Volume 3, Issue 9, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

EFFECTS OF FOOTWEAR ON GAIT AND BALANCE IN UNDERGRADUATE STUDENTS OF ALLIED HEALTH SCIENCES IN SARHAD UNIVERSITY OF SCIENCE AND INFORMATION TECHNOLOGY, PESHAWAR

Syeda Fatima Iqbal[1], Tooba Ejaz[2], Fatima Urooj[3], Dr. Rabia Naeem[4], Dr. Inayat ullah[*5]

[1,2,3]*Doctor of Physiotherapy, student, Sarhad University of sciences and information technology Peshawar, Pakistan*
[4]*Assistant Professor, Sarhad University of sciences and information technology Peshawar, Pakistan*
[*5]*Assistant Professor Sarhad University of sciences and information technology Peshawar, Pakistan*

[1]fatimaiqbal090209@gmail.com, [2]ejaztooba689@gmail.com, [3]fatimaurooj851@gmail.com, [*5]inayatulla.siahs@suit.edu.pk

DOI:https://doi.org/10.5281/zenodo.17513012

Keywords
Footwear, Gait abnormalities, Balance, Observational Gait Analysis, Romberg Test

Article History
Received: 12 September 2025
Accepted: 22 October 2025
Published: 03 November 2025

Corresponding Author: *
Dr. Inayat ullah

Abstract

BACKGROUND & OBJECTIVE:

Footwear influences gait and balance by affecting posture, sensory feedback, and biomechanics. Improper footwear may lead to altered gait patterns and increased fall risk, even in young adults. This study aimed to identify footwear types and associated gait abnormalities among undergraduate Allied Health Sciences students and to evaluate the effects of different footwear on gait and balance at Sarhad University of Science and Information Technology, Peshawar.

METHODOLOGY:

*An analytical cross-sectional study was conducted on 340 undergraduate Allied Health Sciences students aged 18–28 years. Data was collected through non-probability convenience sampling using **Observational Gait Analysis** for gait assessment and the **Romberg Test** for balance evaluation. Statistical analysis was performed using **SPSS version 25**, applying descriptive and correlation analyses to determine associations between footwear type, gait abnormalities, and balance.*

RESULTS:

*Findings revealed that **55.6%** of participants exhibited abnormal gait patterns, the most common being **missing toe-off (17.1%)**, **everted foot (10.9%)**, and **flat foot (6.5%)**. A significant correlation ($\rho = -0.310$, $p < 0.05$) was observed between footwear type and gait abnormalities, while no significant association was found with balance ($\rho = 0.048$, $p > 0.05$). Participants wearing **sandals** showed the highest gait deviations, while those wearing **sneakers/shoes** demonstrated the most normal gait (66.2%). Only **0.9%** of students had a positive Romberg test, indicating minimal balance impairment.*

CONCLUSION:

The study concluded that footwear type significantly affects gait but has minimal impact on balance among young adults. Inappropriate footwear, especially sandals and slippers, was linked to abnormal gait

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

patterns, whereas sneakers were associated with better gait performance. These findings highlight the importance of proper footwear selection for maintaining optimal gait and preventing postural or musculoskeletal problems among students.

INTRODUCTION

Footwear helps in protecting our feet from injury and makes sure of a smooth, painless movement during daily routines, work, recreational activities, and sports. Its selection is based on many factors like economy, culture, and function, but comfort is a top concern almost everywhere (1). Apart from promoting general comfort, proper footwear contributes to physical activity and can even enhance sports performance (2).

Human gait means the way the body moves while walking upright (3). Walking involves a repetition of sequenced limb movements that move the body forward and maintain stability. Since this process requires coordination between the lower limbs and body mass, gait is analyzed through three main approaches: foot contact patterns, stride timing and length, and specific events that are dividing the gait cycle into functional stages (4).

