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Relationship Between Body Mass Index and Severity of Plantar Fasciitis in Adults

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ABSTRACT

Background: Plantar fasciitis is a frequent cause of heel pain and functional impairment, and symptom burden may increase with excess body weight due to greater mechanical loading on the plantar fascia. Evidence relating body mass index (BMI) to plantar fasciitis severity remains limited in Pakistani adult populations. Objective: To determine the relationship between BMI and plantar fasciitis severity in adults. Methods: A cross-sectional study was conducted at the University of Lahore Teaching Hospital among 196 adults aged 20–45 years with clinically diagnosed plantar fasciitis confirmed by positive Windlass test. BMI was calculated and categorized using WHO thresholds. Severity was assessed using the Numeric Pain Rating Scale (NPRS) and Foot Function Index-Revised (FFI-R). Spearman correlation tested associations between BMI and severity scores, and chi-square assessed categorical relationships between BMI groups and severity strata using SPSS v22. Results: Participants had mean BMI 26.28 ± 5.71 kg/m², with 30.1% overweight and 29.1% obese. BMI correlated strongly with NPRS ($r = 0.844$, $p < 0.001$) and FFI total disability ($r = 0.771$, $p < 0.001$). Obese participants demonstrated markedly higher severe pain frequency than normal and underweight groups ($\chi^2 = 86.09$, $p < 0.001$) and greater disability ($\chi^2 = 49.18$, $p < 0.001$). Conclusion: Higher BMI is strongly associated with greater pain intensity and disability in plantar fasciitis, supporting BMI-based risk stratification and integration of weight-management strategies into rehabilitation

Keywords
plantar fasciitis; body mass index; heel pain; disability; Foot Function Index; Numeric Pain Rating Scale.

INTRODUCTION

Plantar fasciitis (PF) is one of the most prevalent causes of inferior heel pain and is responsible for a substantial proportion of foot-related musculoskeletal complaints in clinical practice. It is typically characterized by localized pain and tenderness at the anteromedial aspect of the calcaneal tuberosity, often exacerbated during the first steps after waking or following prolonged periods of rest, and may worsen with sustained weight-bearing or long-distance walking (1). Although PF has historically been described as an inflammatory disorder, accumulating evidence supports a predominantly degenerative process driven by repetitive microtrauma, impaired tissue healing, and structural overload at the plantar fascia insertion, which may explain its tendency to persist and recur despite conservative therapy (2). The disorder contributes significantly to activity limitation, reduced participation in daily and occupational tasks, and long-term reduction in quality of life, with a lifetime incidence estimated at approximately 10% in the general population (3). While PF frequently presents unilaterally, bilateral involvement may occur and, in some cases, warrants evaluation for systemic inflammatory arthropathies, including spondyloarthropathies and reactive arthritis (4).

Obesity and excess body mass have emerged as prominent modifiable determinants of foot pain and foot-related disability, largely through increased plantar loading and altered lower limb biomechanics. Body mass index (BMI), calculated as weight in kilograms divided by height in meters squared, is widely applied to classify weight status and estimate adiposity-related risk in adults (5). Higher BMI has been associated with elevated plantar pressures, altered foot posture, decreased ankle joint mobility, and structural adaptations such as increased plantar fascia thickness and changes in heel pad mechanical properties, which collectively may predispose individuals to PF and intensify symptom severity (6,7). In biomechanical terms, increased body mass increases compressive and tensile forces transmitted through the plantar fascia during stance and gait, potentially accelerating degenerative changes, increasing insertional strain, and amplifying pain sensitivity during weight-bearing activities (8). Consequently, individuals with overweight or obesity may not only be more susceptible to PF but may also experience more severe pain and functional impairment than those with normal body mass.

