Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i1.1681
*Biol. Clin. Sci. Res. J., Volume 6(1), **2025**: 1681*
Original Research Article

Frequency and Morbidity Associated With Flat Foot Anomaly Among School Going Children

Awais Gohar[1], Farhan Shah[1], Syed Bilal Hassan[1], Iqra Hamid Khan[1,2*]

[1]University Institute of Public Health, The University of Lahore, Pakistan
[2]Lincoln University College, Selangor, Malaysia
**Corresponding author's email address:* iqra.hamid@pht.uol.edu.pk

(Received, 24th November 2024, Accepted 18th January 2025, Published 31st January 2025)

Abstract: *Flat foot anomaly, commonly seen in children, occurs when the foot's arch is flattened, leading to potential orthopedic complications that can affect mobility and physical activity.* ***Objective:*** *To explore the prevalence and impact of flat feet on foot health, daily functioning, and long-term well-being.* ***Methodology:*** *This cross-sectional study assessed the prevalence and morbidity of flat foot anomaly in school children aged 7 to 14 years in Lahore, using the Plantar Arch Index (SPI) and Foot Health Status Questionnaire (FHSQ). Data analysis was performed using SPSS, with descriptive statistics and Pearson's Chi-square test, considering a p-value of ≤ 0.05 as significant.* ***Results:*** *The study included 223 male participants with a mean age of 10.14 ± 2.45 years, where 62.3% (139 participants) were normal weight, and 19.7% (44 participants) had flat feet. A significant association was found between BMI and foot status (p = 0.000*), with underweight children having more flat feet. Pain location (p = 0.005*) and pain level (p = 0.041*) were also significantly associated with flat foot prevalence, along with differences in pain (p = 0.050*) and foot health status (p < 0.001*).* ***Conclusion:*** *This study highlights the significant impact of flat foot anomalies on pain tolerance and foot health, emphasizing the importance of early identification and intervention to prevent complications in school-aged children.*

Keywords: Flat foot anomaly, children, prevalence, morbidity, foot health, physical activity, Staheli's Arch Index, foot stability

[***How to Cite:*** Gohar A, Shah F, Hassan SB, Khan IH. Frequency and morbidity associated with flat foot anomaly among school-going children. *Biol. Clin. Sci. Res. J.*, **2025;** 6(1): 177-181. doi: https://doi.org/10.54112/bcsrj.v6i1.1681

Introduction

Flat foot anomaly, a common condition in children, occurs when the arch of the foot is flattened, causing the entire sole to rest on the ground. This condition can lead to various orthopedic complications, affecting children's ability to engage in physical activities and potentially leading to long-term mobility issues if left unaddressed. (1)

Flat foot anomaly, a common condition in children, occurs when the foot's arch collapses, causing the entire sole to touch the ground. This can lead to significant orthopedic problems, hindering children's ability to engage in physical activities and possibly resulting in long-term mobility issues. Given its high prevalence, flat foot often goes undiagnosed in early childhood, making early detection and intervention crucial to prevent complications. (2) This study examines the prevalence of flat foot in school-aged children and its effects on foot health, daily activities, and overall physical function. Flat feet can lead to pain in the knees, hips, and back due to an abnormal gait and may also contribute to conditions like bunions, hammer toes, and shin splints. Moreover, it can cause structural deformities resulting from misalignments in the hip, spine, and knee.(3)

In children, flat foot is most commonly flexible, with the arch developing between the ages of 3 and 10. The condition can be classified based on arch height and heel eversion angle, which are important factors in assessing foot posture.(4, 5)

Studies indicate that between 20% and 37% of children have flat feet, with genetics playing a major role in their development. The medial longitudinal arch, which supports the foot's structure, is formed by various bones and ligaments, but muscle weakness and inadequate support can lead to flat feet. Both dynamic factors, like posterior tibial tendon insufficiency, and static factors, such as abnormal foot shape, can restrict foot movement, causing pain and instability.(6)

Children with pes planus may not experience symptoms until adolescence, with pain usually felt in the medial arch or ankle, often described as cramps or a deep arching sensation. The condition can cause muscle strain, alter gait patterns, and deformities such as everted feet or calcaneal valgus if left untreated.(7)

