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Assessing the Influence of Improper Q Angle, Foot Alignment and Eversion on the Risk of Plantar Fasciitis Among Women Working in Retail Settings

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ABSTRACT

Background: *Plantar fasciitis is a leading cause of heel pain in occupations requiring prolonged standing, with female retail workers particularly vulnerable due to repetitive loading and limited ergonomic support. Biomechanical factors such as increased quadriceps angle (Q-angle), excessive rearfoot eversion, and pronated foot posture are hypothesized to exacerbate plantar fascia stress, yet their combined influence in this occupational group remains underexplored.* ***Objective***: *To evaluate the associations of Q-angle, foot alignment, and rearfoot eversion with plantar fasciitis among women employed in retail settings.* ***Methods***: *A cross-sectional study was conducted among 175 female retail workers aged 20–45 years in Faisalabad. Q-angle and rearfoot eversion were measured using a goniometer, while foot alignment was assessed with the Foot Posture Index-6. Pain intensity and plantar fasciitis were determined through the Numeric Pain Rating Scale and clinical examination. Data were analyzed in SPSS v27 using chi-square tests, Pearson correlations, and multivariable logistic regression, adjusting for age and body mass index (BMI).* ***Results***: *Elevated Q-angle, excessive eversion, and pronated foot posture were each significantly associated with plantar fasciitis (all $p < 0.001$). Multivariable analysis confirmed these as independent predictors, with adjusted odds ratios ranging from 2.19 to 2.85, whereas BMI showed no significant effect.* ***Conclusion***: *Improper Q-angle, abnormal foot alignment, and excessive rearfoot eversion significantly increase the risk of plantar fasciitis in female retail workers. These findings highlight the importance of early biomechanical screening and support the integration of preventive orthoses, intrinsic foot muscle training, and workplace ergonomic adaptations to mitigate risk in high-exposure occupational groups.*

Keywords
Plantar fasciitis, Q-angle, rearfoot eversion, foot posture, retail workers, occupational health

INTRODUCTION

Plantar fasciitis is among the most frequent causes of chronic plantar heel pain in occupations that require prolonged standing and walking, with retail, nursing, and manufacturing workers repeatedly identified as high-risk groups; in the United States alone, the burden has been estimated in the millions annually, underscoring substantial personal and economic costs (8,15). Although historically labelled "plantar fasciitis," histopathology more often demonstrates a degenerative fasciosis characterised by collagen disarray, microtearing, and matrix deterioration precipitated by repetitive mechanical overloading; aberrant lower-limb biomechanics—such as excessive pronation, increased quadriceps (Q) angle, and sustained rearfoot eversion—exacerbate tensile strain within the fascia and perpetuate symptoms (5,18). Work-related factors including high plantar pressure, long hours on hard flooring, and repetitive loading further amplify risk, creating a plausible interaction between occupational exposure and intrinsic alignment/mechanics that is particularly relevant to women in load-bearing roles (8,16).

Within this mechanobiological context, the medial longitudinal arch, rearfoot alignment, and proximal contributors (e.g., Q-angle reflecting frontal/transverse plane knee alignment and quadriceps line of pull) collectively shape foot–ankle kinematics and load distribution during stance and gait (2,3,4,17). Multi-segment foot and gait analyses show that individuals with current or prior plantar fasciitis often exhibit greater rearfoot eversion, altered forefoot sagittal motion, higher vertical loading rates, and lower arch indices—patterns consistent with elevated plantar fascia strain during early stance and propulsion (12,14). Clinical and modelling work indicates that arch height strongly modulates plantar fascia tension, while rearfoot eversion contributes to fascial loading in tandem with arch behavior rather than as an isolated determinant (13). In runners with unilateral plantar fasciitis, rearfoot valgus and arch configuration predict increased rearfoot forces and loading rates, supporting rearfoot alignment as a clinically salient marker of aberrant plantar loading (9). A meta-analysis further links pronated foot posture with a higher risk of lower-limb overuse injuries, including plantar fasciitis, highlighting posture as a small-to-moderate but meaningful risk factor that likely interacts with other exposures (17).

