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Original Article

Anatomy Section

Flat Foot in 14-16 Years Old Adolescents and its Association with BMI and Sports Activity

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ABSTRACT

Introduction: The main arches of foot are the medial longitudinal, the lateral longitudinal and the transverse arches. The term pes planus denotes an excessively flat foot. There is no precise degree of flatness that defines pes planus and it may be either physiological or pathological.

Aim: To identify flat foot in age group of 14-16 years by clinical examination, classify them into flexible and rigid and to study the association of Body Mass Index (BMI) and sports activity with flat foot.

Materials and Methods: The present cross-sectional study was conducted on 323 adolescents in the age group of 14-16 years chosen from five high schools in and around MS Ramaiah Medical College Campus, Bangalore, Karanataka, India. Both foot were clinically examined separately, with foot raised off the ground (non weight bearing) and standing on the same foot with the other foot raised (weight bearing position). Presence of arch in non weight bearing and absence in weight bearing was classified as flexible flat foot. Absence in both positions was classified rigid flat foot. The BMI was calculated and history of sports activity was recorded. Descriptive statistics were used to analyse the data.

Results: Out of the total participants, 106 (32.8%) participants had flat foot. Among them, 89.62% were flexible and 10.37% rigid flat foot. Bilateral Pes Planus was common when compared to unilateral, being more prevalent among the male students. Chi-square test gave a p-value of 0.521 for flexible and 0.176 for rigid flat foot in association with BMI.

Conclusion: Flat foot in the age group of 14-16 years is predominantly flexible. Higher prevalence of flexible and rigid flat foot was observed among males. No association between BMI or sports activity with Pes Planus was noted.

Keywords: Body mass index, Flexible, Pes planus, Rigid

INTRODUCTION

There are three arches of the foot, namely; medial, lateral longitudinal and transverse arches. The medial longitudinal arch is characteristic of its elasticity. The plantar fascia, short and long plantar ligaments and spring ligaments are static stabilisers of the foot. It is supported by the plantar calcaeonavicular ligament and small joints of the foot, deltoid ligament which restore the normal position after the stretching in weight bearing movements. The tibialis posterior tendon supports the plantar calcaneonavicular ligament by preventing the undue tension of the ligament and thus, preventing extended stretching. Weakness of tibialis posterior tendon leads to collapse of the medial longitudinal arch [1]. Hence, the tibialis posterior is an important muscle providing dynamic support to the foot and the ligaments play a major role in static support thus, maintaining the mechanical integrity of the medial longitudinal arch of foot. The arch is in addition supported by the small ligaments and muscles of the joints of the foot and tendons of tibilais anterior, and peroneus longus. The contribution to the stability of the arches is more significantly by the ligaments than the bones.

The lateral longitudinal arch is characteristic of its stability. Ligaments play a very important role in stabilising the lateral longitudinal arch, especially the lateral part of the plantar aponeurosis and the long and short plantar ligaments. The muscles which support the arch are the extensor tendons and the muscles related to the little toe. The peroneus brevis and tertius act as sling and peroneus longus acts by sustentacular mechanism.

In the transverse arch of the foot, ligaments bind the cuneiforms and metatarsal bases. The transverse arch of the foot is maintained by the plantar, dorsal and interosseus ligaments. The tendon of peroneus longus and tibialis posterior approximates the medial and lateral border of the foot. Both these factor provide stability to the arch, more so to the ligaments [1].

Flat foot (pes planus) is defined as a condition where the medial longitudinal arch of the foot is lost and hence, the whole sole of foot rests on the ground [2]. There is no precise degree of flatness that defines pes planus. Development of arch normally starts at the age of 2-3 years and is completely formed by the age of 5-7 years [3]. When the foot were evaluated with footprints of children aged less than 10 years using heel to arch width ratio and found that nearly 100% of 2 years were flat-footed but the same pattern was seen only in 4% of 10 year olds. It was believed that foot fat pad obscured the presence of arch. This was objected by a study showing radiographic evidence of actual flattening of the arch [4].