Dynamic factors like posterior tibial tendon insufficiency cause forefoot valgus and Achilles tendon contractures, leading to foot instability and inflammation. Static factors, such as abnormal foot morphology, limit midfoot movement, resulting in pain and inflammation.(8)

The stability of the foot arch depends heavily on the strength of muscles and ligaments. Weak muscles, especially those responsible for stabilizing the core and lower body, can exacerbate flat foot conditions. Poor posture, obesity, and improper footwear also contribute to the development of flat feet, making early screening and intervention vital for preventing long-term impacts on mobility and quality of life.(9),(10)

Inadequate muscle strength plays a key role in flat foot presentation, as muscle weakness, often following illness, leads to poor posture. This weakness affects the gluteal muscles, which are important for stability, causing children to adopt abnormal postures such as a forward head, flat chest, rounded back, and outward limb turns.(11) As muscle weakness progresses, uneven weight distribution places extra strain on the foot's arch, ultimately resulting in flat foot. Various factors contribute to flat foot, including obesity, improper footwear, poor posture, and weakness of ligaments or muscles.(12)

Obesity in children places excessive stress on growing foot structures, leading to potential structural malformations. Screening for foot problems in overweight children is crucial for identifying underlying issues that may limit their daily functioning. Flat foot, a common condition, if left undiagnosed, can disrupt the body's overall mechanics, making early diagnosis and treatment essential to prevent long-term effects on the child's quality of life. (13)

This study offers an essential understanding of the prevalence and health consequences of flat feet among schoolchildren, a condition that impacts their daily activities and overall well-being. By identifying this common yet frequently overlooked problem, the study seeks to increase awareness and encourage proactive measures to enhance foot health and prevent future complications.

Methodology

This cross-sectional analytical study aimed to assess the prevalence and morbidity of flat foot anomaly among school children aged 7 to 14 at a public school in Lahore. Children were selected based on simple random sampling, and all those with neurological diseases, foot surgery, or other deformities were excluded. The sample size of 223 children was calculated using a 95% confidence level and a 5% margin of error, taking the anticipated frequency from previous studies as 17.6%1 %.

Data collection utilized the Plantar Arch Index (SPI) and Foot Health Status Questionnaire (FHSQ) to assess flat feet and foot health across four domains (pain, foot function, footwear and general foot health). Data on age, gender, sports participation, and foot/ankle pain history were collected after obtaining informed consent. BMI, height, and weight were also measured. Footprints were taken after immersing the foot in the ink and then on the blank paper to assess the plantar arch index (SPI) using Staheli's Arch Index method, with SPI >1.15 indicating flat feet as indicated in Figure 1.

Data were analyzed using SPSS version 25.0, with descriptive statistics and Pearson's Chi-square test applied. A p-value of ≤ 0.05 was considered significant.

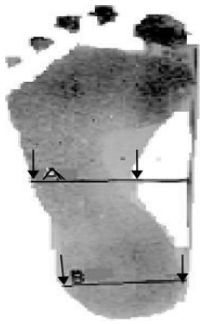

Figure 1: Footprint showing the measurement for Staheli's Arch Index (SPI). The perpendicular lines at the medial forefoot (A) and heel region (B) are used to calculate the A and B values, which are then used to determine the SPI and identify flat feet.

Results

Data was collected from a total of 223 male participants, with a mean age of 10.14 ± 2.45 years. The majority of participants (60.08%) were older than 10 years, while 39.92% were younger than 10 years.

Regarding BMI, the distribution among participants was as follows: 139 (62.3%) had a normal weight, 39 (17.5%) were overweight, 24 (10.8%) were underweight, and 21 (9.4%) were classified as obese.

In terms of foot status, figure 3 shows how SPI was calculated among school going children and out of the all 223 respondents, 179 (80.3%) participants had normal feet, while 44 (19.7%) were diagnosed with flat feet as illustrated in figure 2.