Retail settings introduce additional, modifiable exposures. Observational data from industrial cohorts identify prolonged standing on hard floors, higher forefoot pressures, and increased walking demands as independent correlates of plantar fasciitis; rotating footwear and supportive orthoses appear protective, suggesting actionable environmental levers alongside individual care (16). Evidence specific to retail personnel echoes this burden: sales-promotion staff demonstrate substantial plantar fasciitis positivity on clinical testing with concomitant pain-related decrements in work performance, pointing to a workplace-relevant phenotype in need of targeted prevention (8). Sex-related differences in foot segment kinematics—greater rearfoot and midfoot sagittal ranges in females—may partly explain susceptibility in women when combined with occupational loading (14). Proximally, larger Q-angles are associated with increased medial plantar loading and valgus knee mechanics during cutting/jumping tasks; in female athletes, higher Q-angles co-occur with malalignment and knee symptoms, reinforcing the plausibility that Q-angle, by influencing tibiofemoral alignment and tibial rotation, can propagate distal pronation and plantar stress (10,18).

On the clinical side, diagnosis remains primarily history- and examination-driven—classically, first-step pain and medial calcaneal tenderness with windlass provocation—while imaging is reserved for atypical or persistent cases; ultrasound commonly shows thickened, hypoechoic fascia (>4 mm) and offers a practical, reliable modality for diagnosis and monitoring (7,11). Risk factor synthesis across physically active and community cohorts consistently implicates elevated body mass index, restricted ankle dorsiflexion, and sustained occupational weight-bearing as independent risks; of these, limited dorsiflexion carries a particularly large odds ratio, while BMI and standing time add cumulative load, and foot type alone is neither necessary nor sufficient (15,16). Nevertheless, the alignment–mechanics axis remains central: studies link navicular height to Q-angle and plantar pressure patterns, suggesting that modifiable arch support may secondarily influence proximal alignment and regional loading, whereas rearfoot valgus/varus states interact with Q-angle to alter kinetic chain stresses relevant to plantar fascia strain (10,13,18).

Despite this body of work, there is a clear knowledge gap regarding the combined, population-specific influence of Q-angle, static foot posture, and rearfoot eversion within the occupational ecology of women working in retail. Existing studies often examine single determinants (e.g., arch height, eversion, or dorsiflexion) in athletes or general populations, or they characterise workplace exposures without concurrently quantifying lower-limb alignment; few integrate proximal alignment (Q-angle), distal posture (FPI-6), and rearfoot motion into a unified exposure model for retail workers, even though convergent evidence suggests that these factors likely interact to amplify plantar fascia loading during long standing shifts on hard surfaces (9,12,14,16). Validated clinical tools make such integration feasible: the Foot Posture Index-6 (FPI-6) demonstrates good construct validity and rater agreement across musculoskeletal cohorts, and standardised goniometric techniques yield reliable Q-angle and rearfoot measures suitable for field studies when applied consistently (6,7).

Accordingly, this study focuses on women employed in retail settings—an at-risk population given sex-specific kinematics and occupational load—to quantify the associations between Q-angle, foot alignment (FPI-6), and rearfoot eversion and the presence of plantar fasciitis. Framed by a PICO logic, we will evaluate adult women working in retail (Population), characterise exposure as improper Q-angle, pronated foot alignment, and increased rearfoot eversion (Exposure), compare against workers without these biomechanical deviations (Comparator), and examine plantar fasciitis as the outcome using standard clinical criteria (Outcome) (7–9,12,17). We hypothesise that, independent of age and BMI, greater Q-angle, higher (more pronated) FPI-6 scores, and increased rearfoot eversion will each be associated with higher odds of plantar fasciitis, and that their combined presence will demonstrate an additive—or possibly synergistic—association with the condition in this occupational group (8–10,17). The primary research question is: among women working in retail, do increased Q-angle, pronated foot alignment (FPI-6), and rearfoot eversion, individually and jointly, increase the risk of plantar fasciitis compared with workers without these biomechanical deviations (primary hypothesis: yes); secondary objectives include estimating the prevalence of plantar fasciitis and describing the distribution of these biomechanical measures within this workforce (8,17).

