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Prevalence of Pes Planus and Pes Cavus in School Going Children

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ABSTRACT

Pes planus and pes cavus are common foot deformities that may affect a child's posture and mobility. **Objective:** To investigate the incidence of idiopathic pes planus and pes cavus among school-going children with no known neurological or anatomical irregularities and without any known systemic diseases. **Methods:** This descriptive cross-sectional study was conducted on 75 school-going children aged 5 to 12 years in Lahore, using a convenient sampling technique. Data were collected through structured footprint analysis and a demographic questionnaire. Footprints were obtained using the ink method and analyzed using Staheli's Index to classify foot types as normal, pes planus, or pes cavus. Children with neurological disorders, foot deformities, systemic diseases, or a history of lower limb surgeries were excluded. Data were collected using SPSS version 26.0. **Results:** A total of 75 school-going children participated in the study, with a mean age of 9.35 ± 1.90 years. About half of the participants (52%) reported engaging in physical activity. Sandals were the most commonly worn footwear (34.7%), followed by barefoot walking (24%). A positive family history of foot conditions was reported by 56%, and 46.7% experienced foot pain. Foot type analysis showed that the majority had normal arches (64% both feet), with pes cavus more prevalent on the right foot (33.3%) than pes planus (2.7%). On the left foot, pes cavus and pes planus were observed in 25.3% and 10.7%, respectively. **Conclusion:** Pes cavus was more prevalent than pes planus, especially in the right foot, though overall rates were low.

INTRODUCTION

Foot deformities are a significant concern in musculoskeletal health, affecting individuals of all ages and often leading to mobility issues, pain, and long-term complications if left untreated [1]. Among the most common deformities are pes cavus and pes planus, which represent opposite abnormalities in foot structure and function [2]. Pes cavus, characterized by an excessively high medial longitudinal arch, is often linked to underlying neurological disorders, particularly in children and adolescents [3, 4]. This deformity alters foot biomechanics, leading to instability, increased risk of ankle sprains, and difficulties with weight distribution, ultimately affecting gait and overall mobility [5]. The most clinically significant form, pes cavovarus, frequently occurs in individuals with neurological conditions such as Charcot–Marie–Tooth (CMT) disease, cerebral palsy, or

Friedreich's ataxia, and tends to worsen over time, causing functional impairment and pain. Early detection and intervention are critical in managing this condition effectively and preventing further musculoskeletal complications [4]. Pes cavus is a foot deformity characterized by an abnormally high longitudinal arch. While it may be a benign anatomical variant, it often signifies an underlying neurological disorder, particularly in children and adolescents [6]. Identifying the condition early is essential, as progressive forms can lead to pain, instability, and long-term functional impairment. Among its various forms, pes cavovarus is the most common and is frequently associated with neurological conditions such as Charcot–Marie–Tooth disease (CMT)[7]. The foot functions as a tripod, distributing weight among the heel, first metatarsal, and fifth metatarsal. A pes cavus deformity

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arises when these points shift, causing an exaggerated arch. This condition can be either rigid or flexible, affecting the foot's biomechanics across multiple planes [8]. Pes cavus is described as a medial longitudinal arch that is too high. Although it may be linked to issues of a neuromuscular disorder, idiopathic cavus foot in most children is actually idiopathic without pathology. It can cause the gait to change, result in high foot pressure, and cause discomfort of the posture. Establishing its prevalence among school going children is relevant to screen its prevalence early and offer preventive medicineFoot type analysis revealed that 64% had normal arches on both feet, while pes cavus (25.33%) was more prevalent than pes planus (2.7%), especially on the right foot [9]. In many cases, both forms coexist, creating a mixed presentation. Among these, pes cavovarus is the most clinically significant, characterized by a high arch, clawing of the toes, forefoot pronation, and a varus (inward-tilted) position of the heel. This particular form is often linked to neuromuscular disorders and tends to worsen over time if left untreated [10]. The exact prevalence of pes cavus remains unclear, though studies suggest it affects about 2% of children by age three and increases to around 7% by adolescence. In adults, the prevalence ranges between 10.5% and 25% [11]. While some cases are idiopathic with no apparent cause, many arise due to an underlying neurological, muscular, or orthopedic condition. Among neurological causes, peripheral neuropathies such as CMT are the most common. This hereditary condition leads to progressive nerve degeneration, resulting in muscle weakness and foot deformities, including pes cavus [12]. Other neurological conditions such as cerebral palsy, Friedrich's ataxia, and spinal cord anomalies like syringomyelia or tethered cord syndrome may also contribute to the development of cavus foot [13]. Non-neurological causes include congenital anomalies, post-traumatic changes, and vascular issues that alter normal foot development. When the condition is unilateral, spinal abnormalities must be carefully considered as potential causes [14]. Abnormal foot arches, such as pes planus (flat feet) and pes cavus (high arches), can affect posture, balance, and overall musculoskeletal health in children.