Clinically, flat foot can broadly be classified as flexible and rigid, depending on whether the arch is lost on weight bearing or, respectively. Flexile flat foot can be diagnosed clinically when the foot is flat on standing and reconstitutes with toe walking, hallux, dorsiflexion or foot hanging [5]. Rigid flat foot and symptomatic flexible flat foot is an indication for treatment. Symptoms can be vague pain in medial side of ankle, swelling on medial side of foot, difficulty in walking on uneven surfaces, foot fatigue, painful limp and knee or hip pain due to unsteady gait putting stress on these joints.

Most of the literature demonstrates the incidence/prevalence of flat foot in children (9-13 years) and adults. Flat foot has been identified by plantar arch index, navicular drop test or foot posture index [6-9]. According to Mosca VS [10], actual prevalence of flat foot is not known as there is no established literature regarding criteria for defining a flat foot. The discussion is whether flexible flat foot is a variation in normal foot shape or a deformity.

Calcaneonavicular coalition and talocalcaneal coalition if present usually completes around 14-16 years of age and that is why this clinical study has probed into clinical identification of flat foot in this age group and early identification will facilitate immediate treatment and prevent progression of the condition and complications.

The Orthopaedicians diagnose flat foot by clinical examination. Here, the presence or absence of medial longitudinal arch of foot is observed for in weight bearing position. If the arch was present or slightly depressed but visible arch on standing, it is considered normal. Absence of the medial longitudinal arch or convexity of the medial aspect of foot in standing position is considered as flat foot [11-13]. Since studies done in the age group of 14-16 years group were less, the present study was proposed with an aim of assessing the occurrence of flat foot by clinical examination to clinically identify flat foot in age group of 14-16 years.

Study Objectives

- To identify flexible and rigid flat foot in the age group of 14-16 years.
- To study the association of BMI and sports activity with flat foot. Also, to see the association of gender with flat foot.

MATERIALS AND METHODS

The present cross-sectional study was conducted in five high schools in and around MS Ramaiah Medical College campus, Bengaluru, Karnataka, India. The study was conducted in the year November 2018 to May 2019 after Ethics Committee clearance (5/10/2018) with Ethical Clearance Letter Number: MSRMC/EC/2018. Informed consent from the parents and assent from participants were obtained.

Inclusion criteria: Adolescents aged between 14-16 years were included.

Exclusion criteria: Adolescents with neuromuscular conditions and foot deformities other than flat foot were excluded from the study.

Sample size calculation: A study by Babu Y et al., revealed that the prevalence of flat foot disorder was 16% [7]. In the present study expecting to get similar results with 95% confidence level and 25% relative precision, the study required a sample of minimum 323 subjects.

Study Procedure

Height, weight, gender and age of the participants was recorded. The BMI was calculated using the data of height and weight of the participants. History of sports activity in participants was documented by asking them questions such as what sports were they playing and number of hours spent in sports. All the participants were screened for flat foot by clinical examination [5,12,13]. The participants were made to sit so that both the foot were off the ground (in non weight bearing position) and observed for the presence/absence of arch. Then, the participants were made to stand on one foot (in weight bearing position) and again observed for presence or absence of the arch. This was done for both foot. Presence of arch in sitting position and absence of arch on standing indicated flexible flat foot. Absence of arch in both positions indicated rigid flat foot. Photographs and videos were taken as evidence in the above-mentioned clinical examination.

STATISTICAL ANALYSIS

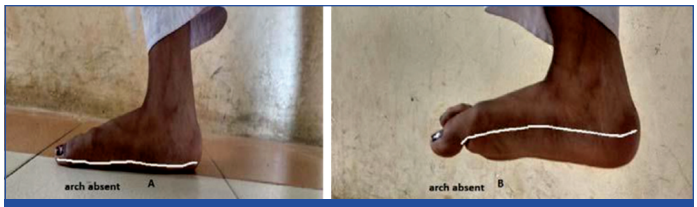
Descriptive statistics of flat foot disorder were analysed and summarised in terms of percentage. Chi-square test (or Fisher's exact when the count in a cell was ≤5) was used to study the association of flat foot with sports activity, BMI and gender.