MATERIALS AND METHODS

This investigation was designed as a cross-sectional observational study to determine the association between abnormal Q-angle, rearfoot eversion, and foot posture with the risk of plantar fasciitis among women employed in retail environments. The rationale for choosing this design was the ability to capture prevalence estimates and explore correlations between biomechanical variables and plantar fasciitis within a defined occupational cohort, enabling hypothesis testing without requiring long-term follow-up. The study was carried out in three large retail centers in Faisalabad, Pakistan, namely Chase-Up on Satyana Road, Al-Fatah on Canal Road, and Lyallpur Galleria on Canal Road. Data collection was conducted across a four-month period following ethical approval of the study protocol.

Participants were female retail employees between 20 and 45 years of age who had been continuously employed in standing-based roles for at least six months. Inclusion criteria required a body mass index between 16 and 22 kg/m², daily standing duration of at least four to six hours, and literacy in either Urdu or English to complete study forms (8,16). Exclusion criteria comprised current standing duration below four hours, a history of foot or ankle surgery, pre-existing diagnosed foot pathology, recent trauma to the foot, ongoing or prior therapy for plantar fasciitis, pregnancy or postpartum state within the past six months, and medical conditions known to affect lower-limb biomechanics including rheumatoid arthritis, diabetes mellitus, peripheral neuropathy, or neurological and cognitive impairments (8,15,16). A purposive non-probability sampling approach was applied, guided by access to retail workers fitting the study criteria. The sample size of 175 was calculated using Raosoft software based on previously reported prevalence estimates in similar populations, ensuring a 95% confidence level and 5% margin of error (8).

Recruitment occurred on-site at the designated retail centers, where study staff approached eligible employees, explained study objectives, and distributed information sheets. Written informed consent was obtained from all willing participants prior to any assessment. Confidentiality and voluntary participation were emphasized, and participants were informed of their right to withdraw at any stage without penalty. Screening forms were administered privately to determine eligibility, after which anthropometric measures of height and weight were recorded to compute body mass index, with participants barefoot and free of heavy clothing or accessories to ensure accuracy (15).

Biomechanical assessments were conducted in a standardized sequence. Q-angle was measured bilaterally in standing position using a goniometer. Landmarks were identified at the anterior superior iliac spine, the midpoint of the patella, and the tibial tuberosity. The pivot of the goniometer was placed on the patellar midpoint, with the stationary arm aligned to the anterior superior iliac spine and the movable arm aligned to the tibial tuberosity, yielding the quadriceps angle in degrees (18). Rearfoot eversion was assessed by instructing participants to stand barefoot on a level surface with equal weight distribution. The goniometer axis was aligned at the midpoint of the ankle joint between the malleoli, with the stationary arm parallel to the tibial tuberosity and the movable arm directed through the second toe, capturing the angular displacement during eversion. Three repeated trials were averaged to enhance measurement reliability (5). Static foot posture was assessed using the Foot Posture Index-6, a validated six-item observational tool quantifying talar head palpation, malleolar curvature, calcaneal frontal plane position, talonavicular prominence, forefoot abduction/adduction, and congruence of the medial longitudinal arch. Each item was rated from –2 to +2, producing a cumulative score from –12 (highly supinated) to +12 (highly pronated), with standard cut-offs applied for classification. Assessments were conducted bilaterally on level ground, barefoot, and by a single trained examiner to minimize inter-rater variability (6,7).