Balance is defined as the body's ability to maintain its center of gravity and be steady. It depends on the coordination of visual cues, body movement, and muscle activity. There are two types of balance: static and dynamic balance (5). Static balance is the ability to withhold a position by adjusting the support base. Dynamic balance, on the contrary, stabilizes the body during motion, using the muscles and joints to counteract external forces, allowing movement while maintaining stability (6).

Footwear and insoles play an important role in balance and gait in patients and normal subjects. Studies have demonstrated that insoles with tubing or vibration components can improve balance and thick or soft material can worsen it (7). Footwear is also involved in postural stability and sensory feedback through proprioception and touch. Plantar cutaneous mechanoreceptors, which are excited by touch, provide plantar pressure distribution information to the central nervous system(8).

Risk factors for impaired gait and balance include dizziness, vertigo, and other balance disorders, which can significantly affect daily functioning and increase the risk of falls (9). These impairments often reduce independence, cause fear of movement, and compromise overall quality of life. (10). Foot biomechanics also play a crucial role in maintaining stability, as even small changes in foot support can affect balance and postural control (11)

Diagnosis of balance and gait impairments relies on clinical tests to assess fall risk, including the Timed Up and Go (TUG) test, Berg Balance Scale (BBS), gait speed tests, dual-task tests, single-leg stance, 10 Meter Walk Test, Functional Reach Test (FRT), tandem gait, and chair stand test (12). Resistance exercises improve muscle strength and balance among healthy elderly people. Unsupervised home programs will maximize participation by avoiding the need to travel. Two or more supervised training sessions per week included in training programs is advised to improve balance (13). Treatment can range from a combination of gait training, assistive technology, fall prevention, and multimodal rehabilitation. (14).

Epidemiologically, balance and gait impairments are common among older adults, affecting 13% of those aged 65–69 and 46% of those over 85. Gait disorders impact 35% of adults over 70 and increase the risk of institutionalization and death by 2.2 times. Poor balance and gait also contribute to a higher risk of falls, with 28% of older adults falling annually, accounting for 55.8% of accidental fatalities in this population (15).

The influence of footwear on balance and gait among young adults, particularly university students, is an underexplored area. After a thorough review of the literature, it is evident that limited studies have investigated how different types of footwear affect gait patterns and postural

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

stability in this population. This study aims to bridge this knowledge gap by examining the impact of various footwear types; shoes, slippers, sandals, and heels on balance and gait parameters among undergraduate students.

Methods:

This study used an analytical cross-sectional design to explore the effects of different footwear types on gait and balance among undergraduate students. Data was collected over six months, from March 2025 to August 2025, at a single site, Sarhad University of Science and Information Technology, Peshawar. Ethical approval was obtained from the Institutional Research Ethical Committee and informed consent was secured from all participants prior to data collection. Only face-to-face interactions were used to recruit participants.

A non-probability convenience sampling technique was adopted, selecting students who were readily available and willing to participate. The minimum sample size was calculated using Raosoft, Inc., with a 5% margin of error, 95% confidence level, and 50% response distribution, resulting in a required sample of 340 participants. Inclusion criteria included undergraduate students of Allied Health Sciences, aged 18–28 years, of both genders, and willing to participate. Exclusion criteria included students with musculoskeletal injuries or lower limb surgeries affecting gait, neurological, vestibular, or congenital conditions impacting balance or gait and students using assistive walking devices such as crutches or walkers.

For data collection, Observational Gait Analysis and the Romberg Test were used to assess gait patterns and balance. Data was analyzed using SPSS version 25. Descriptive statistics including frequencies, percentages, tables, and graphs were used to summarize demographic variables, footwear types, and gait abnormalities. Correlation analysis was performed to examine associations between footwear types and gait or balance outcomes. Ethical considerations included maintaining participant confidentiality and informing respondents of the study objectives.

Results:

Age of participants:

The figure shows frequency of age in the total population. Among the 340 students the majority of participants 93, (29.5%) were aged 22 years , while only 1 participant (0.3%) was aged 18 years.