Current literature has frequently emphasized BMI as a risk factor for the occurrence or incidence of PF rather than a determinant of symptom magnitude. Several observational studies have reported significant associations between elevated BMI and PF diagnosis across occupational groups and community populations (9,10), and clinical investigations have suggested that BMI contributes to greater symptom burden, particularly when combined with other mechanical factors such as calcaneal spur morphology and restricted ankle dorsiflexion (11). However, evidence remains inconsistent regarding whether BMI predicts long-term persistence of symptoms, and some cohort studies have not identified BMI as a major prognostic determinant over extended follow-up, suggesting that BMI may influence severity at presentation more strongly than chronicity in all populations (12). Moreover, studies that specifically quantify pain intensity and disability outcomes using validated instruments such as the Numeric Pain Rating Scale (NPRS) and Foot Function Index (FFI) remain limited, particularly in South Asian settings (13). This lack of region-specific severity-focused evidence is clinically important, as BMI distribution, occupational loading patterns, footwear practices, and physical activity behaviors differ across populations and may modify the relationship between BMI and PF symptom expression (14).

In Pakistan, where the burden of overweight and obesity is increasing and musculoskeletal pain-related disability is common, understanding whether BMI meaningfully predicts PF severity has implications for clinical assessment, early risk stratification, and rehabilitation planning. If higher BMI is strongly associated with more intense pain and greater disability, BMI could be incorporated as a practical clinical marker to guide individualized care, emphasize weight-management integration into physiotherapy programs, and improve patient outcomes through load reduction strategies. Therefore, the present study was designed to evaluate the relationship between BMI and PF severity among adults aged 20–45 years diagnosed with plantar fasciitis at a tertiary-care teaching hospital, using NPRS for pain intensity and the FFI-R for functional disability assessment.

The research question guiding this investigation was: Is higher body mass index associated with greater pain intensity and functional disability among adults with plantar fasciitis? The study hypothesized that BMI would demonstrate a significant positive correlation with both NPRS pain scores and FFI-R disability scores in this adult PF population.

MATERIALS AND METHODS

This observational cross-sectional study was conducted in the Orthopedic and Physiotherapy Units of the University of Lahore Teaching Hospital, Lahore, Pakistan, over a six-month period after institutional approval. The study was designed to examine the association between body mass index (BMI) and plantar fasciitis (PF) severity among adults, using standardized clinical and patient-reported outcome measures. Cross-sectional methodology was selected because it enables efficient estimation of exposure–outcome relationships in symptomatic clinical populations where both BMI and symptom severity can be measured at a single time point (1).

Adults aged 20–45 years with clinically diagnosed plantar fasciitis were recruited using a convenience sampling approach. Eligibility required localized heel pain at the medial calcaneal tuberosity with symptoms typically worse during the first steps in the morning or after rest, and a positive Windlass test to confirm plantar fascia involvement (2). Participants were required to ambulate independently and have measurable height and weight enabling BMI classification into World Health Organization (WHO) categories: underweight (<18.5 kg/m²), normal (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥30 kg/m²) (3). Individuals were excluded if they had other clinically significant foot/ankle disorders (e.g., pes planus, Achilles tendinopathy), systemic or metabolic conditions affecting the foot (e.g., uncontrolled diabetes mellitus, inflammatory arthropathy, gout, peripheral vascular disease), recent foot or ankle trauma within three months, foot/ankle surgery within the past six months, pregnancy, or neurological/cognitive impairment affecting questionnaire reliability (4,5).

After eligibility screening, informed written consent was obtained from all participants prior to data collection. Anthropometric measurements were taken using standardized procedures. Body weight was recorded in kilograms and height in centimeters; BMI was calculated as weight (kg) divided by height squared (m²) and categorized according to WHO thresholds (3). Pain severity was assessed using the Numeric Pain Rating Scale (NPRS), a validated 0–10 scale where 0 represents no pain and 10 represents worst imaginable pain, widely used for musculoskeletal pain quantification (6). Functional disability due to plantar fasciitis was assessed using the Foot Function Index-Revised (FFI-R), which evaluates foot-related pain, stiffness, difficulty, activity limitation, and social issues using structured items to quantify disability impact (7). The Windlass test was performed using established clinical technique (forced dorsiflexion at the metatarsophalangeal joints with the ankle stabilized) to reproduce plantar fascia pain (2). Data were recorded on structured forms and entered into a coded dataset to maintain confidentiality.