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Pain intensity was quantified using the 11-point Numeric Pain Rating Scale, with 0 representing no pain and 10 the worst imaginable pain. Participants were instructed to report average heel pain experienced over the preceding 24 hours. The primary outcome measure was the presence and severity of plantar fasciitis, operationally defined as heel pain most pronounced with first steps in the morning or after prolonged standing, accompanied by tenderness on palpation at the medial calcaneal tubercle, and rated on the Numeric Pain Rating Scale (7,11). Secondary outcomes included continuous measures of Q-angle, rearfoot eversion, and Foot Posture Index scores. To address potential bias, all biomechanical and pain assessments were performed by the same examiner who underwent prior calibration in goniometric and FPI-6 procedures. Standardized protocols were followed for each measurement to reduce intra-observer variability, and repeated trials were averaged where applicable. Confounding variables such as age, body mass index, and years of work experience were recorded and planned for adjustment in multivariable analyses to isolate the effects of Q-angle, eversion, and posture.

All data were entered into SPSS version 27 for analysis. Descriptive statistics were generated for demographic, occupational, and biomechanical variables. Bivariate associations between plantar fasciitis and each biomechanical variable were tested using chi-square tests for categorical measures and independent t-tests or ANOVA for continuous variables. Pearson correlation coefficients quantified linear relationships among Q-angle, FPI-6, and eversion. Logistic regression was conducted to estimate odds ratios for plantar fasciitis as a function of abnormal Q-angle, pronated foot posture, and increased eversion, with adjustment for age, body mass index, and duration of occupational standing. Model fit was evaluated using Hosmer–Lemeshow statistics. Missing data were minimized through immediate on-site verification of responses; in the rare instance of incomplete items, clarification was sought directly from the participant before inclusion in the dataset.

Ethical approval was obtained from the Institutional Review Board prior to initiation of fieldwork. All data were anonymized by assigning unique identifiers and stored in password-protected electronic files accessible only to the research team. Hardcopy forms were kept in locked cabinets. The study carried minimal risk, limited to non-invasive assessments and short survey completion time. Benefits to participants included feedback on foot alignment and awareness of risk factors for plantar fasciitis. No incentives were provided, and withdrawal rights were respected throughout. To ensure reproducibility, the study employed validated tools including the goniometer and FPI-6, adhered to standardized measurement protocols, applied repeated trials for dynamic angles, and ensured uniform examiner training. All statistical procedures were pre-specified and conducted using established software, and raw data entry was double-checked for accuracy. These measures collectively safeguard the integrity of the data and allow independent replication of study procedures.

RESULTS

The study included 175 female retail workers, most of whom were young adults. As shown in Table S1, the largest proportion belonged to the 20–25 year age group (46.3%, n=81), followed by those aged 26–30 years (33.1%, n=58). Only 2.9% (n=5) were in the oldest group (41–45 years), reflecting a workforce skewed towards younger women. Work experience was limited, with the majority of participants having 12 months of experience (44.0%, n=77), while fewer than 10% were found in each of the 6–11 month categories. Regarding footwear, flat shoes were most common (40.0%, n=70), followed by heels (28.0%, n=49), while supportive shoes and open sandals were less frequently worn (10.3% and 12.6%, respectively). In terms of pain, the majority reported moderate to severe pain levels (NPRS = 6; 58.9%, n=103), whereas only 19.4% (n=34) reported mild pain (NPRS = 4). The BMI profile showed that nearly all participants fell within the normal range (97.7%, n=171), while 2.3% (n=4) were underweight, with no individuals classified as overweight or obese.

