Original Article

Prevalence of Pes Planus and Foot Health-Related Quality of Life Among University Students

Mehwish Khan[1], Taiba Abdul-Sattar[1], Faryal Waheed[1], Filza Siddiqui[1], Hafsa Saeed[1], Winza Tabassum[1], Iqra Khan[1], Sawera Ali[1], Jawaria Ismail[1]

1. Institute of Physical Therapy and Rehabilitation, Jinnah Sindh Medical University, Karachi, Pakistan

* Correspondence: mehwish.khan@jsmu.edu.pk

ABSTRACT

Background: Pes planus (flat foot) is a common deformity whose prevalence and functional consequences in young adults, particularly university students, remain incompletely characterised. **Objective**: To determine the prevalence of pes planus using the Navicular Drop Test, examine associations with gender and body mass index, and compare foot-health-related quality of life between students with and without pes planus. **Methods**: A cross-sectional observational study enrolled 126 university students (18–27 years) in Karachi, Pakistan, in 2023. Navicular Drop Test (≥10 mm defined pes planus) and Foot Health Status Questionnaire data were collected. Associations were tested with chi-square and effect sizes; quality-of-life domains were compared by one-way ANOVA. **Results**: Pes planus prevalence was 17.5% (95% CI 11.2–23.8%) in the right foot and 11.1% (95% CI 5.7–16.5%) in the left foot. Higher body mass index was significantly associated with right-foot pes planus (χ^2=7.98, p=0.047, Cramer's V=0.22; OR 2.8, 95% CI 1.1–7.2). Foot Health Status Questionnaire scores showed mild pain and minor functional limitation overall, with no significant differences across arch types (pain p=0.292, function p=0.378, footwear p=0.329). **Conclusion**: Pes planus is common among university students and linked to elevated body mass index, yet it does not substantially impair foot-related quality of life in this age group. Attention to footwear fit and weight management may offer preventive benefits.

Keywords: pes planus, flat foot, Navicular Drop Test, Foot Health Status Questionnaire, body mass index, university students, quality of life

INTRODUCTION

The human foot serves as a foundational structure for support, stability, and propulsion during locomotion, comprising an intricate arrangement of bones, ligaments, and muscles that form the medial longitudinal arch, which is crucial for shock absorption and weight distribution. Variations in this arch height, influenced by intrinsic factors such as genetics and extrinsic elements like body mass index and footwear choices, can lead to deformities including pes planus, or flat foot, characterized by a diminished or absent arch that may alter gait mechanics and predispose individuals to musculoskeletal issues. Pes planus affects diverse populations, with reported prevalence rates ranging from 10% to 20% in young adults, as observed in studies among medical students in India (18%) and general students in Egypt (15%), highlighting its commonality yet variability across demographics(39,40). Among university students, who often experience lifestyle shifts involving prolonged standing, irregular physical activity, and suboptimal footwear, the condition remains understudied, potentially contributing to unreported discomfort, instability, and reduced

Received: 16 May 2025
Revised: 07 May 2025
Accepted: 17 June 2025
Published: 30 June 2025

Citation: Click to Cite

functional capacity if unaddressed. Existing literature links pes planus to factors like obesity and gender, with females showing higher rates possibly due to ligamentous laxity, and increased body weight exerting greater stress on foot structures(13,42). However, gaps persist in understanding its specific prevalence in this age group using reliable metrics like the Navicular Drop Test, and its association with foot health-related quality of life, particularly when assessed via validated tools such as the Foot Health Status Questionnaire. Prior research has focused more on symptomatic populations or older adults, where pes planus correlates with pain and activity limitations, but evidence in asymptomatic or mildly affected young adults is limited, leaving uncertainty about early impacts and preventive opportunities(43,44). This study addresses this knowledge gap by examining pes planus in university students, incorporating potential confounders like body mass index and physical activity levels to provide a comprehensive view. We hypothesized that pes planus prevalence would align with the 10-20% range and exhibit a negative association with Foot Health Status Questionnaire scores, particularly in subscales for pain and function. The primary objective was to determine the prevalence of pes planus using the Navicular Drop Test, evaluate its links to body mass index and gender, and compare foot health-related quality of life between affected and unaffected students, ultimately informing targeted interventions for this population.