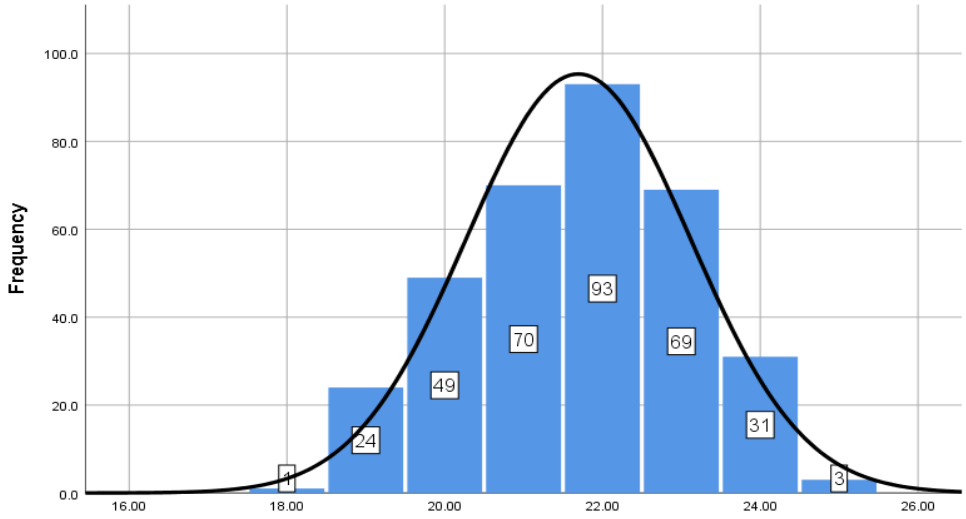

Figure 1 Histogram showing age of participants

Gender of Participants:

The figure shows percentage of participants of both genders, out of total 340 participants there were 147 (43.2%) males and 193 (56.8%) females.

Volume 3, Issue 9, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

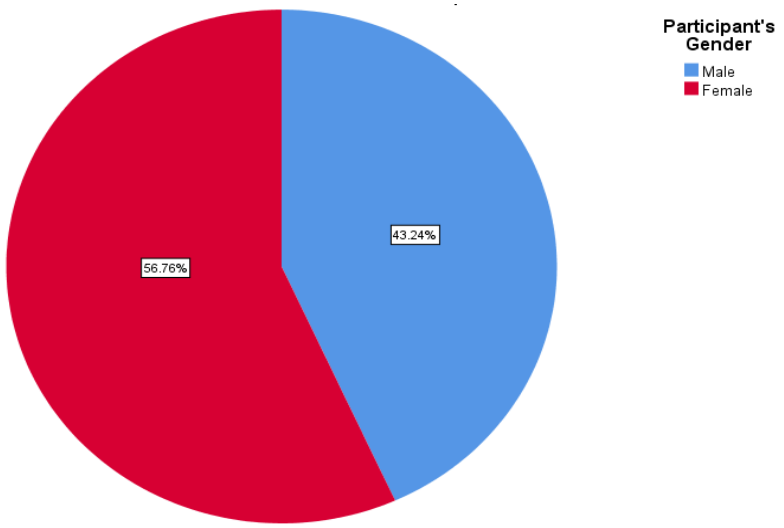

Figure 2 Pie-chart showing gender of participants

Footwear type preferences among participants: The figure shows the footwear type preferences among participants, out of total 340 participants mostly preferred footwear were Sneakers/Shoes (129) , while the least preferred footwear were Heels (26).