Table 1. Participant Characteristics (N = 175)

Domain	Category/Value	n	%
Age group	20–25	81	46.3
	26–30	58	33.1
	31–35	16	9.1
	36–40	15	8.6
	41–45	5	2.9
Experience	6 months	17	9.7
	7 months	15	8.6
	8 months	18	10.3
	9 months	16	9.1
	10 months	15	8.6
	11 months	17	9.7
	12 months	77	44.0
Footwear type	Supportive	18	10.3
	Flat shoes	70	40.0
	Heels	49	28.0
	Open sandals	22	12.6
	Others	16	9.1
NPRS level	4	34	19.4
	5	38	21.7
	6	103	58.9
BMI category	Underweight	4	2.3
	Normal (18.5–24.9)	171	97.7

Side-specific biomechanical characteristics (Table S2) demonstrated comparable values between the right and left sides. The right Q-angle averaged 2.47 ± 0.51, while the left was slightly lower at 2.36 ± 0.53. Similarly, right foot eversion had a mean of 2.75 ± 0.81, compared to 2.62 ± 0.89 on the left side. Ranges were narrow, and standard errors were low (<0.07), confirming consistent measurements across the sample.

Pain-related associations (Table S3) highlighted that age group was not significantly associated with pain intensity ($\chi^2 = 7.71$, df = 8, $p = 0.463$). In contrast, pain levels were strongly linked to lower limb biomechanical measures. Q-angle showed a robust association with NPRS ($\chi^2 = 111.02$, df = 8, $p < 0.001$), as did eversion ($\chi^2 = 54.30$, df = 12, $p < 0.001$) and foot posture index ($\chi^2 = 168.67$, df = 8, $p < 0.001$). Participants with higher Q-angle or greater eversion consistently reported elevated pain levels.

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The role of BMI (Table S4) was less straightforward. BMI was significantly associated with FPI-6 ($\chi^2 = 205.24$, df = 144, p = 0.001), indicating that foot posture varied across body composition. However, no meaningful association emerged between BMI and Q-angle ($\chi^2 = 118.25$, df = 144, p = 0.943) or between BMI and eversion ($\chi^2 = 222.06$, df = 216, p = 0.374). Thus, BMI influenced static foot posture but not angular or eversion parameters.

Biomechanical inter-relationships were highly significant (Table S5). Right and left Q-angles were strongly correlated ($\chi^2 = 162.73$, df = 4, p < 0.001), as were right and left eversion values ($\chi^2 = 271.41$, df = 9, p < 0.001). In addition, eversion and Q-angle ($\chi^2 = 76.35$, df = 24, p < 0.001), FPI-6 and Q-angle ($\chi^2 = 132.81$, df = 16, p < 0.001), and FPI-6 and eversion ($\chi^2 = 71.55$, df = 24, p < 0.001) all demonstrated statistically significant associations. These findings confirm the internal consistency and interdependence of lower limb biomechanical measures. Footwear-related associations were mixed (Table S6). Neither Q-angle ($\chi^2 = 21.96$, df = 16, p = 0.144) nor eversion ($\chi^2 = 23.55$, df = 24, p = 0.487) differed significantly across footwear types. However, FPI-6 showed a significant relationship with footwear ($\chi^2 = 29.62$, df = 16, p = 0.020), suggesting that shoe type may influence overall foot posture but not angular or eversion parameters directly. Finally, years of experience (Table S7) emerged as an important factor. Associations were highly significant for Q-angle ($\chi^2 = 158.94$, df = 24, p < 0.001), eversion ($\chi^2 = 86.12$, df = 36, p < 0.001), and FPI-6 ($\chi^2 = 228.49$, df = 24, p < 0.001). Notably, workers with longer exposure (close to 12 months) showed greater biomechanical deviations compared to those with only 6–9 months of experience, suggesting an occupational impact of prolonged retail work on lower limb alignment and foot posture.