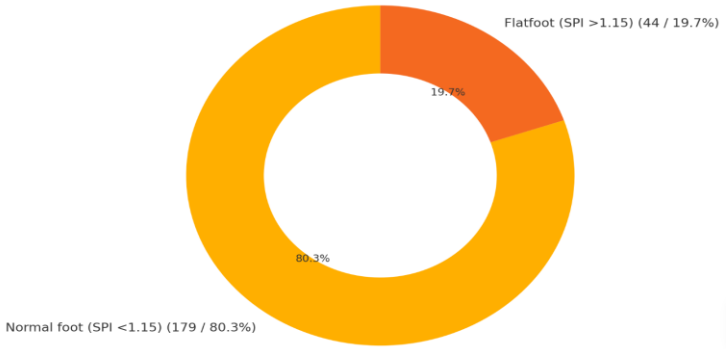

Figure 2: Distribution of flatfoot anomaly among school going children.

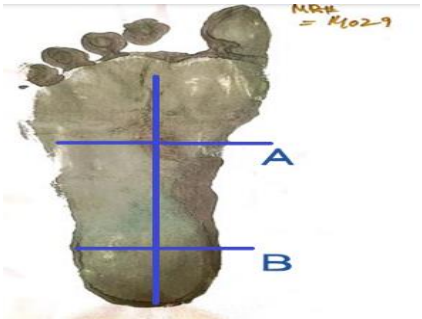

Figure 3: Footprint of a child captured during data collection to assess the Staheli Arch Index (SPI) for flat foot diagnosis. The measurement lines, marked as 'A' and 'B', help calculate the SPI by comparing the width of the arch area (A) to the width at the heel (B). Based on the SPI value, a child is classified as having flat feet if the SPI exceeds 1.15

There were certain variables and foot status (normal foot vs. flat foot) measured as illustrated in table no.1. A highly significant relationship was found between BMI and foot status (p-value = 0.000*), with underweight children showing a higher frequency of flat feet compared to normal weight children, and obese children exhibiting the least flat foot cases. The location of pain also had a significant impact (p-value = 0.005*), with more flat foot cases observed in children who localized pain to the left foot. Furthermore, the level of pain demonstrated a significant association (p-value = 0.041*), with children experiencing moderate to severe pain having a higher incidence of flat feet, while those with no or mild pain had more normal feet. However, physical activity and participation in sports did not show significant associations with foot status, as their p-values were greater than 0.05.

Table 1: Association of variables with foot health status

Variables	Categories	Normal Foot	Flat Foot	p-value
BMI	Underweight	14	10	0.000*
	Normal	123	16	
	Over weight	23	16	
	Obese	19	2	
Physical Activity	Never	48	15	0.147
	Rare	13	7	
	Sometimes	83	14	
	Always	35	8	
Participation in sports	Never	90	16	0.256
	Rare	30	7	
	Sometimes	32	13	
	Always	27	8	
Location of Pain	can't localize	69	13	0.005*
	right	74	11	
	left	28	14	
	both sides	8	6	
Level of Pain	None	105	18	0.041*
	Very Mild	12	5	
	Mild	2	3	
	Moderate	13	5	
	Severe	47	13	

***indicates significant**

Independent T test was used to find the association of domains of foot health status questionnaire with foot status. P-value for pain and foot health status was less than 0.05 thus statistically significant while function and footwear was not statistically significant as illustrated in table no.2.

The Pain domain showed a significant difference between normal and flat foot groups (p-value = 0.050*), with normal feet having a higher mean score. Similarly, Foot Health Status was significantly higher in normal feet compared to flat feet (p-value < 0.001*), indicating better overall foot health in those with normal feet.

Table 2: Association of foot status with domains of FHSQ

Domains	Normal foot n= 179	Flat foot n= 44	p-value
	Mean ± S.D.	Mean ± S.D.	
Pain	11.95 ± 2.799	10.93 ± 3.996	0.050*
Function	10.35 ± 4.6	10.1 ± 5.3	0.788
Footwear	6.99 ± 4.03	8.3 ± 4.6	0.075
Foot Health Status	6.1 ± 3.3	8.9 ± 4.4	<0.001*

Discussion

Children with acquired flat foot, foot surgery, lower limb deformities, or conditions such as club foot were excluded from this study. Data was collected from 223 participants aged 7 to 14, with congenital flat feet (both flexible and rigid) who could perform activities independently. The study was conducted in a government school, utilizing the Foot Health Status Questionnaire and basic demographic data collection. Flat foot was assessed using the footprint method. The average age of participants was 10.14 ± 2.45 years. The study found a significant relationship between flat foot occurrence and Body Mass Index ($P < 0.05$), with higher weight leading to increased risk of flat feet. Flat foot prevalence was more common in overweight and obese children. Additionally, a significant relationship was found between flat foot occurrence and physical activity ($P < 0.05$), with more cases observed in children who engaged in less or no physical activity and those who did not participate in sports.