RESULTS

Out of the 323 participants. 106 had clinical flat foot and 217 had normal foot. Out of 106, 69 were males and 37 were females. A total of 95 participants had flexible flat foot and 11 had rigid flat foot. The [Table/Fig-1,2,3] shows the detection of arches in the foot. It was found that 32.8% of participants demonstrated flat foot by clinical examination. Of these 89.63% were flexible and 10.37% were rigid flat foot [Table/Fig-4].

[Table/Fig-1]: Normal foot arch in weight bearing and non weight bearing position.

[Table/Fig-2]: Flexible flat foot in weight bearing and non weight bearing position.



[Table/Fig-3]: Rigid flat foot in weight bearing and non weight bearing position.

Variables	Number	Percentage
Flat foot	106	32.8
Flexible flat foot	95	29.4
Rigid flat foot	11	3.4

[Table/Fig-4]: Showing the percentage of flexible and rigid flat foot.

Laterality of Flat Foot

Among the flexible flat foot, bilaterality was seen in 83.16% and unilaterality in 16.84%. Among rigid flat foot, bilaterality and unilaterality was seen almost equally quantifying to 54.54% and 45.45% respectively [Table/Fig-5].

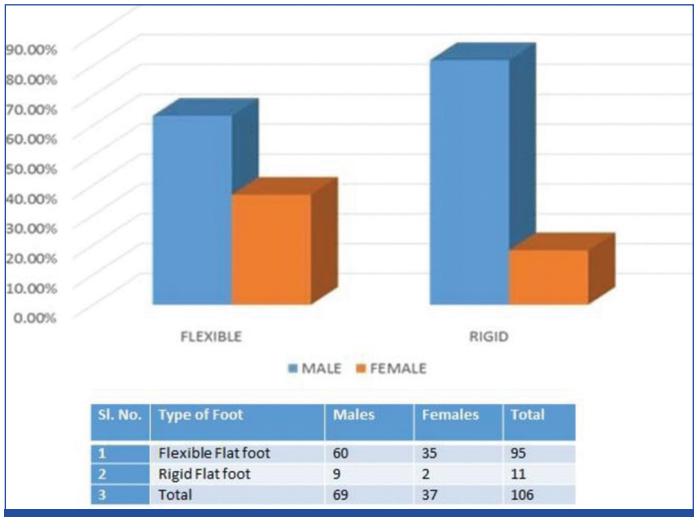
S. No.	Flat foot	Unilateral	Bilateral
1	Flexible (95)	16 (16.84%)	79 (83.16%)
2	Rigid (11)	5 (45.45%)	6 (54.54%)

[Table/Fig-5]: Showing the laterality of flat foot.

Gender Variation

[Table/Fig-6] demonstrates the gender distribution of flexible and rigid flat foot. Males had a higher incidence of flat foot (flexible and rigid).

Pearson Chi-square test did not reveal any significant association between gender and flexible flat foot (p-value=0.712). For rigid flat foot, since the count in a cell was less than 5, fisher exact test



Sl. No.	Type of Foot	Males	Females	Total
1	Flexible Flat foot	60	35	95
2	Rigid Flat foot	9	2	11
3	Total	69	37	106

[Table/Fig-6]: Showing gender variation in Flexible and Rigid flat foot.

was applied. The fisher test did not show any association between gender and rigid flat foot (p-value=0.215). Hence, no association was observed between gender and flat foot.

Sports Activity and Flat Foot

Among the participants with flat foot, 52 (49.1%) were involved in sports activity. Remaining participants with flat foot that is 54 (50.9%) were not involved in any kind of sports activity. Among the participants with normal foot arches, 121 (55.8%) were involved in sports activity and 96 (44.2%) were not involved in sports activity. Pearson Chi-square test revealed a p-value of 0.257.There was no significant association of flat foot on sports activity.