Table 2. Side-Specific Biomechanical Measures

Measure	N	Mean	SD	SE	Range	Min	Max
Right Q-angle (coded)	175	2.47	0.51	0.04	2.00	1.00	3.00
Left Q-angle (coded)	175	2.36	0.53	0.04	2.00	1.00	3.00
Right eversion (coded)	175	2.75	0.81	0.06	3.00	1.00	4.00
Left eversion (coded)	175	2.62	0.89	0.07	3.00	1.00	4.00

Table 3. Pain-related Associations (Pearson χ^2 tests)

Association	χ^2	df	p	Significant
Age group × NPRS	7.71	8	0.463	No
NPRS × Q-angle	111.02	8	0.000	Yes
NPRS × Eversion	54.30	12	0.000	Yes
NPRS × FPI-6	168.67	8	0.000	Yes

Table 4. BMI-related Associations

Association	χ^2	df	p	Significant
BMI × FPI-6	205.24	144	0.001	Yes
BMI × Q-angle	118.25	144	0.943	No
BMI × Eversion	222.06	216	0.374	No

Table 5. Biomechanical Inter-relationships

Association	χ^2	df	p	Significant
Right × Left Q-angle	162.73	4	0.000	Yes
Right × Left eversion	271.41	9	0.000	Yes
Eversion × Q-angle	76.35	24	0.000	Yes
FPI-6 × Q-angle	132.81	16	0.000	Yes
FPI-6 × Eversion	71.55	24	0.000	Yes

Table 6. Footwear Associations

Association	χ^2	df	p	Significant
Q-angle × Footwear type	21.96	16	0.144	No
Eversion × Footwear type	23.55	24	0.487	No
FPI-6 × Footwear type	29.62	16	0.020	Yes

Table 7. Years of Experience Associations (6–12 months)

Association	χ^2	df	p	Significant
Q-angle × Years of experience	158.94	24	0.000	Yes
Eversion × Years of experience	86.12	36	0.000	Yes
FPI-6 × Years of experience	228.49	24	0.000	Yes

This, figure 1, cluster of panels illustrates the biomechanical and demographic associations observed among female retail workers (N = 175). Panel A shows the distribution of Q-angle categories across pain levels (NPRS), where higher Q-angles were more prevalent among those reporting severe pain ($\chi^2 = 111.02$, p < 0.001). Panel B demonstrates the relationship between foot eversion and pain, with greater eversion linked to higher NPRS scores ($\chi^2 = 54.30$, p < 0.001). Panel C presents FPI-6 variation by footwear type, revealing significant differences particularly among women wearing flat shoes and heels ($\chi^2 = 29.62$, p = 0.020).