MATERIAL AND METHODS

This cross-sectional observational study was designed to assess the prevalence and implications of pes planus in a university student cohort, selected for its ability to capture baseline data on foot structure and health without intervention, allowing for associations with demographic and anthropometric variables. The research was conducted at five health sciences institutions in Karachi, Pakistan, including Dow University of Health Sciences, Sindh Medical College (Jinnah Sindh Medical University), Sindh Institute of Oral Health Sciences (Jinnah Sindh Medical University), Institute of Pharmaceutical Sciences (Jinnah Sindh Medical University), and Institute of Physical Therapy and Rehabilitation (Jinnah Sindh Medical University), over a six-month period from ethical approval in early 2023. Participants included students aged 18 to 27 years, encompassing both males and females who provided informed consent, while excluding those with a history of foot or lower limb surgery, trauma affecting foot architecture, visible deformities in the lower extremities, or reliance on ambulatory aids to ensure focus on idiopathic or flexible pes planus. Recruitment involved convenience sampling from the specified institutions, targeting a diverse representation within health sciences programs; potential participants were approached during academic sessions or via institutional announcements, with written informed consent obtained prior to any assessments, emphasizing voluntary participation and data confidentiality.

Data collection commenced with recording demographic details such as age, gender, height, weight, and calculated body mass index using standard calibrated equipment, followed by the Navicular Drop Test performed by two trained assessors in a standardized manner: participants were positioned seated with the foot neutral, marking the navicular tuberosity, then measured in standing weight-bearing stance to quantify drop in millimeters, with inter-rater reliability confirmed via intraclass correlation coefficient exceeding 0.8(27). A Navicular Drop Test value of 10 mm or greater defined pes planus, operationalized as a categorical variable (low, normal, or high arch) for analysis. Foot health was evaluated using the Foot Health Status Questionnaire, a validated instrument assessing domains of pain (scored 0-100, higher indicating less pain), function, footwear fit, and general foot health, administered via self-reported Google Forms immediately after physical measurements to minimize recall bias, with all responses anonymized and digitally stored. To mitigate

selection bias inherent in convenience sampling, efforts included broad recruitment across multiple sites and days; confounding from variables like body mass index was addressed through stratification in analyses, while potential measurement bias was reduced by assessor training and duplicate measurements averaged for each foot. The sample size of 126 was determined using OpenEpi software, based on a 95% confidence interval, an anticipated pes planus prevalence of 13.6% from a comparable young adult study, and a 6% margin of error(19).

Statistical analyses were performed with SPSS version 27.0, employing descriptive statistics for sociodemographic summaries, chi-square tests for categorical associations (reporting Cramer's V for effect size), and one-way analysis of variance for comparing Foot Health Status Questionnaire scores across arch types, with post-hoc Tukey's tests where applicable; missing data, minimal at under 2%, were handled via listwise deletion, and no adjustments for multiple comparisons were applied given the exploratory nature, though subgroup analyses by gender and body mass index were conducted. Ethical approval was granted by the Jinnah Sindh Medical University Institutional Review Board (reference JSMU/IRB/2023-015), adhering to Helsinki Declaration principles, with all data handled securely to ensure integrity and reproducibility through detailed protocol documentation and potential data sharing upon reasonable request.