Previous research has provided strong evidence on the prevalence of flat foot in children. A 2019 study by Saffa Ibrahim et al. found that 42.24% of children aged 11 to 16 had flat feet, with 23.3% having bilateral flat foot and 19% having unilateral flat foot. The study concluded that flat foot

prevalence in children is moderately high, and noted that gender and age had no significant impact on its occurrence, with no significant differences found between bilateral and unilateral cases. (14)

In contrast, our study found that gender is associated with the occurrence of flat feet, with a higher prevalence observed in male participants compared to females ($P < 0.05$). The exact reason for this is still unclear, though some studies suggest that females may have a higher prevalence of flat feet in adulthood due to increased body weight compared to males. (13, 15). Still many studies still support that boys are more prevalent case of flat foot than girls. (16, 17)

A study by Ahmad H. Alghadir et al. found that 30.4% of 550 participants had flat feet, with higher prevalence in overweight (33.3%) and obese (62.5%) individuals. The study also noted a higher incidence of flat feet in boys compared to girls, and concluded that flat foot is linked to obesity, with changes in adipose markers such as adiponectin, resistin, TNF-alpha, and leptin playing a role.(18) A similar study found that the prevalence of flexible flat foot decreased from 39.5% at age 6 to 11.8% at age 11, with the condition stabilizing between ages 12 and 13. The study concluded that flexible flat foot showed no relationship with age or gender, but there was a positive correlation between BMI and flat foot occurrence. These findings suggest that flexible flat foot decreases with age and stabilizes between 11 and 13 years, while BMI is associated with the presence of flat foot. (19)

The findings of this study align with previous research, emphasizing obesity as a significant factor in the development of flat foot. The study observed a higher prevalence of flat foot among overweight and obese children ($P < 0.05$), with 3.1% underweight, 51.1% normal weight, 21.1% overweight, and 24.7% obese children. The foot arch is primarily unstable, supported by ligaments that act as sensory organs to initiate muscle reflexes. Muscle strength is crucial for maintaining foot stability; weak muscles can lead to flat foot. The spring ligament complex plays a role in stabilizing the arch, though evidence for its effectiveness is limited. Additionally, the plantar fascia contributes to stability through the windlass effect, and excessive stress on it can lead to plantar fasciitis, a common condition in individuals with pes planus. (10)

Structural abnormalities in the foot, caused by the increased stresses from body weight, can lead to deformities and misalignments in the knee, hip, and spine.(3) As being overweight cause strain of the arch for longer period it ultimately results in flat foot.

Furthermore, the study evaluated the relationship between pes planus and obesity in school-going children. The analysis revealed a higher prevalence of flat foot in overweight and obese children compared to those with normal weight ($P < 0.05$). It was concluded that overweight children exhibited pronated heels, increased pain, and reduced dorsiflexion range during physical activities, with obesity being associated with ankle deformities. (20). Additionally, the study examined the link between pes planus and obesity in school-going children. The results showed a higher prevalence of flat feet in overweight and obese children compared to those with normal weight ($P < 0.05$). It was concluded that overweight children experienced pronated heels, increased pain, and limited dorsiflexion during physical activities, with obesity contributing to ankle deformities.(21)

Conclusion

The study underscores the significant role obesity plays in the prevalence of flat foot anomalies among school-aged children, with overweight and obese children showing higher rates. It also reveals a strong link between flat foot status and factors like pain and foot health, as children with flat feet tend to report lower pain tolerance and poorer foot health scores. These findings highlight the importance of early identification and intervention to avoid long-term issues such as pain, knee problems, and limited mobility.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-MMS-033-24)

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AG

Manuscript drafting, Study Design,

FH

Review of Literature, Data entry, Data analysis, and drafting articles.