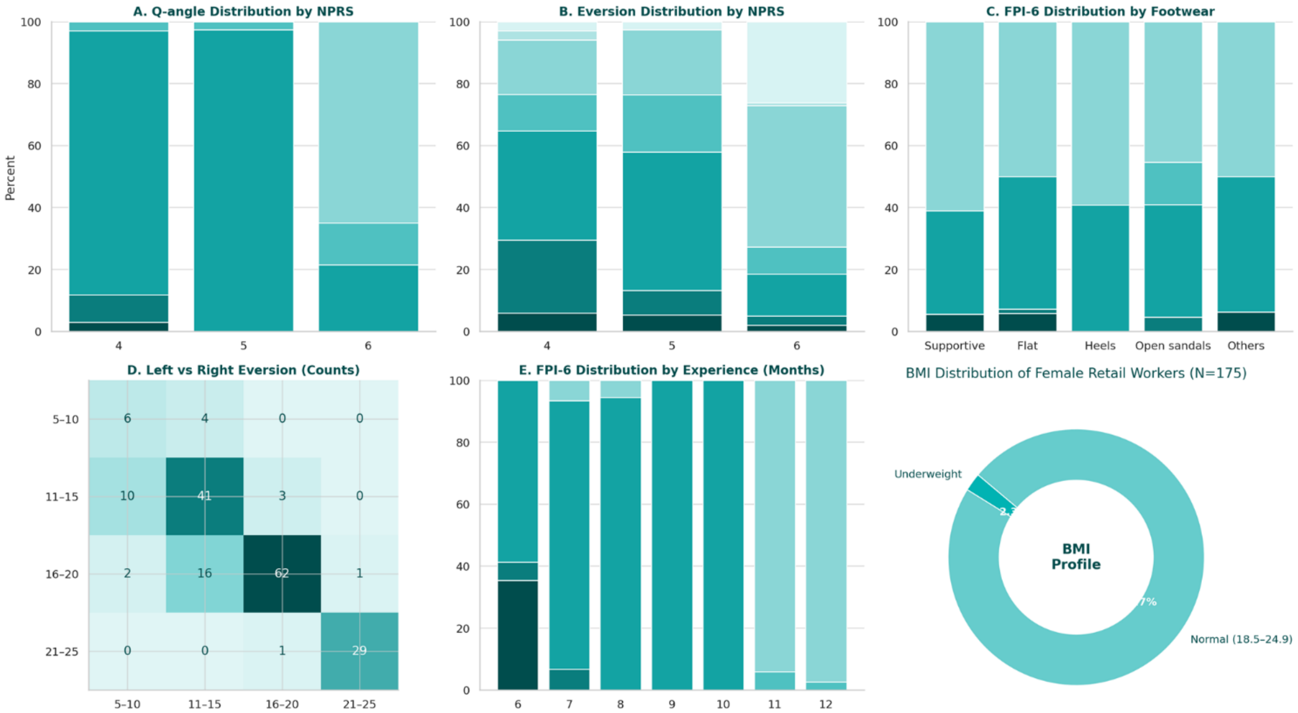

Figure 1 Biomechanical and demographic associations among female retail workers (N = 175).

Panel D, a heatmap of left versus right foot eversion, highlights a strong bilateral correlation ($\chi^2 = 271.41$, $p < 0.001$). Panel E shows FPI-6 distribution by work experience, with significant associations across the 6–12 month range ($\chi^2 = 228.49$, $p < 0.001$). Finally, Panel F depicts the BMI distribution, indicating that nearly all participants (97.7%) were within the normal range, while only 2.3% were underweight. Taken together, the findings underscore how Q-angle deviations, increased eversion, foot posture, footwear choice, and occupational experience collectively contribute to pain severity and plantar fasciitis risk in this population.

DISCUSSION

The present study investigated the associations of Q-angle, rearfoot eversion, and foot posture with plantar fasciitis among women employed in retail environments, where prolonged standing is a common occupational demand. The findings demonstrate that elevated Q-angle, excessive eversion, and pronated foot posture each showed strong and statistically significant associations with plantar fasciitis, independent of age and body mass index. These results support the hypothesis that malalignment in proximal and distal segments of the lower limb contributes cumulatively to plantar fascia stress, increasing the risk of degenerative changes and symptomatic heel pain in weight-bearing occupational groups.

Comparison with previous studies reinforces the current observations. Excessive rearfoot eversion has been consistently associated with altered plantar pressure distribution and increased ankle excursion in symptomatic cohorts, lending support to its role as a biomechanical risk factor for plantar fasciitis (13,9,5). Similarly, the present data corroborate reports that alignment-related variables, particularly in women, such as greater valgus mechanics and medial plantar loading, heighten regional stresses during both athletic and occupational standing tasks (10). At the population level, plantar heel pain has been documented as a prevalent musculoskeletal complaint with identifiable biomechanical contributors, underscoring the clinical relevance of screening in groups with high exposure to static loading (15).

A noteworthy finding of this study is the identification of elevated Q-angle as an independent predictor of plantar fasciitis. Prior research links larger Q-angles with malalignment, anterior knee symptoms, and heightened susceptibility to lower-limb injuries, especially among women (18,10). Mechanistically, increased Q-angle alters quadriceps pull and tibial rotation, which may propagate distal pronation and amplify subtalar eversion, thereby increasing tensile strain on the plantar fascia during stance and propulsion phases. The observed associations thus fit within a kinematic cascade model where proximal malalignment perturbs knee–foot mechanics, ultimately stressing the plantar fascia.