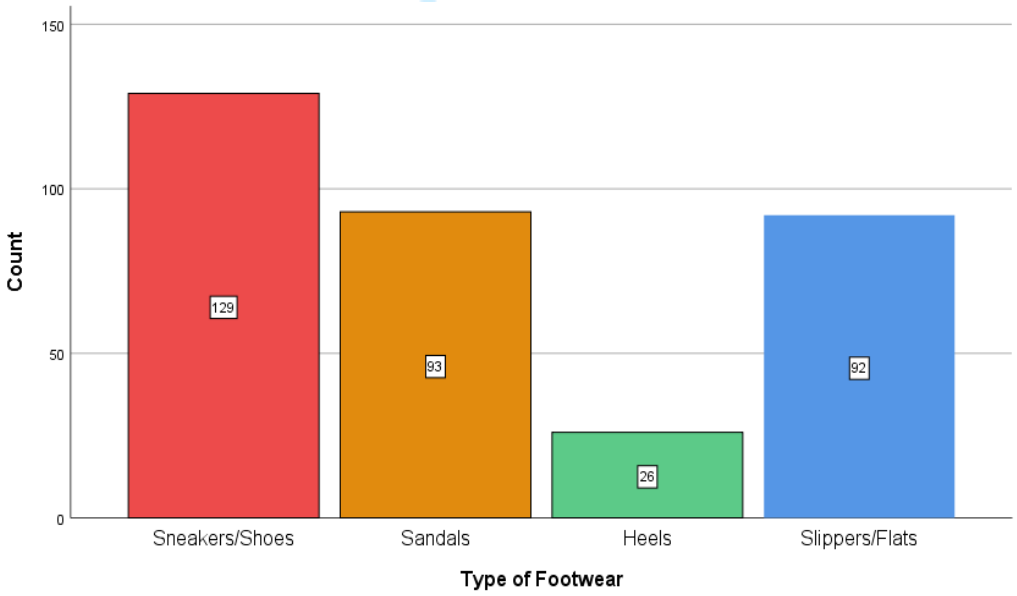

Figure 3 Footwear type preferences among participants

Gait abnormalities observed among participants: The table shows gait abnormalities observed among participants, out of 340 participants 58 (17.1%) had missing toe off, 22 (6.5%) had flat foot, 37 (10.9%) had everted foot, 26 (7.6%) had decrease dorsiflexion, 18 (5.3%) had foot slap, 22 (6.5%) had foot drag abnormality while only 1(0.3%) and 2 (0.6%) had inverted foot and missing heel strike.

		Frequency	Percent
Valid	missing toe off	58	17.1
	flat foot	22	6.5
	everted foot	37	10.9

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

	decreased dorsiflexion	26	7.6
	foot slap	18	5.3
	foot drag	22	6.5
	inverted foot	1	.3
	missing heel strike	2	.6
	none	154	45.3
	Total	340	100.0

Table 1 Gait abnormalities observed among participants

Results of Romberg test assesment:

The figure shows the result of Romberg test, out of 340 total participants 337 (99.1%) had a negative result for the test while only 3 (0.9%) had a positive result.