SBH

Conception of Study, Development of Research Methodology Design,

IHK

Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Abich Y, Mihiret T, Yihunie Akalu T, Gashaw M, Janakiraman B. Flatfoot and associated factors among Ethiopian school children aged 11 to 15 years: A school-based study. PloS one. 2020;15(8):e0238001.
2. Pourghasem M, Kamali N, Farsi M, Soltanpour N. Prevalence of flatfoot among school students and its relationship with BMI. Acta orthopaedica et traumatologica turcica. 2016;50(5):554-7.
3. Han Y, Duan D, Zhao K, Wang X, Ouyang L, Liu G. Investigation of the relationship between flatfoot and patellar subluxation in adolescents. The Journal of Foot and Ankle Surgery. 2017;56(1):15-8.
4. Momanyi BO. Prevalence and Associated Factors of Pes Planus in Children and Young Adults With Down's Syndrome at Kenyatta National Hospital: UON; 2021.
5. Hung NN, Duc HH. Overview and Treatment for A Flatfoot in Children. International Journal of Orthopaedics. 2022;9(2):1614-31.
6. Dsouza SR, Gangane GR, Malawade MR. Correlation of Obesity and Flat-Foot in Haemophilic Adolescents in Karad. Journal of Evolution of Medical and Dental Sciences. 2021;10(27):2007-12.
7. Slater G, Mathen L, Slater T. Idiopathic Symptomatic Planovalgus Foot-Current Concepts In Minimally Invasive Correction. J Regen Biol Med. 2022;4(2):1-22.
8. Ahmed SM, Shine S, Asefa G, Belay M. Prevalence and Associated Factors of Stunting among School Age Children in Addis Ababa City, Ethiopia 2021. Annals of Global Health. 2022;88(1).
9. Veselinovska SS. ASSOCIATION BETWEEN SOCIOECONOMIC STATUS AND THE BODY MASS INDEX OF 6 TO 9-YEAR-OLD CHILDREN IN URBAN AND RURAL AREAS. Воспитание/Vospitanie-Journal of Educational Sciences, Theory and Practice. 2021;16(1):9-25.
10. Kılıçoğlu Öİ, Salduz A, Birişik F, Bilgili F, Polat G, Kaya İ, et al. High rates of psychiatric disorders and below normal mental capacity associated with spastic peroneal flatfoot: a new relationship. The Journal of Foot and Ankle Surgery. 2018;57(3):501-4.

11. Evans AM. Screening for foot problems in children: is this practice justifiable? Journal of foot and ankle research. 2012;5(1):1-10.
12. Chen K-C, Yeh C-J, Tung L-C, Yang J-F, Yang S-F, Wang C-H. Relevant factors influencing flatfoot in preschool-aged children. European journal of pediatrics. 2011;170(7):931-6.
13. 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. Journal of clinical and diagnostic research: JCDR. 2017;11(4):LC22.
14. Ibrahim S, Khan MS, Asif M, Hussain F. Prevalence of Flat Feet among School Children. Website: www ijpot com. 2019;13(3):214.
15. Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of flexible flat foot in adults: a cross-sectional study. Journal of clinical and diagnostic research: JCDR. 2017;11(6):AC17.
16. Lin C-J, Lai K-A, Kuan T-S, Chou Y-L. Correlating factors and clinical significance of flexible flatfoot in preschool children. Journal of pediatric orthopaedics. 2001;21(3):378-82.
17. Evans AM, Rome K. A review of the evidence for non-surgical interventions for flexible pediatric flat feet. Eur J Phys Rehabil Med. 2011;47(1-2):1-21.
18. Alghadir AH, Gabr SA, Rizk AA. Plasmatic adipocyte biomarkers and foot pain associated with flatfoot in schoolchildren with obesity. Revista da Associação Médica Brasileira. 2019;65:1061-6.
19. Yin J, Zhao H, Zhuang G, Liang X, Hu X, Zhu Y, et al. Flexible flatfoot of 6–13-year-old children: A cross-sectional study. Journal of Orthopaedic Science. 2018;23(3):552-6.
20. Sadeghi-Demneh E, Azadinia F, Jafarian F, Shamsi F, Melvin JM, Jafarpishe M, et al. Flatfoot and obesity in school-age children: a cross-sectional study. Clinical obesity. 2016;6(1):42-50.
21. Zara K, Mishal Ali R, Bushra M, Imran A. Pes planus and genu vallgum; factors associated. 2015.