology* (1994).Page number 161-165.
- [4]. John Ebnezor. *Essential of orthopaedics for physiotherapists* (2000) 3rd edition. Page number 265-267.
- [5]. Stuart.L.Weintein. *Tureks Orthopaedics-Principles and their applications* (1984),6th edition. Page number 687-694.
- [6]. Terry Canale. *Campbells operative orthopaedics* (1998) 9th edition –Vol 2. Page number 1712-1741.
- [7]. John Crawford Adams , David L. Hamblen-*Outline of Orthopaedics* (1995) 12th edition page number 378-383
- [8]. Arnaldo José Hernandez, Luiz Koichi Kimura, Marcos Henrique Ferreira Laraya ,Edima Fávaro. *Calculation of Staheli's Plantar Arch Index and Prevalence of Flat Feet:A Study with 100 children aged 5-9 years.* *Acta Ortop Bras.* 2007; 15(2):68-71.
- [9]. Henry Gray-*Text book of Grays Anatomy-The anatomical basis of clinical practice* 40th edition. Page number 1450.
- [10]. Peter R .Cavanagh and Mary M.Rodgers (1985)-*The arch index- A usefull measure from foot prints.* *Division of physical therapy.*
- [11]. Simon Kendal (2010) *Children With Flat Feet Conditions - Types of Foot Problems Among Kids*[<http://EzineArticles.com/4280005>]
- [12]. Simon Kendol (2009)— *Flat Feet Pain - Discover the Various Causes of This Foot Condition* [<http://EzineArticles.com>].

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