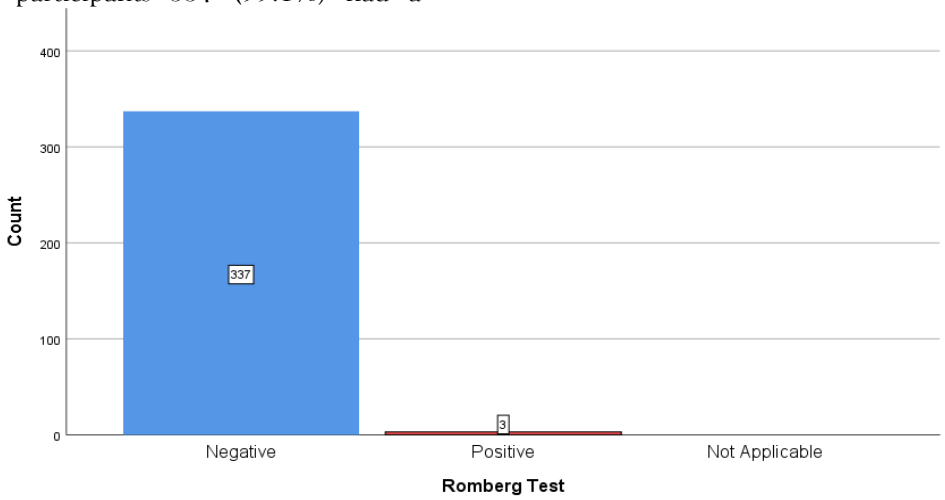

Figure 4 Results of Romberg test assessment

Correlation of Footwear Type with Gait Abnormalities:-

The table shows Spearman's correlation coefficient (rho) with the value of -0.310 which indicates a moderate negative correlation between footwear type and gait abnormalities.

			Type of Footwear	Abnormalities observed
Spearman's rho	Type of Footwear	Correlation Coefficient	1.000	0.310**
		Sig. (2-tailed)	.	0.000
		N	340	340
	Abnormalities observed	Correlation Coefficient	0.310**	1.000
		Sig. (2-tailed)	0.000	.
		N	340	340

Table 2 Correlation of Footwear Type with Gait Abnormalities

Correlation of Footwear Type with Balance:-

The table shows Spearman's correlation coefficient (rho) with the value of 0.048 which indicates no significant correlation between footwear type with balance.

			Type of Footwear	Balance
Spearman's rho	Type of Footwear	Correlation Coefficient	1.000	0.048
		Sig. (2-tailed)	.	0.378

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

		N	340	340
	Balance	Correlation Coefficient	0.048	1.000
		Sig. (2-tailed)	0.378	.
		N	340	340

Table 3 Correlation of Footwear Type Type with Balance

Discussion:

Most existing research on footwear and gait focuses on older adults or clinical populations, but limited studies have explored how everyday footwear affects gait and balance among young university students. The present study addressed this gap by examining 340 undergraduate Allied Health Sciences students at Sarhad University, finding a high prevalence of gait abnormalities, particularly with sandals, slippers, and heels.

Several studies support the findings of the present research on footwear and gait. Karasawa et al. (2022) investigated 12 healthy adults in Japan using wearable sensors during a 10-meter walk test and found that open-back shoes (slippers) significantly disrupted gait mechanics, causing greater left-right step length differences and reduced postural tilt angles compared to closed-back shoes. These results align with our study, where students wearing sandals or slippers exhibited more gait abnormalities, including absent toe-off (81%), foot drag, and foot slap, while sneaker users showed relatively normal gait (66.2%). Similarly, Mohamed et al. (2021) examined 30 young female students in the UAE and reported that high heels reduced walking distance and increased postural sway and fatigue, consistent with our findings of reduced dorsiflexion and other gait impairments among heel wearers. Balance impairments, however, remained minimal in both studies (16).

However, some studies present contrasting results. Hoerzer et al. (2015) evaluated 15 healthy adults in Canada and reported that running in shoes decreased gait asymmetry compared to barefoot conditions, suggesting improved neuromuscular control. These findings differ from ours, likely due to differences in activity type (running vs. walking), footwear type (neutral running shoes vs. everyday sandals/slippers), and assessment methods (sensor-derived indices vs. clinical observation). While shoes may enhance gait symmetry during dynamic running, our results indicate that certain everyday footwear can negatively affect walking patterns, even in healthy young adults (17).

Conclusion:

Our study concluded that there were significant negative effects of footwear on gait abnormalities. Among which missing toe off was the most commonly observed abnormality in students who wore sandals. On the other hand, there was no significant relationship between footwear type and balance. These results are indicative that inappropriate footwear could influence gait even in the absence of a balance issue. These results suggest appropriate footwear as being significant in ensuring gait wellness, particularly among young adults.