The primary exposure variable was BMI, analyzed both as a continuous measure and as categorical BMI group (underweight, normal, overweight, obese). Primary severity outcomes were NPRS pain intensity (ordinal/continuous distribution) and FFI-R total disability score (ordinal/continuous distribution). For categorical association analyses, NPRS was merged into two clinically interpretable groups (mild/moderate vs severe), and FFI-R total was merged into two groups (low disability vs high disability) based on the study's predefined cut-points used during analysis.

To minimize information bias, all measurements were performed using consistent measurement procedures and the same validated tools across participants (6,7). Selection bias was partially addressed by applying uniform inclusion/exclusion criteria and recruiting consecutively during the sampling period in the same clinical setting. Although several potential confounders (e.g., footwear type, occupational standing duration, activity level) were not controlled analytically in the presented dataset, these were restricted through exclusions (systemic disease, major alternative foot pathologies) and are acknowledged as residual confounding risks. Data integrity was ensured through verification of completeness, range checks, and consistency checks prior to analysis.

The sample size was 196, calculated using Epitools for estimation of a population proportion at 95% confidence with absolute precision. Statistical analyses were conducted using IBM SPSS version 22. Continuous variables (age, height, weight, BMI, NPRS, FFI-R total) were summarized as mean ± standard deviation (SD), and categorical variables (sex, BMI categories, severity categories) as frequencies and percentages. Because symptom severity and BMI category relationships were ordinal and distributional assumptions for parametric testing were not met, Spearman's rank correlation coefficient (rho) was used to examine associations between BMI and NPRS, BMI and FFI-R total, and NPRS and FFI-R total. Chi-square tests of independence were used to assess associations between BMI categories and dichotomized NPRS severity, and between BMI categories and dichotomized FFI-R disability groups. Effect size for chi-square associations was quantified using Cramer's V. Missing data handling was not required because all 196 cases were complete across the analyzed variables. Statistical significance was set at $p \leq 0.05$. The study followed institutional ethical standards, with confidentiality ensured through anonymization and secure data storage, and participants were informed of their right to withdraw at any stage without penalty.

RESULTS

A total of 196 participants with clinically confirmed plantar fasciitis were analyzed. The mean age was 32.41 ± 7.76 years (range: 20–45), and the mean BMI was 26.28 ± 5.71 kg/m² (range: 16.1–36.0), indicating substantial dispersion in weight status. The sample was slightly female predominant (53.6%) and demonstrated a high burden of excess body weight, with 59.2% classified as overweight or obese. Pain severity measured using NPRS showed that most participants reported moderate pain (56.6%), while 28.1% reported severe pain and 15.3% reported mild pain. Correlation analyses demonstrated strong positive relationships between BMI and both pain intensity and disability (FFI total), and chi-square analyses confirmed statistically significant associations between BMI categories and both NPRS severity and functional disability categories.

Table 1. Participant Characteristics (N = 196)

Variable	N	Mean ± SD	Min–Max
Age (years)	196	32.41 ± 7.76	20–45
Height (cm)	196	169.91 ± 8.36	150–192
Weight (kg)	196	76.52 ± 18.14	41.9–129.4
BMI (kg/m²)	196	26.28 ± 5.71	16.1–36.0

Participants had a mean age of 32.41 years, with BMI ranging widely from 16.1 to 36.0 kg/m². Mean weight was 76.52 kg, supporting the observed predominance of overweight and obesity in the cohort. The average BMI of 26.28 kg/m² falls within the overweight range, indicating that excess body mass was a prominent feature of this plantar fasciitis population.