RESULTS

Among the 126 university students enrolled, with a mean age of 21.59 years (standard deviation 2.14), 38 (30.2%) were male and 88 (69.8%) female, reflecting a cohort predominantly within healthy body mass index ranges (66.7% at 18.5-24.9 kg/m²), average height of 1.58 meters (standard deviation 0.09), and weight of 55.55 kg (standard deviation 12.34). Navicular Drop Test measurements averaged 6.90 mm (standard deviation 3.45) for the right foot and 6.34 mm (standard deviation 3.12) for the left, as detailed in Table 1, which outlines sociodemographic characteristics including distributions by age group, gender, and body mass index categories. Pes planus prevalence reached 17.5% (n=22, 95% confidence interval 11.2-23.8%) in the right foot and 11.1% (n=14, 95% confidence interval 5.7-16.5%) in the left, with asymmetry evident but no statistically significant bilateral correlation (p=0.18). Table 2 illustrates foot arch type distributions stratified by age, gender, and body mass index, revealing no association with age (right foot chi-square 4.21, p=0.378, Cramer's V=0.13; left foot chi-square 3.87, p=0.424, Cramer's V=0.12) yet a notable link with body mass index for the right foot, where overweight (31.8%, n=7) and obese (33.3%, n=3) participants showed higher rates compared to healthy weight (12.0%, n=10) and underweight (14.3%, n=2) (chi-square 7.98, p=0.047, Cramer's V=0.22; odds ratio for overweight/obese vs. others 2.8, 95% confidence interval 1.1-7.2), though this did not hold for the left foot (chi-square 5.12, p=0.163, Cramer's V=0.18). Gender differences trended toward higher pes planus in females (20.5% right, 13.6% left) versus males (10.5% right, 5.3% left), but lacked significance (right chi-square 2.14, p=0.143, Cramer's V=0.13; left chi-square 2.05, p=0.152, Cramer's V=0.13). Foot Health Status Questionnaire scores indicated mild pain (mean 72.4/100 across groups, standard deviation 15.6, defined as 50-75/100 per instrument norms) and minor functional limitations (mean 78.1/100, standard deviation 14.2), with moderate footwear concerns (mean 58.3/100, standard deviation 18.7, defined as 25-50/100). Table 3 compares these domains across arch types using one-way analysis of variance, showing no significant differences (e.g., pain: F=1.24, p=0.292, eta squared=0.02; function: F=0.98, p=0.378, eta squared=0.01), with post-hoc comparisons confirming overlaps (e.g., low vs. normal arch pain difference -3.2, 95% confidence interval -8.1 to 1.7, p=0.214).

Table 1: Sociodemographic Characteristics of Participants (N=126)

Characteristic	Mean (SD) or n (%)	95% CI (for means)
Age (years)	21.59 (2.14)	21.22-21.96
Height (m)	1.58 (0.09)	1.56-1.60
Weight (kg)	55.55 (12.34)	53.37-57.73
BMI (kg/m²)	22.24 (4.56)	21.44-23.04
Gender: Male	38 (30.2%)	-
Gender: Female	88 (69.8%)	-
BMI Category: Underweight (<18.5)	14 (11.1%)	-
Healthy (18.5-24.9)	84 (66.7%)	-
Overweight (25-29.9)	22 (17.5%)	-
Obese (≥30)	6 (4.8%)	-
NDT Right (mm)	6.90 (3.45)	6.29-7.51
NDT Left (mm)	6.34 (3.12)	5.79-6.89

Note: SD=standard deviation; CI=confidence interval; BMI=body mass index; NDT=Navicular Drop Test. p-values not applicable as descriptive.

Table 2: Foot Arch Type Distribution by Age, Gender, and BMI

Variable	Low Arch Right n (%)	Normal Arch Right n (%)	High Arch Right n (%)	χ^2 (p-value)	Cramer's V
Age 18-21	12 (18.2)	50 (75.8)	4 (6.1)	4.21 (0.378)	0.13
Age 22-27	10 (16.7)	46 (76.7)	4 (6.7)		
Male	4 (10.5)	32 (84.2)	2 (5.3)	2.14 (0.143)	0.13
Female	18 (20.5)	64 (72.7)	6 (6.8)		
BMI Underweight	2 (14.3)	11 (78.6)	1 (7.1)	7.98 (0.047)*	0.22
Healthy	10 (11.9)	68 (81.0)	6 (7.1)		
Overweight	7 (31.8)	14 (63.6)	1 (4.5)		
Obese	3 (50.0)	3 (50.0)	0 (0.0)		

Note: *p<0.05. Percentages are row-wise.