BMI and Flat Foot

[Table/Fig-7] shows the BMI ranges among the participants having flat foot. High BMI is considered when the value is more than 30 which is called obesity. Only 3.44% and 11% of flexible and rigid flat foot had high BMI [Table/Fig-7]. Pearson Chi-square test value was 0.520 for flexible and 0.176 for rigid flat foot. Thus, there was no association between the BMI and the presence of flat foot.

BMI (Kg/m^2)	Status	Flexible	Rigid
<18.5	Underweight	55.17%	33.30%
18.5-24.9	Normal	39.60%	44.40%
25-29.9	Overweight	1.72%	11.10%
30 and above	Obese	3.40%	11.10%

[Table/Fig-7]: BMI in participants with Flat Foot.

DISCUSSION

Flat foot is a deformity, which is usually physiological and occasionally pathological. The flat foot is present in every newborn and it takes over 10 years for the arches to develop. With increasing age, the prevalence of flat foot decreases, due to the benign nature and spontaneous correction. The real prevalence of symptomatic flat foot is not very high among adolescents [11].

Prevalence of flat foot: The [Table/Fig-8] demonstrates the comparison of prevalence of pes planus among different age groups, based on the various methods of examination [7,8,11,14,15].

S. No.	Study	Sample size	Age group (years)	Method of examination	Prevalence of flatfoot (%)
1.	Ukoha U et al., [14]	649	18-27	Footprints	13.9
2	Bhoir T et al., [8]	80	18-25	Arch Index Foot posture index Navicular drop test	11.25
3	Milenkovic S et al., [15]	228	16	Podoscope	48.7
4	Babu Y et al., [7]	50	14-20	Plantar arch index	16
5	Cilli F et al., [11]	3169	14-15	Clinical examination	0.69
6	Present study	323	14-16	Clinical examination	32.8

[Table/Fig-8]: Showing the comparison of prevalence of flat foot by different methods [7,8,11,14,15].

It is observed that the prevalence of flat foot varies anywhere from 0.69% to 48.7% [7,8,11,14,15]. This variation can be attributed to the differing age groups and methodology employed in the detection of flat foot. Another study also mentions the varied results in incidence of flat foot and state the reason as different methodology used to assess flat foot. The authors also mention the criteria within a particular methodology also varies. Hence the difference in the prevalence of flat foot [16].

If the last two studies mentioned in the [Table/Fig-8] are compared, as the age group is almost the same, yet the prevalence of flat foot varies. This could be because of racial origin and difference in sample size.

Morley AJ evaluated the footprints of children aged less than 10 years using heel to arch width ratio and found that nearly 100% of 2-year-old children were flatfooted but the same pattern was seen only in 4% of 10-year olds [3].

It also can be confirmed that the physiological flat foot diminishes by 10-12 years and further lead to correction of flat foot and its actual prevalence leading to complications and disabilities could be actually very low.

It is worthwhile to consider the social and environmental factors which play a role in the shape of the foot. The Indian population generally prefers to be barefooted and shoe wear is limited to occasions like school only. This may be one of the factors giving such varied incidence of pes planus compared to the other studies [7,8,11,14,15]. Another specific cause can be the presence of medial ray instability in individuals. Medial ray instability involves hypermobility of the medial cuneiform and the first metatarsal. The exact evaluation of this is quite complicated and it has been hypothesised to contribute to hallux valgus. It is a known entity which gives rise to flat foot and is now being recognised as a cause for failures in reconstruction in pes planus [17,18]. Another factor to consider is recurrent talotarsal joint dislocation, currently being recognised as a cause for symptomatic pes planus in the adolescent population and this should be considered while evaluating adolescents [5]. Its assessment is generally overlooked and could explain the increased incidence of pes planus in the study group, and would need further investigation in this regard. The incidence of a midfoot instability in the Indian population is a subject of discussion in most meetings, but it has still not been evaluated in great detail, for the simple reason that a device to test this objectively has not been designed yet.

