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ORIGINAL ARTICLE

Prevalence of pes planus and pes cavus and its association with risk of fall, activities of daily living and muscular discomfort among school teachers of Hayatabad, Peshawar. A cross sectional study.

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ABSTRACT… Objective: To determine the prevalence of pes planus and pes cavus and its association with risk of fall, activities of daily living and muscular discomfort. **Study Design:** Multi-center Cross-sectional study. **Setting:** Hayatabad Public and Private Schools. **Period:** August 2024 to January 2025. **Methods:** This was multi-center cross-sectional study; conducted on school teachers of Hayatabad, Peshawar. Total 113 school teachers (mean age 29.42± 6.07) were included in the study through convenience sampling technique. Demographic details were obtained from all the study participants. Navicular drop test was used to assess arch of the foot. Risk of fall and activities of daily living were assessed using Efficacy Scale International and Foot and Ankle Ability Measure respectively. Cornell Musculoskeletal Discomfort Questionnaire is used for muscular discomfort. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 25. **Results:** The sample in this study consisted of 47.8% male and 52.2% female school teachers. The results of this study showed that pes planus is slightly more prevalent (19.16%) than pes cavus (16.93%). The baseline variables like gender, age and Body Mass Index (BMI) and functional outcomes like risk of fall and activities of daily living were strongly associated with type of foot ($p<0.05$). **Conclusion:** This study found that foot arch deviations, such as pes planus and pes cavus, are highly prevalent and show strong associations with age, gender, and BMI. These deviations also have a significant impact on functional outcomes.

Key words: Activities of Daily Living, Flat Foot, High Arch Foot, Muscular Discomfort, Pes Planus, Pes Cavus, Risk of Fall.

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INTRODUCTION

The human foot is a complex structure of bones, ligaments, muscles, and tendons that supports body weight and enables balance, shock absorption, propulsion, and movement adaptability.[1] The foot arches are vital for maintaining stability and efficient gait, and any alteration can lead to foot stress and lower-limb musculoskeletal complications.[2] Pes planus, marked by a depressed medial longitudinal arch, everted hind foot, and abducted/dorsiflexed midfoot, causes excessive pronation, altered lower-limb mechanics, and poor load distribution; often resulting in pain, stiffness, gait changes, reduced activity, and fatigue.[3] On other hand pes cavus, characterized by an abnormally elevated medial arch may progressively impair function, balance, and footwear tolerance.[4] Foot disorders affect 61–79% of young individuals.[5] Advancement in age poses a higher prevalence of abnormal medial arch structure and related foot pain.[6]

In healthy individuals, abnormal foot architecture has been shown to adversely affect skilled motor performance and elevate the likelihood of injuries.[7] Foot pain is reported as the most common complaint among American population. It is strongly linked to functional disabilities, such as limitations in activities of daily living, reduced social participation, higher medical expenditures, and increased absenteeism from work.[8] Furthermore inconsistent evidence is available regarding the association of risk of fall with foot architecture with some studies reporting a significant relationship while others show no clear link.[9] The lack of standardized treatment protocols and the considerable variation in therapeutic approaches pose a major challenge in managing pes planus and pes cavus.

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This variability contributes to suboptimal treatment outcomes like functional mobility and quality of life.[10]

Although the existing literature acknowledges their prevalence and potential to impact physical function, there is a notable lack of research exploring their association with risk of falls, activities of daily living (ADLs), and musculoskeletal discomfort; particularly in adult working populations. This study addresses a significant gap by focusing specifically on school teachers and examining the associations between foot arch types and key functional risk factors, including fall risk, daily activity limitations, and musculoskeletal discomfort. The findings aim to contribute to early identification and prevention strategies in occupational health settings.

METHODS

This was a multi-center cross sectional study conducted on school teachers of Hayatabad, Peshawar. The approval was obtained from the Review Board of Khyber Medical University (DIR/KMU-ASRB/PP/IPMR/003104). The study duration was 6 months from (from August 2024 to January 2025). The sample size was calculated using the Openepi online sample size calculator (97% confidence level, and a 5% margin of error). Data was collected from 3 public schools and 3 private schools of Hayatabad. A total of 313 teachers were initially screened for eligibility. Following the application of the inclusion criteria, 113 school teachers (both male and female), aged 18–50 years, were selected and recruited into the study through a convenience sampling technique. Participants were excluded from the study if they have (1) history of any neurological condition, such as Meniere's disease or vestibular disease (2) any form of muscle atrophy or dystrophy, (3) BMI over 30, (4) diagnosis of any abnormality or surgery of the lower limbs (5) use of medications that can potentially produce symptoms of dizziness or imbalance (6) individuals with normal foot arches. After fulfilling the eligibility criteria, written informed consent was obtained from all participants for inclusion in the study and for the use of their data in publications, ensuring anonymity. A detailed information sheet was provided to each participant, and any questions related to the study were addressed satisfactorily.