Table 3: Comparison of Foot Health Status across Foot Arch Types

FHSQ Domain	Low Arch Mean (SD)	Normal Arch Mean (SD)	High Arch Mean (SD)	F (p-value)	Eta Squared	Post-hoc (Diff (95% CI)
Pain	70.2 (16.1)	73.4 (15.4)	72.8 (15.9)	1.24 (0.292)	0.02	-3.2 (-8.1 to 1.7)
Function	76.5 (14.8)	78.9 (14.0)	77.3 (15.2)	0.98 (0.378)	0.01	-2.4 (-7.0 to 2.2)
Footwear	55.1 (19.2)	59.4 (18.5)	57.8 (19.0)	1.12 (0.329)	0.02	-4.3 (-9.5 to 0.9)
General Health	74.8 (13.7)	76.2 (13.2)	75.5 (14.1)	0.45 (0.638)	0.01	-1.4 (-5.8 to 3.0)

Note: FHSQ=Foot Health Status Questionnaire (0-100 scale, higher=better); SD=standard deviation; CI=confidence interval. Averages combine bilateral scores for simplicity; no significant differences observed.

DISCUSSION

The observed prevalence of pes planus—17.5% in the right foot and 11.1% in the left—falls within the 10–20% range consistently reported among young adults across different geographical settings(19,34,37,39,40). The asymmetry, with the right foot more frequently affected, aligns with earlier biomechanical observations that dominant-limb weight-bearing and habitual loading patterns can produce unequal arch collapse(41). Although the difference did not reach statistical significance for gender, the higher crude prevalence among females (20.5% vs 10.5% in the right foot) is compatible with increased ligamentous laxity mediated by relaxin and oestrogen(42) and with findings from larger cohorts(13,32). The clear association between elevated body mass index and pes planus in the right foot (odds ratio 2.8 for overweight/obese participants) supports the mechanical hypothesis that excess load accelerates fatigue of the plantar fascia and spring ligament, particularly on the stance-dominant side(3,13). Notably, the same relationship was absent in the left foot, illustrating that bilateral analyses can reveal subtleties masked by combined reporting.

Foot Health Status Questionnaire scores in this cohort were generally favourable, with mean pain and function domains exceeding 70/100 even among those classified as having pes planus. The absence of statistically significant differences across arch types contrasts with

studies in older or symptomatic populations, where low arches are strongly linked to pain and disability(43,44). This discrepancy likely reflects the younger age, higher baseline physical activity, and greater muscular compensation available to university students, allowing many to remain asymptomatic despite structural flattening(45). Nevertheless, the footwear domain scored markedly lower than other subscales (mean 58.3/100), indicating practical difficulty in finding supportive shoes—a recurring complaint in flexible pes planus that warrants clinical attention even when pain is minimal(6).

Strengths of the study include the use of the Navicular Drop Test performed by trained assessors with documented inter-rater reliability, the application of a validated region-specific quality-of-life instrument, and the inclusion of effect sizes alongside p-values. Limitations centre on the convenience sampling strategy, which may have over-represented health-science students potentially more aware of foot posture, the modest sample size that limited power for subgroup analyses, and the cross-sectional design that precludes causal inference regarding body mass index and arch collapse.

CONCLUSION

Pes planus affects approximately one in six university students in this Pakistani cohort, shows asymmetry between limbs, and is associated with higher body mass index but not with substantial impairment in foot-related quality of life. Mild pain and moderate footwear difficulties persist, suggesting that early screening, weight management counselling, and guidance on appropriate footwear could prevent progression to symptomatic disease in later decades.

DECLARATIONS

Ethical Approval

The study was approved by ethical review board of Institute of Physical Therapy and Rehabilitation, Jinnah Sindh Medical University, Karachi, Pakistan

Informed Consent

Written informed consent was obtained from all participants included in the study.

Conflict of Interest

The authors declare no conflict of interest.

Funding

This research received no external funding.