Table 2. Sex Distribution (N = 196)

Sex	Frequency	Percent (%)
Female	105	53.6
Male	91	46.4
Total	196	100.0

Females constituted 53.6% (n = 105) and males 46.4% (n = 91), demonstrating a slightly female-predominant PF cohort.

Table 3. BMI Categories (N = 196)

BMI Category	Frequency	Percent (%)	Cumulative (%)
Underweight	22	11.2	11.2
Normal	58	29.6	40.8
Overweight	59	30.1	70.9
Obese	57	29.1	100.0
Total	196	100.0	—

Overweight (30.1%) and obese (29.1%) participants comprised 59.2% of the cohort, showing a high excess-weight burden in individuals presenting with PF. Only 29.6% were normal weight and 11.2% underweight.

Table 4 (Revised). Distribution of NPRS Pain Severity Categories (N = 196)

NPRS Severity Category	NPRS Range	Frequency (n)	Percent (%)	Cumulative Percent (%)
Mild pain	1–3	30	15.3	15.3
Moderate pain	4–6	111	56.6	71.9
Severe pain	7–10	55	28.1	100.0
Total	—	196	100.0	—

Pain severity was predominantly moderate: 56.6% (n = 111) reported NPRS scores in the 4–6 range. Severe pain was present in 28.1% (n = 55), indicating that over one-quarter of participants had clinically significant high-intensity pain. Mild pain was observed in only 15.3% (n = 30), reflecting that most PF cases presenting to the hospital exhibited moderate-to-severe symptom burden.

Table 5. Spearman Correlations Between BMI, NPRS, and FFI Total (N = 196)

Correlation Pair	Spearman's rho (r)	p-value	Interpretation
BMI – NPRS	0.844	<0.001	Very strong positive correlation
BMI – FFI Total	0.771	<0.001	Strong positive correlation
NPRS – FFI Total	0.754	<0.001	Strong positive correlation

BMI showed a very strong positive association with pain intensity ($r = 0.844$, $p < 0.001$), indicating that participants with higher BMI consistently reported higher pain levels. BMI was also strongly correlated with overall disability (FFI total: $r = 0.771$, $p < 0.001$), and NPRS showed a strong association with disability ($r = 0.754$, $p < 0.001$). These findings support a robust severity pathway wherein higher BMI is associated with worse pain and greater functional impairment.
Table 6. Association Between BMI Category and NPRS Severity (Mild/Moderate vs Severe)

Table 6A. BMI Category vs NPRS Severity (N = 196)

BMI Category	Mild/Moderate Pain	Severe Pain	Total	Severe Pain (%)
Underweight	22	0	22	0.0
Normal	58	0	58	0.0
Overweight	45	14	59	23.7
Obese	16	41	57	71.9

Total	141	55	196	28.1

A marked BMI-linked escalation in severe pain was observed. Severe pain occurred in 0% of underweight and normal-weight participants, increased to 23.7% among overweight participants, and rose sharply to 71.9% among obese participants. This association was highly significant ($\chi^2 = 86.093$, $p < 0.001$) with a large effect size (Cramer's V = 0.663). Clinically, obese participants had 8.24-fold higher odds of severe pain compared with overweight participants (95% CI 3.58–18.94), demonstrating strong BMI-related pain amplification. High disability was absent in underweight and normal-weight participants (0%) but affected 42.4% of overweight and 47.4% of obese participants. The association between BMI category and disability group was significant ($\chi^2 = 49.183$, $p < 0.001$) with a large effect size (Cramer's V = 0.501). However, obese participants did not show substantially higher odds of high disability than overweight participants (OR = 1.22, 95% CI 0.59–2.55), suggesting disability rises sharply after overweight status and remains elevated thereafter.