Hence, further clinical examination and investigations are required to identify the symptomatic adolescents with pes planus.

Flexible flat foot vs rigid flat foot: Cilli F et al., study showed 100% of flexible flat foot when compared to the present study showing 93.1% of flat foot being flexible. This only demonstrates that flexible flat foot is more commonly present than rigid flat foot. Rigid flat foot is usually congenital and is caused due to bony or soft tissue defects such as tarsal coalition, accessory navicular bone, and congenital vertical talus to name a few [11,19,20].

The flexible flat foot is mainly due to laxity of the ligaments than the abnormal bone morphology. The flexible flat foot might progress by external factors such as bone fractures/dislocation/arthritis/tendon abnormalities/excessive weight bearing. Radiographic evidence is not much in patients with flexible flat foot which indicates towards muscle and ligaments as causative factors. Among the muscles, posterior tibial tendon dysfunction and short Achilles tendon are known causes for flexible flat foot [16,21].

The patients with flexible flat foot are either asymptomatic or symptomatic. The symptomatic ones usually complain of pain on weight-bearing and disability in addition to deformity. Physical evaluation of the muscle action and evidence of laxity of the ligaments is required for deciding on the management. Follow-up would also be required.

Laterality of flat foot: The [Table/Fig-9] shows the comparison of studies on the laterality of the flat foot [7,8,14,22]. All studies including the present study demonstrates that bilateral flat foot is more common when compared to unilateral flat foot. Some of the studies have shown that bilateral flat foot could lead to more knee pain and disabilities in future affecting the quality of life than those having unilateral flat foot [23]. This could be indicative of a genetic predisposition for occurrence of flat foot.

Gender variation: With respect to gender, most studies demonstrate higher prevalence in females than in males [Table/Fig-10] [14,24,25]. The present study revealed a higher percentage of flat foot in males

S. No.	Study	Flat foot prevalence	Bilateral	Unilateral
1	Ukoha U et al., [14]	13.9%	8.9%	5%
2	Didia BC et al., [22]	11%	7.5%	3.5%
3	Bhoir T et al., [8]	11.25%	11.25%	0
4	Babu Y et al., [7]	16%	8%	8%
5	Present study	32.8%	29.4%	3.4%

[Table/Fig-9]: Showing the comparison of laterality of flat foot among various studies [7,8,14,22].

when compared to females. The present study (p=0.712, 0.215) and other studies did not show any association between gender and flat foot prevalence [8,26]. Some studies demonstrate higher prevalence of flat foot in males [27]. Hence, there is no strong evidence to say either of the gender is significantly associated with flat foot. This could be due to small sample size or sample size not being gender matched.

S. No.	Study	Flat foot in males	Flat foot in females
1	Ukoha U et al., [14]	6.8%	7.1%
2	Eluwa MA et al., [24]	5.8%	7.6%
3	Okezue OC et al., [25]	8.4%	25%
4	Present study	21.36%	11.46%

[Table/Fig-10]: Showing comparison of gender variation in flat foot [14,24,25].

Sports activity and flat foot: One of the studies tried to find out the association between flat foot and physical activities, BMI and kind of sports in university athletes (n=76, age-18-25). The authors concluded that there was no significant association between physical activity and flat foot among the university athletes [28].

Another study in the age group of 10-14 yrs (n=92) tried to assess the correlation of physical activity and flat foot. Pearson Chi-square test revealed a negative correlation between physical activity and arches of foot [29].

Another study tried to analyse the relationship between the physical activity and age on flat foot of children in elementary school children. Their study showed a significant correlation between age and arches of foot. The arch index reduced as the age increased. The study also demonstrated a strong correlation between flat foot and physical activity (p=0.040). As the child is involved in physical activity the fat pads breaks at a faster rate hence arches are well formed early. Whereas inactivity could lead to flat foot occurrence. Hence, good physical activity in children favours good arch formation [30]. No association was found between physical activity and flat foot in the present study.