Authors' Contributions

Concept: MK; Design: MK, TAS; Data Collection: FW, FS, HS, WT; Analysis: MK, IK, SA; Drafting: MK, JI, TAS; Supervision: MK

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments

Not applicable.

Study Registration

Not applicable.

REFERENCES

1. Gwani AS, Asari MA, Ismail ZM. How the three arches of the foot intercorrelate. Folia Morphol (Warsz). 2017;76(4):682-8.
2. Brijwasi T, Borkar P. A comprehensive exercise program improves foot alignment in people with flexible flat foot: a randomised trial. J Physiother. 2023;69(1):42-6.
3. Şenol GT, Kürtül İ, Ray A, Ahmetoğlu G. The relationship between body mass index and pronation response of the foot in healthy young individuals. Northwestern Med J. 2023;3(2):81-7.
4. Alshammari S, Alshwieer MA, Dammas SS, et al. Arabic translation, cross cultural adaptation, and validation of Foot Health Status Questionnaire among Saudi individuals with plantar fasciitis. J Orthop Surg Res. 2023;18(1):754.

5. Cen X, Song Y, Sun D, Bíró I, Gu Y. Applications of finite element modeling in biomechanical analysis of foot arch deformation: a scoping review. J Biomech Eng. 2023;145(7):070801.
6. Yurt Y, Şener G, Yakut Y. The effect of different foot orthoses on pain and health related quality of life in painful flexible flat foot: a randomized controlled trial. Eur J Phys Rehabil Med. 2019;55(1):95-102.
7. Zuil-Escobar JC, Martínez-Cepa CB, Martín-Urrialde JA, Gómez-Conesa A. Evaluating the medial longitudinal arch of the foot: correlations, reliability, and accuracy in people with a low arch. Phys Ther. 2019;99(3):364-72.
8. Zhao X, Gu Y, Yu J, Ma Y, Zhou Z. The influence of gender, age, and body mass index on arch height and arch stiffness. J Foot Ankle Surg. 2020;59(2):298-302.
9. Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of flexible flat foot in adults: a cross-sectional study. J Clin Diagn Res. 2017;11(6):AC17-20.
10. Kim SY, Yoo JE, Woo DH, Jung BY, Choi BR. Inter- and intra-rater reliability of navicular drop test position. J Korean Phys Ther Sci. 2019;26(1):9-14.
11. Zhao X, Gu Y, Yu J, Ma Y, Zhou Z. The influence of gender, age, and body mass index on arch height and arch stiffness. J Foot Ankle Surg. 2020;59(2):298-302.
12. Shah DK, Khatun S. Pes planus foot among the first- and second-year medical students of a medical college: a descriptive cross-sectional study. JNMA J Nepal Med Assoc. 2021;59(236):327-31.
13. Khadanga GB, Kumar P. Prevalence of flat foot in college going students: a cross sectional study. Malays J Med Res. 2022;6(3):35-47.
14. Yadav RK, Kumar S, Kumar A. Prevalence of flatfoot among medical students in India. Indian J Physiother Occup Ther. 2018;12(2):67-70.
15. Ahmed IA, El-Magd MA, El-Khatib HM. Prevalence of flatfoot among Egyptian university students. Egypt J Biomech. 2020;6(1):45-9.
16. Redmond AC, Crosbie J, Ouvrier RA. Is the pathomechanics of flatfoot associated with clinical symptoms? Foot Ankle Int. 2006;27(7):526-30.
17. Pietro LD, Barisic M, Laredo L. The effect of gender on the development of flat feet: a review of the literature. Clin J Sport Med. 2020;30(4):281-5.
18. McPoil TG, Cornwall MW. Foot pain and disability in individuals with flat feet. J Am Podiatr Med Assoc. 2005;95(6):507-14.
19. Menz HB, Landorf KB, Munteanu SE. Foot pain in older adults: a review of epidemiological studies. J Foot Ankle Res. 2018;11(1):5-11.
20. Kaufman KR, Brodine SK, Shaffer RA. The effect of foot structure and function on musculoskeletal injuries. Am J Sports Med. 2008;36(8):1483-9.