The study aimed to determine the prevalence of pes planus and pes cavus in school-going children.

METHODS

This study employed a descriptive cross-sectional design. A total of 75 school-going children aged 5 to 12 years were recruited through convenience sampling from selected schools in Lahore. Online sample size calculator was used to calculate the sample size. The footprint study utilized the ink method, where each participant was asked to step onto an inked pad and then place their foot on white A4 paper while standing on a stable wooden platform to ensure proper weight distribution. This process was repeated for both feet. The collected footprints were analyzed to determine the plantar arch index using Staheli's Index, which classified foot types into normal, pes planus, or pes cavus. Additionally, a demographic questionnaire was used to gather information such as age, gender, BMI, and history of foot pain. The collected data were recorded systematically and were later analyzed statistically to assess the prevalence of different foot types among school-going children [15]. The criteria of inclusion included school children of the age between 5-12 years and children who could stand up and obey simple instructions. Children with any diagnosed musculoskeletal or neurological abnormalities (e.g., cerebral palsy or CharcotMarieTooth disease), congenital foot deformities, systemic disease, recent foot or lower limbs injury or a history of lower limb surgery were excluded in the study. To reduce confounding effects and to make sure that only idiopathic cases of pes planus and pes cavus should take part in the analysis, these criteria were put to work. Participants' responses were collected, and all data were entered into an SPSS file. The data were analyzed using SPSS version 26.0 and interpreted to derive further results. Descriptive statistics of categorical data, such as frequency, percentage, cross-tabulation, bar charts, and pie charts, were used to represent variables. For non-categorical (continuous) data, (mean, median), dispersion (standard deviation, range), and histograms were used to summarize and interpret the data.

RESULTS

Data were collected from 75 valid responses, with no missing values. The mean age was 9.35 ± 1.90 years, indicating that most participants were around 10 years old, with a moderate variation. The minimum and maximum ages recorded were 5 and 10 years, respectively (Table 1).

Table 1: Descriptive Statistics of Age (n=75)

Variables	Value
Mean ± SD	9.35 ± 1.899
Minimum	5
Maximum	10

Out of 75 individuals, 46 were female (61.3%) and 29 were male (38.7%). The data showed a higher proportion of female participants compared to males (Figure 1).

Gender

Male ■
Female ■

38.67%
29

61.33%
46
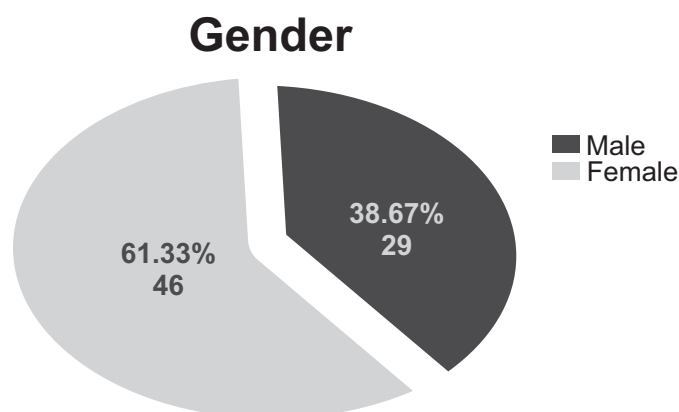
Figure 1: Graphical Representation of Gender (n=75)

Out of 75 valid responses, 35 participants (46.7%) reported experiencing foot pain, while 40 participants (53.3%) did not. This indicates that nearly half of the participants experienced some form of foot pain (Table 2).