Limitations of the Study:

There are several recommendations for future research to consider. Firstly, subsequent studies should include students from multiple universities and academic programs to enhance generalizability. Secondly, the use of sophisticated objective measures, such as gait analysis software or wearable sensors, is recommended to obtain more precise assessments compared to observational methods alone. Additionally, footwear selection should be verified through direct observation or digital monitoring rather than relying solely on self-reporting. Experimental or longitudinal study designs are advisable to better evaluate temporal relationships between footwear and gait patterns. Finally, larger and more diverse sample sizes are needed to improve statistical power and ensure more robust and generalizable results.

REFERENCES:

1. Menz HB, Bonanno DR. Footwear comfort: a systematic search and narrative synthesis of the literature. Journal of Foot and Ankle Research. 2021;14(1):63.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

2. Shields N, Lim P, Wollersheim D, Nikolopoulos N, Barrett J, Evans A, et al. Do foot posture, deformity, and footwear fit influence physical activity levels in children with Down syndrome? A prospective cohort study. Journal of Intellectual & Developmental Disability. 2017;42(4):332-8.
3. Achan P, Paterson M, Monsell F. 26 Gait. Basic Orthopaedic Sciences. 2018:377.
4. Perry J, Burnfield JM. Phases of gait. Gait Analysis: CRC Press; 2024. p. 9-16.
5. Eylen MA, Daglioglu O, Gucenmez E. The Effects of Different Strength Training on Static and Dynamic Balance Ability of Volleyball Players. Journal of Education and Training Studies. 2017;5(13):13-8.
6. Ahmad T, Nawaz A, Ejaz U, Shah IA. Evaluation of Static and Dynamic Balance among Undergraduate Students of Allied Health Sciences in Sarhad University of Science and Information Technology, Peshawar. Journal of Rehabilitation and Clinical Research (JRCR). 2023;1(2):49-54.
7. Mohamed MK, Taha RA, Baig HT, Heji HG, Abyan NO, Ramakrishnan S, et al. Effect of footwear on balance and gait among young female students. Journal of Orthopaedics and Sports Medicine. 2021;3(1):8-18.
8. Alghadir AH, Zafar H, Anwer S. Effect of footwear on standing balance in healthy young adult males. Journal of musculoskeletal & neuronal interactions. 2018;18(1):71.
9. Murdin L, Schilder AG. Epidemiology of balance symptoms and disorders in the community: a systematic review. Otology & Neurotology. 2015;36(3):387-92.
10. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly: A clinical guide. Wiener Klinische Wochenschrift. 2017;129(3):81-95.
11. Al Abdulwahab SS, Kachanathu SJ. The effect of various degrees of foot posture on standing balance in a healthy adult population. Somatosensory & motor research. 2015;32(3):172-6.
12. Beck Jepsen D, Robinson K, Ogliari G, Montero-Odasso M, Kamkar N, Ryg J, et al. Predicting falls in older adults: an umbrella review of instruments assessing gait, balance, and functional mobility. BMC geriatrics. 2022;22(1):615.
13. Lacroix A, Hortobagyi T, Beurskens R, Granacher U. Effects of supervised vs. unsupervised training programs on balance and muscle strength in older adults: a systematic review and meta-analysis. Sports medicine. 2017;47(11):2341-61.
14. Ataullah A, De Jesus O. Gait disturbances. StatPearls [Internet]: StatPearls Publishing; 2024.
15. Osoba MY, Rao AK, Agrawal SK, Lalwani AK. Balance and gait in the elderly: A contemporary review. Laryngoscope investigative otolaryngology. 2019;4(1):143-53.
16. Karasawa S, Yamamoto M, Sakurai J, Kawasaki S, Kobayashi H. The Impact of Footwear on Posture, Gait and Balance. Health. 2022;14(2):209-18.
17. Hoerzer S, Federolf PA, Maurer C, Baltich J, Nigg BM. Footwear decreases gait asymmetry during running. PloS one. 2015;10(10):e0138631.

1.