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Association of Foot Health with Quality of Work and Fatigue Severity Among the University Teachers

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ABSTRACT

Background: University teaching involves prolonged standing and walking that may compromise foot health and contribute to reduced work functioning and fatigue. Objective: To determine the association of foot health with work impairment and fatigue severity among university teachers. Methods: This analytical cross-sectional study included 369 university teachers recruited from three universities in Lahore (September–December 2025). Foot health was assessed using the Foot Health Status Questionnaire (FHSQ) across foot pain, foot function, footwear, and general foot health domains. Work impairment was measured using the Work Productivity and Activity Impairment questionnaire (WPAI), reporting absenteeism, presenteeism, overall work productivity loss, and activity impairment as percentages. Fatigue was assessed using the Fatigue Severity Scale (FSS; total 9–63). Associations were tested using correlation analysis with two-tailed significance at $p<0.05$. Results: The mean age was 31.71±6.28 years; 65.6% were female. Mean WPAI outcomes were absenteeism 4.99±12.48, presenteeism 26.45±19.91, overall work productivity loss 26.29±19.95, and activity impairment 25.34±19.31. Mean FSS total was 32.84±11.13. Worse foot health correlated with higher work impairment and fatigue; the strongest association was between foot function and activity impairment ($r=0.548$, $p<0.001$), and footwear problems showed the strongest association with fatigue ($r=0.452$, $p<0.001$). Conclusion: Poorer foot health among university teachers is associated with greater work impairment and higher fatigue severity, supporting the need for occupational and ergonomic strategies targeting foot health.

Keywords

Foot health status; work productivity; activity impairment; fatigue severity; body mass index.

INTRODUCTION

The foot is a complex anatomical and biomechanical structure distal to the ankle joint, formed by multiple bones, joints, muscles, tendons, and ligaments that work in coordinated sequences to support body weight, attenuate ground-reaction forces, and enable efficient forward propulsion during gait. Structurally, the foot comprises 26 bones organized into the forefoot, midfoot, and hindfoot, while synovial joint architecture and cartilage-lined articulating surfaces facilitate low-friction movement under repetitive loading demands. (1,2) Because the foot is the primary interface between the body and the ground, compromised foot health can impair mobility, balance, and functional capacity and can manifest as pain-related limitation that extends beyond locomotion into occupational performance and daily activities. (1,2)

Footwear is a modifiable determinant of foot health, and appropriate fit and design have been emphasized as clinically relevant to comfort, pressure distribution, and prevention of podiatric complaints. However, in many occupational settings footwear selection remains driven by aesthetic preference, institutional dress norms, or convenience rather than functional requirements, which may contribute to persistent discomfort, pain, or impaired foot function over time. (3) In workforces exposed to prolonged standing, footwear characteristics can influence symptom development and discomfort trajectories, and prolonged standing itself has been recognized as an occupational exposure associated with lower-limb discomfort and fatigue, even within relatively short durations of static standing. (4)

Prolonged occupational standing, commonly operationalized as spending more than half of work time in standing posture, is prevalent across multiple industries and has been linked to musculoskeletal symptoms, vascular pooling, venous stasis, and fatigue-related discomfort of the lower limbs. Physiological studies suggest that stationary standing increases hydrostatic venous pressure and lower-limb venous pooling, while sustained low-level muscular activation—particularly in the calf musculature—can reduce local perfusion and contribute to fatigue and discomfort. (5–7) Such mechanisms may also alter plantar loading patterns, including increased plantar pressure under the forefoot with fatigue, thereby plausibly worsening foot pain and functional limitation in individuals exposed to repetitive standing and walking demands. (6) Large occupational datasets further support that prolonged standing is associated with musculoskeletal symptoms and physical fatigue, and ergonomic countermeasures such as mats, insoles, standing aids, and structured breaks have been discussed, although effectiveness can vary and remains incompletely established across settings. (8,9)

Teaching is an occupation characterized by extended standing during lectures, frequent walking between classrooms, sustained postures while presenting or writing, and additional workload demands that may reduce opportunities for recovery. Work-related musculoskeletal disorders are widely reported among teaching professionals and may contribute to absenteeism, presenteeism, and reduced productivity, with adverse implications for both individual wellbeing and institutional performance. (10–13) While musculoskeletal symptoms among teachers have been explored in prior literature, the specific linkage between multidimensional foot health status and quantifiable work impairment outcomes—as well as fatigue severity—appears comparatively under-characterized within university teaching populations in Pakistan, particularly using validated instruments that simultaneously capture foot pain/function, work impairment, and fatigue burden. (10–13)