Table 2: Descriptive Statistics of Foot Pain (n=75)

Response	Frequency (%)
Yes	35 (46.7)
No	40 (53.3)
Total	75 (100.0)

The mean Right Staheli Index was 0.5389 ± 0.1851, indicating a moderately arched foot on average. The values ranged from 0.23 to 0.93, reflecting a variation from high arches (pes cavus) to low arches (pes planus) among participants (Table 3).

Table 3: Descriptive Statistics of Right Staheli Index (n=75)

Variables	Value
Mean ± SD	0.5389 ± 0.1851
Minimum	0.23
Maximum	0.93

Out of 75 valid responses, 48 participants (64.0%) were classified as having a normal foot type. Pes cavus was observed in 25 participants (33.3%), while pes planus was the least common, seen in only 2 participants (2.7%). This indicates that the majority of participants had normal right foot arches, with a significant portion exhibiting a high arch (pes cavus) (Table 4).

Table 4: Descriptive Statistics of Right Foot type (n=75)

Foot Type	Frequency (%)
Normal	48 (64.0)
Pes Planus	2 (2.7)
Pes Cavus	25 (33.3)
Total	75 (100.0)

All 75 entries were valid with no missing data. The mean Left Staheli Index was 0.605 ± 0.219, with values ranging from a minimum of 0.18 to a maximum of 0.99, indicating variation in the plantar arch characteristics of the participants' left feet.

Table 5: Descriptive Statistics of Left Staheli Index (n=75)

Variables	Value
Mean	0.6049 ± 0.2193
Minimum	0.18
Maximum	0.99

DISCUSSION

The objective of this study is to determine the prevalence of pes planus and pes cavus in school going children. In this study of 75 school-going children (mean age 10.35 years), most participants were female (61.3%) and underweight (76%). About 52% engaged in physical activity, and sandals were the most commonly worn footwear. Foot type analysis revealed that 64% had normal arches on both feet, while pes cavus (25.33%) was more prevalent than pes planus (2.7%), especially on the right foot. The prevalence of pes cavus has been observed to be high (in right foot 33.3%, in left foot 25.3), which is far much higher accompanied compared to other reports in the pediatric literature where estimates put prevalence of idiopathic cases between 2-7 percent. This inconsistency can be explained by methodological drawbacks like application of Staheli Index without age-related normative curves, possible misinterpretation of high arches in growing feet, application of small, non-random sample. Although, due to the lack of clinical confirmation, these could have been overestimated considering only the analysis of static footprints. Current study results had resembled with previous study by Kharbuja and Dhungel, normal foot arch type was found to be more prevalent 64% on the right and 64% on the left foot. Prevalence of pes planus recorded was relatively less than pes cavus [15]. Such decreased incidence of flat foot in this study in comparison to the studies made in western countries (15%) could be because of children not wearing shoes. Almost same results had found in current study in which pes cavus is more prevalent than pes plenus and mostly seen in right foot [16]. Another study examined how different foot postures normal, planus, and cavus affect foot movement patterns during walking [17]. Although the prevalence of pes cavus in the right foot was a bit higher, this is of incident nature. In normal persons, the gait examinations always show an even weight distribution between the legs. Consequently, lateral asymmetry results are more likely caused by methodological diversity, measurement bias or differences in sample than a real biomechanical difference in loading therefore, it might have been more prone to develop foot deformity [18]. The findings of our study regarding the prevalence of foot deformities align with previous research, which reported a notable occurrence of pes planus and pes cavus in southern populations and

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identified similar prevalence and associated factors among school-aged children in Ethiopia[19, 20].

CONCLUSIONS

This study highlighted a higher prevalence of pes cavus (25.3%) compared to pes planus (2.7%) among school-going children in Bhaktapur, with a notable dominance on the right foot. The findings contrast with global pediatric literature, likely due to methodological limitations such as small, non-random sampling, reliance on the Staheli Index without age-specific norms, and absence of clinical confirmation. Cultural practices, including walking barefoot and wearing sandals, may influence arch development. The relatively low incidence of flatfoot and higher cavus prevalence suggest the need for standardized, clinically validated assessment tools and larger, randomized studies to draw more accurate conclusions about pediatric foot morphology in this region.

Authors Contribution

Conceptualization: MQ
Methodology: WR, ST, TA, SS
Formal analysis: WR, ST, TA, SS
Writing, review and editing: WR, ST, TA, SS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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