Table 6B. Chi-square and Effect Size

Statistic	Value
Pearson Chi-square (df = 3)	86.093
p-value	<0.001
Cramer's V	0.663 (large)
OR (Obese vs Overweight, severe pain)	8.24
95% CI for OR	3.58–18.94

Table 7A. BMI Category vs Disability Group (N = 196)

BMI Category	Low Disability	High Disability	Total	High Disability (%)
Underweight	22	0	22	0.0
Normal	58	0	58	0.0
Overweight	34	25	59	42.4
Obese	30	27	57	47.4
Total	144	52	196	26.5

Table 7B. Chi-square and Effect Size

Statistic	Value
Pearson Chi-square (df = 3)	49.183
p-value	<0.001
Cramer's V	0.501 (large)
OR (Obese vs Overweight, high disability)	1.22
95% CI for OR	0.59–2.55

In this cohort of 196 plantar fasciitis patients, excess body weight was highly prevalent, with 59.2% classified as overweight or obese and mean BMI 26.28 ± 5.71 kg/m². Pain severity was mainly moderate (56.6%), while 28.1% reported severe pain and 15.3% mild pain. BMI demonstrated a very strong correlation with NPRS pain ($r = 0.844$) and a strong correlation with disability (FFI total: $r = 0.771$), and pain was strongly correlated with disability ($r = 0.754$), all with $p < 0.001$. Chi-square analysis confirmed that severe pain increased sharply with higher BMI category, rising from 0% in underweight/normal participants to 23.7% in overweight and 71.9% in obese participants ($\chi^2 = 86.093$, $p < 0.001$; V = 0.663). Similarly, high disability increased from 0% in underweight/normal groups to 42.4% in overweight and 47.4% in obese participants ($\chi^2 = 49.183$, $p < 0.001$; V = 0.501). These findings demonstrate a statistically strong and clinically meaningful gradient linking increased BMI with greater plantar fasciitis pain intensity and functional impairment.

DISCUSSION

This study examined the relationship between body mass index (BMI) and the severity of plantar fasciitis (PF) in a symptomatic adult population and demonstrated a clear BMI–severity gradient across pain and disability outcomes. The principal finding was that BMI showed a very strong positive correlation with pain intensity (NPRS; $r = 0.844$, $p < 0.001$) and a strong correlation with functional disability (FFI total; $r = 0.771$, $p < 0.001$). In parallel, categorical analyses reinforced these associations: severe pain was concentrated predominantly in obese participants (71.9%), while underweight and normal-weight participants showed no severe pain in the dataset. Similarly, high disability was observed almost exclusively among overweight and obese participants. Collectively, these results support the clinical premise that higher BMI is not only linked to PF occurrence but also to symptom magnitude and functional limitation, aligning with prior evidence that obesity is a key modifiable risk factor in PF pathogenesis and clinical burden (1,2).

A plausible explanation for these findings is mechanical overload. The plantar fascia is an important passive stabilizer of the medial longitudinal arch and undergoes repetitive tensile loading during gait and prolonged standing; increased body mass raises plantar pressure and ground reaction forces, increasing the likelihood of microtrauma and degenerative changes at the calcaneal insertion (3,4). In your cohort, nearly 60% of patients were overweight or obese, and severe pain clustered strongly in the obese group, which supports the concept that greater axial loading amplifies pain experience and accelerates functional compromise. Biomechanical evidence further suggests that elevated BMI alters the mechanical properties of plantar soft tissues, including reduced plantar fascia stiffness and altered heel pad characteristics, which may diminish shock absorption and increase localized strain, thereby intensifying symptoms (5). These mechanical pathways plausibly explain the observed strong correlation between BMI and both NPRS and FFI disability.

The findings are consistent with studies reporting BMI as a significant predictor of symptom severity and patient-reported impairment in PF. Cho et al. reported that higher BMI, along with age and spur size, is associated with worse patient symptoms, highlighting obesity as a clinically meaningful determinant of pain and limitation (6). Similarly, evidence from healthcare worker cohorts indicates that BMI remains a prominent correlate of PF, particularly in individuals exposed to long standing and occupational loading (1). Your results extend these observations by demonstrating not merely an association with PF presence but a strong relationship with severity indicators—pain intensity and disability—within a Pakistani clinical population where evidence has been limited.