BMI and flat foot: The present study did not show any significant association between BMI and flat foot. Many studies also have derived a similar conclusion of no association between flat foot and BMI, height and weight [8,9,10,16]. One study comprising of adults who were traffic officials demonstrated an association between BMI and flat foot especially among the obese women.

Since, in the present study the sample size did not comprise of many individuals where BMI was >30, this could be one of the reasons for not showing a relation.

Limitation(s)

The study was restricted to adolescents as early detection could lead to early intervention and prevention of complications. The flat foot identification is controversial as detection is being done by various methods. Hence, there is a need to validate the methods against a gold standard method. Race differences, gender matching and detection of flat foot in obese individuals are required for concluding on their association with flat foot.

CONCLUSION(S)

Flat foot occurrence is moderately prevalent as flexible flat foot in Indian adolescents whereas the rigid flat foot prevalence is low. They may be asymptomatic, but become symptomatic later. Bilateral flat foot being more common than unilateral, indicates a genetic predisposition. The flat foot need not get corrected. The present study did not reveal any association between gender and flat foot, despite being more prevalent among the male. No association was found between BMI, sports activity and flat foot.

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REFERENCES

[1] Anthony V D'Antoni. Ankle and foot: In: Susan Standring, editor. Gray's Anatomy The Anatomical Basis of Clinical Practice. 41st ed. Philadelphia: Elsevier; 2016. p1418-1450.
[2] Michaudet C, Edenfield KM, Nicolette GW, Carek PJ. Foot and ankle conditions: Pes planus. FP Essent. 2018;465:18-23.
[3] Morley AJ. Knock-knee in children. Br Med J. 1957;2:976-79.
[4] Gould N, Moreland M, Alvarez R, Trevino S, Fenwick J. Development of the child's arch. Foot Ankle. 1989;9:241-45.
[5] Evan Siegall. Flexible Pes Planovalgus (Flexible Flatfoot). Lineage Medical Inc.; 2021. Updated on 11.2.2021. Cited on 20.12.2021. Availale from: https://www.orthobullets.com/pediatrics/4069/flexible-pes-planovalgus-flexible-flatfoot.
[6] Daniel DK, Chandrasekaran C, Mano A. A study on prevalence of flat feet among school children in kanchipuram population. Int J Anat Res. 2015;3(3):1240-44.
[7] Babu Y, Mohanraj KG, Pranati T. Assessment of Plantar Arch Index and Prevalence of Flat Feet among South Indian Adolescent Population. J Pharm Sci Res. 2017;9(4):490-92.
[8] Bhoir T, Anap DB, Diwate A. Prevalence of flat foot among 18-25 years old physiotherapy students: Cross sectional study. IJBAMR. 2014;3(4):272-78.
[9] Nurzynska D, Di Meglio F, Castaldo C, Latino F, Romano V, Miraglia R, et al. Flatfoot in children: Anatomy of decision making. Italian Journal of Anatomy and Embryology. 2012;117(2):98-106.
[10] Mosca VS. Flexible flatfoot in children and adolescents. J Child Orthop. 2010;4:107-21.
[11] Cilli F, Pehlivan O, Keklikçi K, Mahiroğulları M, Kuşkucu M. Prevalence of flatfoot in Turkish male adolescents. Joint diseases and related surgery. 2009;20(2):90-92.
[12] What is the Difference Between Flexible Flatfoot and Rigid Flatfoot? Springfield Podiatry Associates; 2021. (Cited on 20.12.2021). Available from: https://www.springfield-podiatry.com/component/k2/item/117-what-is-the-difference-between-flexible-flatfoot-and-rigid-flatfoot.html.