Demographic details were obtained from all the participants. A detailed evaluation of foot was conducted for each patient. To classify participants into pes cavus and pes planus category "navicular drop test" was performed. Navicular drop is a reliable test for assessing foot arch (ICC= 0.82 - 0.89).[11] illustration of the test is given in the Appendix I. Functional outcomes included risk of fall assessment and activities of daily living.

To assess the risk of fall among participants; "Fall Efficacy Scale International" was used. This tool evaluates concern about fear of falling. It is a valid, reliable, and easy-to-understand tool for measuring fear of fall; suitable for use across different cultures. A higher score indicates poor outcome showing high concern about falling.[12]

Foot and Ankle Ability Measure (FAAM-ADL) was used for assessing activities of daily living. Previous studies have reported that FAAM has high correlation with the function (r = 0.87, 95% confidence interval [CI] 0.81-0.91) and pain component (r = 0.75, 95% CI 0.65-0.83). A higher score on FAAM suggests better functional status.[13]

Muscular discomfort was measured using Cornell Musculoskeletal Discomfort Questionnaire; it is a valid and reliable instrument for the exploration of musculoskeletal discomfort. The higher score suggests high degree of discomfort.[14,15]

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Mean and standard deviation were calculated for continuous variables such as age. Categorical variables, including age groups, BMI, Navicular Drop Test results, and the Foot and Ankle Ability Measure categories, were presented using frequency tables. The Chi-square test and cross-tabulation were applied to assess the association between variables. A p-value ≤ 0.001 was considered statistically significant.

RESULTS

The mean age of the sample was 29.42 ± 6.07 years, comprising 47.8% male and 52.2% female school teachers. The majority of participants (58.4%) had a normal BMI, while 31% were classified as

overweight. Based on the Navicular Drop Test, 53.1% of the participants exhibited pes planus, whereas 46.9% had pes cavus. (See Table-I) The prevalence of pes planus was (19.16%); slightly higher than prevalence of pes cavus (16.93%).

TABLE-I

Characteristics of study population

Parameters	Categories	Frequency	%
Age	Young Adult (18-25)	26	23.0
	Early Adult (26-30)	43	38.1
	Adult (31-35)	33	29.2
	Middle Aged Adults (41-45)	11	9.7
Gender	Male	54	47.8
	Female	59	52.2
BMI	Underweight	12	10.6
	Normal weight	66	58.4
	Over weight	35	31.0
Navicular Test	Pes planus	60	53.1
	pes cavus	53	46.9
Foot & Ankle Ability Measure	Moderate difficulty	41	36.3
	Slight difficulty	47	41.6
	No difficulty at all	25	22.1
Risk of fall	Fairly concerned	66	58.4
	Somewhat concerned	47	41.6

Based on chi square test, it was determined that structure of foot is strongly associated with individual's age, gender, BMI, foot &ankle ability and risk of fall ($p < 0.05$). See Table-II

Statistically significant association was observed between foot architecture and reports of discomfort across lower extremities on Cornell Musculoskeletal Discomfort Questionnaire ($p<0.05$). See Figure-1(a, b).

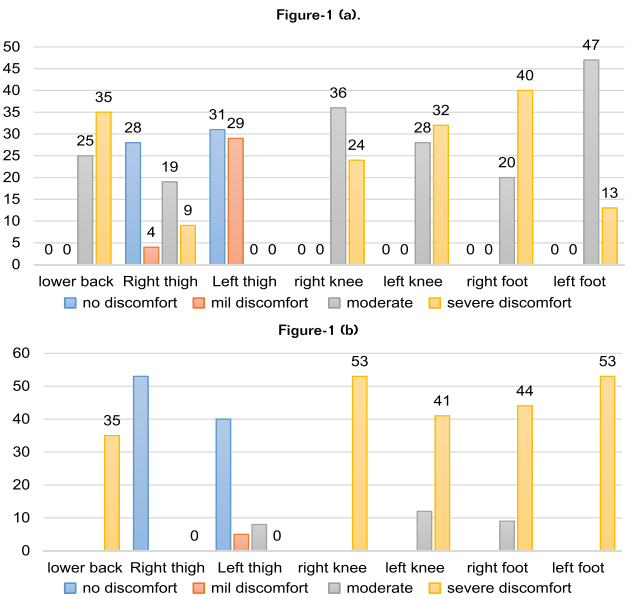
TABLE-II

Foot architecture in relation to Age, Gender, BMI and Functional outcomes

Variable	Categories	Structure of Foot		P- Value
		Pes Planus	Pes Cavus	
Age	Young Adult	10	16	0.005
	Early Adult	19	24	
	Adult	22	11	
	Middle Aged Adults	9	2	
Gender	Male	6	53	0.001
	Female	54	0	
BMI	Underweight	12	0	0.001
	Normal weight	48	18	
	Over weight	0	35	
Foot & Ankle Ability	Moderate difficulty	0	41	0.001
	Slight difficulty	37	10	
	No difficulty at all	23	2	
Risk of fall	Fairly concerned	50	16	0.001
	Somewhat concerned	10	37	