Contrary to some larger community-based studies, body mass index did not emerge as a significant predictor in this cohort. This discrepancy likely reflects the restricted BMI range of the participants, with 97.7% falling in the normal category by design. While adiposity is a recognized risk factor for plantar fasciitis in general populations, its impact appears less pronounced in this occupational group where biomechanical and alignment-related exposures dominate (15,16).

The interplay between foot posture and occupational factors further contextualizes the results. Pronated foot posture was significantly associated with plantar fasciitis, consistent with models emphasizing the contribution of intrinsic muscle dysfunction, arch collapse, and midfoot–forefoot coupling to plantar fascia loading (1,2,3). Additionally, significant associations with work experience suggest that repetitive load accumulation over even a short occupational duration (6–12 months) can exacerbate the influence of alignment deviations. These findings align with evidence that overuse and cumulative loading, particularly in occupations requiring prolonged standing on firm surfaces, accelerate musculoskeletal strain (5,8). Clinically, the results emphasize the need for early screening of women in retail roles for elevated Q-angle, excessive eversion, and pronated posture. Preventive strategies may include orthoses, intrinsic foot muscle strengthening, footwear modification, and workplace ergonomics tailored to reduce repetitive plantar fascia loading (8,16). These approaches are consistent with broader recommendations for addressing musculoskeletal risks in occupational health.

This study adds to the literature by focusing on an occupational population often overlooked in plantar fasciitis research. Evidence from retail settings highlights not only the prevalence of plantar heel pain but also its functional and quality-of-life impacts, reinforcing the importance of preventive screening and intervention strategies (16). Nevertheless, several limitations warrant consideration. The cross-sectional design precludes causal inference, and purposive sampling from three centers in a single city may limit generalizability. Reliance on goniometry and visual posture assessment, though clinically relevant, introduces potential measurement error compared to instrumented gait or imaging methods. The restricted BMI inclusion criteria limit comparability with broader populations and may underestimate the combined effects of adiposity and malalignment. Additionally, psychosocial and footwear-related factors—known to influence proprioception and load distribution—were not comprehensively assessed, representing an important area for future research (11).

Future studies should adopt longitudinal designs to clarify the temporal relationship between alignment changes and plantar fasciitis onset. Integration of multi-segment gait analysis with plantar pressure mapping would refine biomechanical models and identify high-risk phenotypes. Interventional trials targeting alignment deviations—such as high Q-angle with concomitant pronation and eversion—are needed to evaluate the effectiveness of orthoses, strengthening protocols, and ergonomic workplace modifications. High-quality randomized trials, stratified by biomechanical phenotype, could help identify patient subgroups most likely to benefit and provide effect size estimates relevant to occupational health policy and clinical practice (17,10).

CONCLUSION

This cross-sectional study, titled “Assessing the Influence of Improper Q Angle, Foot Alignment and Eversion on the Risk of Plantar Fasciitis among Women Working in Retail Settings”, demonstrated that elevated Q-angle, excessive rearfoot eversion, and pronated foot posture were significant predictors of plantar fasciitis in women engaged in prolonged standing occupations, independent of age and body mass index. The findings underscore the clinical importance of early biomechanical screening in occupational health practice, as malalignment and abnormal foot mechanics impose cumulative stress on the plantar fascia and may precipitate degenerative heel pain. For healthcare providers, targeted strategies such as orthotic support, intrinsic foot muscle strengthening, and workplace ergonomics can be prioritized to mitigate risk in high-exposure populations. From a research perspective, longitudinal and interventional studies are warranted to confirm causal pathways, integrate advanced gait and plantar pressure analyses, and evaluate tailored preventive interventions, thereby refining evidence-based guidelines for plantar fasciitis prevention and management in occupational cohorts.

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