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Accordingly, the present study focuses on university teachers as the target population (P), examining foot health status as the primary exposure/clinical indicator measured across pain, function, footwear, and general foot health domains (I), and evaluating its association with work impairment outcomes and fatigue severity (O), without an intervention comparator given the observational cross-sectional design (C). The objective was to determine the association of foot health with work impairment and fatigue severity among university teachers in Lahore. It was hypothesized that poorer foot health would be associated with greater work impairment and higher fatigue severity. (10–13)

MATERIALS AND METHODS

This analytical cross-sectional study was conducted over four months from September 2025 to December 2025 among university teachers recruited from three universities in Lahore, Pakistan: The University of Lahore, Riphah International University, and Nur International University. The target sample size was 369, calculated using OpenEpi version 3 with a 95% confidence level and a 5% margin of error. (14) A non-probability purposive sampling strategy was applied to recruit full-time university teachers meeting eligibility criteria, with recruitment undertaken after administrative permission from the relevant institutional authorities. Before participation, the study objectives and procedures were explained, and written informed consent was obtained from each participant; questionnaire completion required approximately 15 minutes per participant.

Eligible participants were university teachers aged 25–55 years with more than one year of teaching experience and exposure to occupational standing as part of their job for more than three hours per day. Participants were excluded if they had a history of lower-limb fracture or surgery, congenital lower-limb abnormality, use of walking aids (e.g., cane, crutches, wheelchair), or pregnancy. Data collection was conducted primarily through printed questionnaires, supplemented by online responses through a structured Google Form to facilitate participation across academic schedules and teaching locations.

Foot health status was assessed using the Foot Health Status Questionnaire (FHSQ), a validated self-administered instrument designed to measure foot-related health across four domains: foot pain, foot function, footwear, and general foot health. (15) The FHSQ has demonstrated acceptable construct validity and internal consistency, and items are primarily rated using Likert-type response formats. (15,16) Domain scores were computed according to standard scoring procedures and transformed to a 0–100 scale for each domain, with higher scores indicating better foot health. (15,16) Work impairment was measured using the Work Productivity and Activity Impairment questionnaire (WPAI), Specific Health Problem version, which quantifies work time missed (absenteeism), impairment while working (presenteeism), overall work impairment, and activity impairment attributable to a health problem over a defined recall period. (17,18) WPAI outcomes were calculated using standard WPAI scoring formulas and expressed as percentages from 0 to 100, with higher values indicating greater impairment. (18) Fatigue severity was measured using the Fatigue Severity Scale (FSS), a 9-item Likert-based instrument in which item responses range from 1 (strongly disagree) to 7 (strongly agree); total fatigue severity was operationalized as the sum score (range 9–63), with higher scores indicating greater fatigue severity. (19)

The primary exposure variables were FHSQ domain scores (foot pain, foot function, footwear, and general foot health). The primary outcome variables were WPAI impairment metrics (absenteeism, presenteeism, overall work impairment, and activity impairment). The secondary outcome variable was fatigue severity (FSS total score). Covariates recorded for descriptive and analytical purposes included age, sex, height, weight, and body mass index (BMI), with BMI categorized using standard clinical groupings consistent with underweight, normal weight, overweight, and obesity classifications as recorded in the study dataset.

Statistical analyses were performed using SPSS version 27. Continuous variables were summarized as mean and standard deviation along with minimum and maximum values, while categorical variables were summarized as frequencies and percentages. Before inferential testing, distributions of continuous variables were evaluated for plausibility and analytic assumptions, including inspection of histograms and normality diagnostics, and bivariate associations were examined for linearity. For association testing, correlation analysis was conducted to evaluate relationships between FHSQ domain scores and WPAI outcomes and between FHSQ domain scores and fatigue severity; Pearson correlation was applied when assumptions were satisfied, and Spearman's rank correlation was used when distributions or scale characteristics indicated non-parametric testing was more appropriate. To address inflation of type I error due to multiple correlation tests across multiple domains and outcomes, p-values were interpreted with multiplicity control using an adjusted procedure applied across the correlation families, while two-tailed testing was retained throughout. Statistical significance was defined at an alpha threshold of 0.05.