The disability findings also reflect a functional cascade often seen in chronic heel pain conditions. As pain increases, gait adaptation, reduced walking tolerance, and avoidance of activity can lead to progressive deconditioning, which in turn increases the likelihood of further weight gain and reinforcement of biomechanical stress on the foot. This reciprocal cycle may partially explain why overweight and obese participants showed substantially higher disability rates compared with normal-weight participants, even though both obesity and overweight categories demonstrated similarly elevated disability proportions. This is consistent with broader observations that overweight status is frequently linked with impaired foot-related function and reduced quality of life, even when diagnostic associations are inconsistent across populations (7,8). In practical rehabilitation terms, the severity pattern suggests that pain and disability may become established once BMI surpasses the overweight threshold, after which symptom persistence and chronicity may be more likely without addressing weight-related load factors.

An important clinical interpretation from your cross-tabulation is the extremely strong concentration of severe pain within obese participants. Although PF can occur across BMI strata, the severity distribution indicates that BMI likely acts as a severity modifier through load, plantar pressure, and tissue resilience mechanisms. This is consistent with evidence showing that BMI correlates with plantar fascia thickness and plantar tissue changes in asymptomatic individuals, suggesting that structural adaptation may occur before symptoms, and that symptomatic PF may represent failure of compensatory mechanisms under sustained load (9). Long-term prognosis evidence has been mixed—some follow-up cohorts did not find BMI to influence long-term symptom persistence (10)—yet the present findings indicate that BMI meaningfully influences symptom burden at presentation, which is a critical clinical decision-making point for individualized care planning.

Beyond biomechanics, PF may also reflect systemic metabolic stress. Emerging evidence suggests associations between PF and inflammatory markers, particularly in individuals with cardiometabolic risk factors (11). While your study excluded uncontrolled diabetes and systemic inflammatory arthropathies, BMI is itself linked with low-grade systemic inflammation that can influence pain sensitization and tissue healing. Therefore, the BMI–severity relationship may reflect both mechanical overload and systemic susceptibility, reinforcing the importance of holistic management beyond isolated local interventions.

These findings have direct implications for clinical practice in physiotherapy and orthopedic settings. Conservative interventions remain cornerstone therapies—stretching, orthoses, night splints, taping, and extracorporeal shock wave therapy in selected cases (12,13). However, the strength of association observed here indicates that clinical evaluation should integrate BMI-based risk stratification as part of routine PF assessment. Weight management strategies, low-impact aerobic conditioning, and patient education may improve outcomes by reducing plantar loading and breaking the pain–inactivity–weight gain cycle. Evidence from bariatric surgery cohorts further suggests that reducing BMI can decrease PF-related healthcare utilization and improve symptoms, supporting BMI modification as a rational adjunct to PF care pathways (14).

The study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design prevents causal inference; higher BMI may worsen PF severity, but severe PF may also reduce activity and increase BMI over time. Second, convenience sampling from one hospital may limit external validity to other Pakistani regions or healthcare settings. Third, residual confounding from occupational standing duration, physical activity, and footwear characteristics cannot be excluded, and these factors may partly mediate or modify BMI-related effects (15). Despite these limitations, the large sample size, consistent clinical confirmation via Windlass test, and use of validated severity tools (NPRS and FFI-R) provide credible evidence that BMI is strongly linked with PF symptom burden in this adult cohort (16,17).

CONCLUSION

This study demonstrates a strong and clinically meaningful relationship between body mass index and plantar fasciitis severity among adults, with higher BMI significantly associated with greater pain intensity and greater functional disability. Overweight and obese participants experienced disproportionate symptom burden, and obese individuals were particularly likely to report severe pain, indicating that BMI acts as a major severity-modifying risk factor. These findings support routine BMI-based risk stratification and the integration of structured weight-management and lifestyle modification strategies into standard physiotherapy and conservative PF care to reduce mechanical loading, improve function, and enhance overall patient outcomes.

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