FIGURE-1

Showing reports of discomfort felt across lower extremities by participants with (a) Pes Planus and (b) Pes Cavus.



DISCUSSION

The findings of this study suggest that foot arch deviations, such as pes planus and pes cavus, are highly prevalent across all the categories of ages and affects both male and female. This study showed a strong association of foot architecture with body mass index. These deviations significantly impact on functional outcomes like activities of daily living and risk of fall.

In our study sample we observed that the prevalence of pes planus (19.16%) is higher than pes cavus (16.93%). On the basis of navicular drop test, no female had pes cavus architecture of foot; all the females presented a pes planus deformity. On other hand, among males only 10.16% were diagnosed with pes planus and 89.83% presented pes cavus deformity. Shah et al. conducted a study, in which he reported 26% of subjects had pes planus and 54% had pes cavus. This high number could be due to the fact that his population had a higher percentage of male 72.0%.[15] This pattern is also confirmed by our study that pes cavus was more prevalent in male population.

Troiano et al. reported that younger age is a significant risk factor for the presence of flat feet (pes planus), suggesting that the condition is more prevalent in early life stages. These findings are consistent with the results of our study, which demonstrated a marked reduction in the incidence of pes planus among individuals older than 40 years. This age-related decline may reflect developmental and structural changes in the foot arch over time, or possibly an adaptive response due to long-term mechanical loading and musculoskeletal maturation. Our findings reinforce the idea that age plays a crucial role in the prevalence and progression of pes planus.[16]

Hajirezaei et al published a study in 2017. The study population comprised 260 female students from Mazandaran University. According to the results, no significant relationship was found between body mass index (BMI) and the presence of flat feet or high arched foot.[17] Contrary to that, the findings of our study show a substantial and significant correlation between the type of foot and BMI. We observed that among overweight individuals; 60% showed pes cavus and zero reports of pes planus and 40% showed normal foot arches. Pes planus was more common in normal weight and underweight individuals 25.3% and 18.18% respectively.

A strong association between foot posture and lower extremity pain was reported by Riskowski et al; he reported that participants with planus structure had higher odds of knee and ankle pain while participants with cavus foot had higher risk of ankle pain.[18] This prediction is confirmed by our study where 66 to 78% participants with pes planus reported moderate to severe type of pain & discomfort in their feet; followed by 40 to 60% pes planus reporting knee pain. A sharp spike (41 to 58%) in the complaint of lower back pain and discomfort is observed in our study as well. Among pes cavus individuals; 100% reports of foot and knee pain was recorded in our study.

In our study, 50% individuals with either pes planus or cavus showed fair concern of balance related to risk of fall. These findings are supported in a study by Sahan et al; in which he objectively compared lower extremity dominance, subtalar angle, balance, fall risk, and performance in young adults with and without pes planus. Significant differences were found in subtalar angles and jump test performance ($p < 0.05$), with reduced values in the pes planus group.[9]

Lopez et al conducted a case control study in 498 participants. Based on the self-reported data on foot health-related quality of life, it was concluded that significant difference exits between cases and controls for foot health, general health and physical activity.[5] These findings align with the results of our study: which determined that functional outcomes like activities of daily living are strongly associated with architecture of foot. Thus concluding that foot pathologies have a negative impact on quality of life.

LIMITATIONS & RECOMMENDATION

This study was a multi-center cross-sectional study that was conducted in specific region of Peshawar; thus the sample may not be a true representation of the entire population of Peshawar. A larger sample size and random inclusion of participants from all regions of Peshawar may produce more

generalizable results.

CONCLUSION

This study found that foot arch deviations, such as pes planus and pes cavus, are highly prevalent and show strong associations with age, gender, and BMI. These deviations also have a significant impact on functional outcomes.

Ethics Approval and Consent to Participate

Ethical approval for the study was granted by the Review Board of Khyber Medical University (DIR/KMU-ASRB/PP/IPMR/003104).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Aqsa Khan:** Data collection, data entry.
2	**Seema Gul:** Manuscript writing, data analysis, proof read.