Ethical approval was obtained prior to study initiation, informed consent was secured from all participants, and participation was voluntary with confidentiality maintained through anonymized data handling and restricted access to the dataset during analysis.

RESULTS

Scoring direction used for analysis (consistency fix): For interpretability alongside WPAI impairment outcomes (where higher % indicates worse productivity), the FHSQ domain scores were analyzed in the symptom-severity direction such that higher values reflected poorer foot health (more pain/limitation/footwear problems/poorer general foot health). Under this coding, positive correlations indicate that worse foot health is associated with higher work impairment and higher fatigue.

Table 1. Participant Characteristics (n = 369)

Variable	Mean ± SD	Min–Max
Age (years)	31.71 ± 6.28	25–50
Height (cm)	164.99 ± 9.09	150–185
Weight (kg)	67.21 ± 12.68	45–89
Category		n (%)
Sex (Male)		127 (34.4)
Sex (Female)		242 (65.6)
BMI: Underweight		20 (5.4)
BMI: Normal		182 (49.3)
BMI: Overweight		128 (34.7)
BMI: Obese		39 (10.6)

Narrative (Table 1): The study included 369 university teachers with a mean age of 31.71 ± 6.28 years (range 25–50). Females comprised 65.6% of the sample. Nearly half of participants had normal BMI (49.3%), while 45.3% were overweight/obese combined (34.7% overweight; 10.6% obese).

Table 2. Descriptive Scores of Foot Health (FHSQ), Work Impairment (WPAI), and Fatigue (FSS) (n = 369)

Measure	Mean ± SD	Min–Max	Interpretation (analysis direction)
FHSQ—Foot pain	8.24 ± 3.42	4–19	Higher = worse pain
FHSQ—Foot function	7.14 ± 3.12	4–16	Higher = worse function
FHSQ—Footwear	8.82 ± 3.39	3–15	Higher = worse footwear problems
FHSQ—General foot health	4.93 ± 1.97	2–10	Higher = worse general foot health
WPAI—Absenteeism (%)	4.99 ± 12.48	0–64.29	Higher = more work time missed
WPAI—Presenteeism (%)	26.45 ± 19.91	10–100	Higher = greater impairment while working
WPAI—Overall work productivity loss (%)	26.29 ± 19.95	10–100	Higher = worse overall productivity
WPAI—Activity impairment (%)	25.34 ± 19.31	10–100	Higher = worse non-work activity impairment
FSS—Total score (9–63)	32.84 ± 11.13	9–63	Higher = worse fatigue severity

Narrative (Table 2): Across the four foot-health domains, mean severity scores were 8.24 ± 3.42 (foot pain), 7.14 ± 3.12 (foot function), 8.82 ± 3.39 (footwear), and 4.93 ± 1.97 (general foot health). Work impairment was most prominent for presenteeism (26.45 ± 19.91%) and overall work productivity loss (26.29 ± 19.95%), while absenteeism was lower on average (4.99 ± 12.48%) but showed wide dispersion (0–64.29%). Fatigue severity (FSS total) averaged 32.84 ± 11.13 on the 9–63 scale.

Table 3. Fatigue Severity Categories (n = 369)

Fatigue category	n (%)
No fatigue	235 (63.7)
Mild fatigue	66 (17.9)
Moderate fatigue	61 (16.5)
Severe fatigue	7 (1.9)

Narrative (Table 3): Most participants reported no fatigue (63.7%), while 36.3% fell into mild-to-severe fatigue categories, with moderate fatigue (16.5%) more common than severe fatigue (1.9%).

Associations Between Foot Health and Work Impairment

Table 4. Correlation of Foot Health (FHSQ Domains) With Work Impairment (WPAI) (n = 369)

FHSQ domain	Absenteeism	Presenteeism	Productivity loss	Activity impairment
Foot pain	0.206 (0.106–0.302), p<0.001	0.418 (0.330–0.499), p<0.001	0.402 (0.313–0.484), p<0.001	0.456 (0.371–0.533), p<0.001
Foot function	0.150 (0.049–0.248), p=0.004	0.401 (0.313–0.484), p<0.001	0.384 (0.294–0.469), p<0.001	0.548 (0.472–0.616), p<0.001
Footwear	0.528 (0.450–0.598), p<0.001	0.209 (0.109–0.305), p<0.001	0.207 (0.107–0.303), p<0.001	0.257 (0.160–0.350), p<0.001
General foot health	0.353 (0.260–0.441), p<0.001	0.374 (0.283–0.459), p<0.001	0.365 (0.273–0.452), p<0.001	0.426 (0.339–0.506), p<0.001