[13] Damien Jonas Wilson. Flexible vs Rigid Flat foot. News Medical Life Sciences. Azo network; 2021. (Cited on 20.12.2021). Available from: https://www.springfield-podiatry.com/component/k2/item/117-what-is-the-difference-between-flexible-flatfoot-and-rigid-flatfoot.html.
[14] Ukoha UU, Egwu OA, Okafor IJ, Ogugua PC, Igwenagu NV. Pes planus: Incidence among an adult population in Anambra State, Southeast Nigeria. International Journal of Biomedical and Advanced Research. 2012;3(3):166-68.
[15] Milenkovic S, Zivkovic M, Bubanj S. Incidence of flat foot in high school students. Physical Education and Sport. 2011;9(3):275-81.
[16] Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of Flexible Flat Foot in Adults: A Cross-sectional Study. JCDR. 2017;11(6):AC17-20.
[17] Morton DJ. Hypermobility of the first metatarsal bone; the interlinking factor between metatarsalgia and longitudinal arch strains. J Bone Joint Surg. 1928:10187-96.
[18] Roukis TS, Landsman AS. Hypermobility of the first ray: A critical review of the literature. J Foot Ankle Surg. 2003;42(6):377-90.
[19] Graham ME- Physcian's guide to Recurrent Talotarsal Joint Displacement. Available from: http://gramedica.com/flipBooks/physicians-guide-rttjd/physicians-guide-rttjd/assets/common/downloads/HyProCurePhysiciansGuide-FINAL_VERSION_9-16_Digital.pdf. (Accessed on 24.9.2020).
[20] Raj MA, Tafti D, Kiel J. Pes Planus. [Updated 2021 Aug 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430802 (Accessed on 08.10.2021).
[21] Ricco I, Gimigliano R, Porpora G, Iolascon G. Rehabilitative treatment in Flexible flat foot: A perspective cohort study. Musculoskeletal Surgery. 2009;93(3):101-07.
[22] Didia BC, Omu ET, Obuoforibo AA. The use of footprints contact index II for the classification of flat foot in a Nigerian population. Foot Ankle. 1987;7(5):285-89.
[23] Iijima H, Ohi H, Isho T. Association of bilateral flat feet with knee pain and disability in patients with knee osteoarthritis: A cross-sectional study. JOR. 2017;23565:2490-98.
[24] Eluwa MA, Omini RB, Kpela T, Ekanem TB, Akpantah AO. The incidence of Pes Planus amongst Akwa Ibom State students in the University of Calabar. The Internet Journal of Forensic Science. 2009;3(2).
[25] Okezue OC, Akpamgbo OA, Ezeukwu OA, John JN, John DO. Adult Flat Foot and its Associated Factors: A Survey among Road Traffic Officials. Nov Tech Arthritis Bone Res. 2019;3(4):65-69.
[26] Pita-Fernandez S, Gonzalez-Martin C, Alonso-Tajes F, Seoane-Pillado T, Pertega-Diaz S, Perez-Garcia S, et al. Flat Foot in a Random Population and its Impact on Quality of Life and Functionality. J Clin Diag Res. 2017;11(4):LC22-27.

[27] Kalra Y, Murthuza A, Geentanjali B, Mokhasi V, Rajini T. Study of footprints to determine the incidence of pes planus in South Indian using Staheli's plantar arch index. International Journal of Current Research. 2016;8(9):38928-32.
[28] Tiaotrakul A, Jaruchart T, Jangthong P, Matitopanam J, Joychue P, Khomawut A. Prevalence and Correlation between Flat Foot and Related Factors in University Athletes. Journal of Sports Sciences and Health. 2021;22(1):86-102.
[29] Truszczyńska-Baszak A, Drzał-Grabiec J, Rachwał M, Chałubińska D, Janowska E. Correlation of physical activity and fitness with arches of the foot in children. Biomedical Human Kinetics. 2017;9(1):19-26.
[30] Jasrin CJ, Mayasari W, Rakhmilla LE. Relationship between Physical Activity and Age on Flatfoot in Children. Althea Medical Journal. 2016;3(3):396-400.

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