Narrative (Table 4): Worse foot health was consistently associated with greater work impairment across all WPAI domains. The strongest relationship was observed between foot function and activity impairment (r=0.548, 95% CI 0.472–0.616, p<0.001), indicating that higher functional limitation in the foot aligned with substantially higher limitation in daily activities. Foot pain showed moderate associations with presenteeism (r=0.418) and activity impairment (r=0.456) (both p<0.001). Footwear problems demonstrated a particularly strong association with absenteeism (r=0.528, 95% CI 0.450–0.598, p<0.001), while remaining weak-to-moderate for other WPAI subscales (e.g., presenteeism r=0.209, p<0.001). General foot health also correlated moderately with presenteeism (r=0.374) and activity impairment (r=0.426) (both p<0.001).

Associations Between Foot Health and Fatigue Severity

Table 5. Correlation of Foot Health (FHSQ Domains) With Fatigue Severity (FSS Total) (n = 369)

FHSQ domain	Pearson r (95% CI)	p-value
Foot pain	0.300 (0.204–0.390)	<0.001
Foot function	0.312 (0.217–0.401)	<0.001
Footwear	0.452 (0.367–0.530)	<0.001
General foot health	0.372 (0.281–0.457)	<0.001

Narrative (Table 5): Fatigue severity increased with worsening foot health across all domains. The largest association was for footwear problems (r=0.452, 95% CI 0.367–0.530, p<0.001), followed by general foot health (r=0.372) and foot function (r=0.312) (both p<0.001). These magnitudes indicate clinically meaningful, moderate relationships between foot-related symptom burden and perceived fatigue severity.

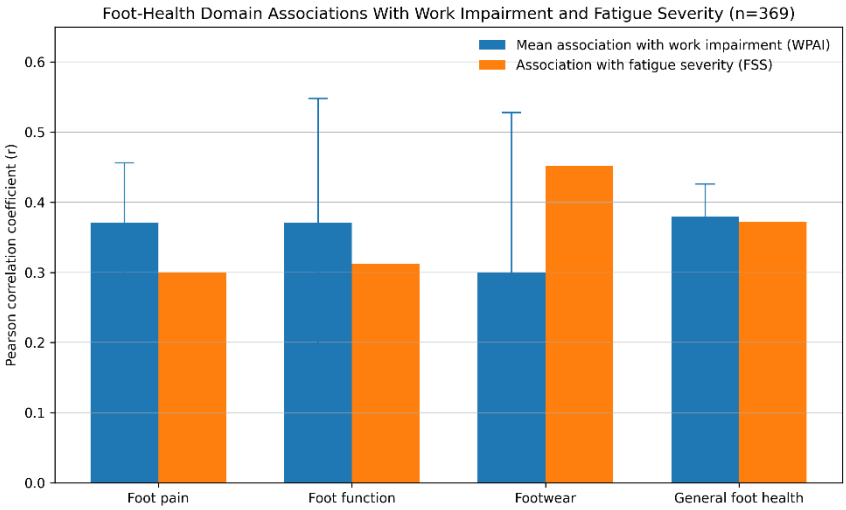

Figure 1. Foot-Health Domain Association Profile With Work Impairment and Fatigue Severity (n=369).

Figure description (numeric-rich, evidence-based): Across domains, the average association with work impairment clustered around r≈0.30–0.38, with general foot health showing the highest composite work-impairment correlation (mean r=0.380) and footwear the lowest (mean r=0.300), albeit with the widest spread due to a strong absenteeism link (max r=0.528). In contrast, fatigue severity demonstrated its strongest association with footwear (r=0.452) compared with foot pain (r=0.300) and foot function (r=0.312), indicating that footwear-related problems tracked more closely with fatigue burden than with the overall work-impairment composite in this cohort.

DISCUSSION

University teaching commonly requires prolonged standing during lectures, repeated short-distance walking between teaching points, and sustained postures while writing or presenting, all of which plausibly increase cumulative load on the foot and ankle complex. Prolonged occupational standing has been linked to lower-limb discomfort through vascular pooling, increased venous pressure, and sustained low-level muscular activation that may contribute to fatigue and discomfort, while fatigue-related changes in plantar loading can further exacerbate symptoms. (4–8) In parallel, footwear characteristics can influence discomfort trajectories during prolonged standing exposures, making footwear a clinically relevant and potentially modifiable factor within occupational settings. (3,4) Within this biomechanical and occupational framework, the present findings demonstrate that worse foot-health symptom burden was consistently associated with higher work impairment and higher fatigue severity, supporting the plausibility that foot-related problems are not merely localized symptoms but may translate into measurable functional and occupational consequences. (4–9)

Across WPAI domains, the strongest observed association was between worse foot function and activity impairment, suggesting that functional limitations in the foot may be particularly important for broader daily functioning outside formal work tasks. This pattern aligns with mechanistic expectations, as functional limitations are likely to affect standing tolerance, gait efficiency, and routine mobility demands throughout the day, which may be compounded by the standing-heavy structure of teaching schedules. (4–6) Foot pain demonstrated moderate associations with presenteeism and activity impairment, indicating that pain may be more strongly linked to reduced effectiveness while working and limitations in non-work activities than to absenteeism. This is consistent with the notion that many teachers may continue working despite pain—potentially due to professional obligations or institutional constraints—while experiencing reduced work efficiency and reduced tolerance for additional activities after work. (10–13) Notably, footwear problems showed the strongest association with absenteeism and the strongest association with fatigue severity, which is clinically interpretable given that inappropriate footwear can increase discomfort during prolonged standing and may accelerate perceived exertion and fatigue over a working day. (3,4,9)

The present findings are broadly concordant with prior evidence indicating that foot-health complaints are common in standing-intensive populations and can be functionally consequential. For example, foot discomfort has been reported at high frequency in nursing students assessed using the same foot-health instrument, supporting the feasibility of detecting meaningful symptom burden in education-related cohorts and reinforcing that foot symptoms can occur even among younger adults. (20) Similarly, evidence from school-teacher populations suggests that ankle/foot discomfort and related functional limitations are common, and the broader teacher literature consistently highlights substantial musculoskeletal symptom prevalence and productivity implications, even though many studies focus on spine or generalized musculoskeletal outcomes rather than foot-specific health. (10–14) Findings also align with community-based data showing that moderate-to-severe foot pain can be present in educated adult cohorts and is associated with poorer foot health, supporting external plausibility for the observed symptom–function relationships. (21)

At the same time, differences across studies in populations, exposure intensity (hours standing/walking), and measurement approach can contribute to variability in the magnitude and profile of associations. For example, studies in healthcare professionals using different measurement tools have reported different distributions of foot pain severity, which may reflect differences in clinical duties, standing patterns, and footwear norms. (22) In contrast, university student cohorts generally spend more lecture time seated than teaching staff, which may explain comparatively better foot-health profiles among students compared with teachers in standing-dominant roles. (23) These contextual differences reinforce the value of evaluating occupationally exposed groups—such as university teachers—using validated measures that capture multidimensional foot health alongside standardized work impairment and fatigue metrics. (15,18,19)

Several limitations should be considered when interpreting these results. The cross-sectional design precludes causal inference, and the observed associations should be interpreted as correlational rather than directional effects. Self-reported measures can introduce reporting bias, and purposive

sampling across three universities may limit generalizability beyond similar institutional contexts. While this study quantified symptom burden and impairment, it did not differentiate specific clinical diagnoses (e.g., plantar fasciitis or neuroma), and unmeasured confounders such as comorbidities, detailed teaching workload, physical activity levels, and footwear type could influence both foot-health scores and impairment outcomes. (4,9) Despite these constraints, the consistent pattern of statistically significant associations across multiple foot-health domains and multiple WPAI outcomes, alongside fatigue severity, supports the clinical relevance of foot health within occupational health strategies for university teaching staff. (3,4,18)

CONCLUSION

In this cohort of university teachers, worse foot-health symptom burden across foot pain, foot function, footwear-related problems, and general foot health was consistently associated with higher work impairment (absenteeism, presenteeism, overall productivity loss, and activity impairment) and higher fatigue severity, indicating that foot-related problems are not isolated complaints but correlate meaningfully with occupational functioning and perceived fatigue in standing-intensive teaching roles.

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