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Original Research Article

Study of association of back pain with foot disorders like calcaneal spur, foot span, foot pain, and foot posture

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Abstract

Background: Back pain is one of the most prevalent musculoskeletal disorders, significantly impacting individuals' quality of life and work productivity. Despite extensive research on its risk factors, the role of foot disorders—such as calcaneal spur, foot span abnormalities, foot pain, and foot posture deviations—in contributing to back pain remains underexplored. Given that the foot serves as the foundation for posture and locomotion, any structural or functional abnormalities may lead to compensatory changes in spinal biomechanics, potentially exacerbating back pain.

Aims & Objective: This study aims to investigate the association between low back pain (LBP) and foot disorders, including calcaneal spur, foot span variations, foot pain, and abnormal foot posture.

Materials and Methods: A prospective observational study was conducted at BJ Medical College, Pune, Maharashtra, over two years. A total of 100 patients with both LBP and foot disorders were included. Clinical, radiological, and biomechanical assessments were performed, including foot measurements, spinal alignment evaluations, MRI analysis, and Visual Analog Scale (VAS) scoring. Statistical analyses were conducted using paired/unpaired t-tests and Chi-square tests, with $p < 0.05$ considered significant.

Results: The study found a significant association between LBP and BMI ($p = 0.004$), with normal-weight individuals reporting higher LBP scores. MRI findings revealed that 39% of patients exhibited L4-5-S1 disc degeneration. High pelvic incidence (>60°) was significantly correlated with severe LBP ($p = 0.005$). Foot abnormalities, including pes planus and increased foot span, were common in LBP patients. Foot pain severity correlated with LBP but was not significantly associated with BMI or serum uric acid levels.

Conclusion: Foot disorders play a crucial role in the development and severity of LBP. The findings emphasize the need for integrating foot assessments into LBP management for effective treatment strategies.

Keywords: Back pain, Foot disorders, Calcaneal spur, Foot span, Foot posture, Lumbar spine, Biomechanics, Pelvic incidence.

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1. Introduction

Back pain is one of the most prevalent musculoskeletal disorders worldwide, with lifetime prevalence rates ranging between 30% and 80%.[1] It is a major cause of disability and work-related limitations.[2] Epidemiological studies indicate that in 2019, approximately 223.5 million individuals globally experienced back pain,[3] with the highest prevalence observed in individuals aged 50–54.[4] Despite substantial research on back pain risk factors, the impact of foot disorders on spinal biomechanics remains insufficiently investigated.

The foot, as the foundation of human movement, plays a crucial role in maintaining posture, balance, and gait.[5] Deviations in foot posture and function can lead to compensatory changes in the lower extremities and spine, potentially contributing to chronic back pain.[6] Several studies suggest an association between foot abnormalities and back pain. Pes planus (flat feet) has been linked to increased

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prevalence of low back discomfort,[7] while cavus foot posture (high-arched foot) has also been associated with spinal misalignment and pain.[8] Additionally, conditions such as calcaneal spur, abnormal foot span, and persistent foot pain may alter gait patterns, affecting spinal load distribution.[9]

This study investigates the relationship between back pain and foot disorders, focusing on calcaneal spur, foot span, foot pain, and foot posture. The findings aim to provide insights into an integrated approach to diagnosing and managing back pain with a greater emphasis on foot health.

2. Materials and Methods

2.1. Study design and setting

This prospective observational study was conducted at BJ Medical College, Pune, Maharashtra, India, over two years.

2.2. Inclusion criteria

1. Individuals aged ≥18 years.
2. Patients presenting with LBP and foot disorders, including calcaneal spur, abnormal foot span, foot pain, or foot posture issues.
3. Visual Analog Scale (VAS) score >5 for LBP or foot pain.

2.3. Exclusion criteria

1. Patients with traumatic fractures of the foot or spine.
2. Isolated back pain or isolated foot disorders.
3. Patients with known malignancy.

2.4. Sample size and data collection

A total of 100 participants were enrolled. Patients underwent clinical, radiological, and biomechanical assessments. Key parameters recorded included:

1. Foot evaluation – Foot size, posture (pes planus or cavus), presence of calcaneal spur, and foot pain severity (VAS score).
2. Back evaluation – Spinal alignment, lumbar disc degeneration (MRI findings), and pain severity.
3. Statistical analysis – Paired/unpaired t-tests and Chi-square tests were used for comparisons, with significance set at $p < 0.05$.

3. Results

The study included 100 patients. Most (52%) were aged 51-70, followed by 31-50 (28%), 18-30 (17%), and 70 and above (3%).

Gender distribution: 51% male and 49% female, indicating a nearly balanced cohort with a slight male predominance.

Occupational distribution: labourers (29%) and housewives (27%) were most common. Teachers (8%), tailors (5%), house help (11%), drivers (7%), nurses (3%), and others contributed smaller percentages.

BMI-related pain data shows LBP scores differ significantly across BMI groups (p=0.004), with normal-weight individuals reporting higher pain (8.36) than overweight (6.38) and obese (8.26). Foot pain scores showed no significant BMI association (p=0.397).

Serum uric acid levels: 73% had 4-4.9 mg/dL, while 27% had 5-5.9 mg/dL. The difference is statistically significant (p<0.001), indicating a strong association with study outcomes.

VAS scores: 39% had moderate pain (4-6), 61% had severe pain (7-10). No significant difference (p=0.33) observed.

Among 100 patients, 52% bent below the knee, 48% up to the knee. No significant difference observed (p=0.689).

41% patients experienced pain during extension, while 59% did not. The difference is not statistically significant (p=0.072).

52% patients had pain on lateral bending, 48% did not. No significant difference observed (p=0.689).

51% patients had an abnormal midline axis, 49% normal. No significant difference observed (p=0.072).

59% patients had degenerative signs, 41% did not. No significant difference observed (p=0.072).

38% patients had SAP migration, while 62% did not, indicating a notable presence but a majority without migration.

36% patients had borderline high pelvic incidence (≤60), while 64% had high pelvic incidence (>60). The difference is statistically significant (p=0.005).

All 100 patients (100%) had a high pelvic tilt (>8), with no cases in the borderline high category (≤8), indicating uniform high pelvic tilt.

Table 1 shows MRI findings: L4-5-S1 disc level was most common (39%, p<0.001), followed by L3-4-5 (33%), L3-4-5-S1 (20%), and L2-3-4 (8%).

Table 1: MRI findings

MRI findings	No. of Patients	Percentage	P-Value
L4-5-S1 disc	39	39%	<0.001
L3-4-5 disc	33	33%	
L3-4-5-S1 disc	20	20%	
L2-3-4 disc	8	8%	
Total	100	100%	

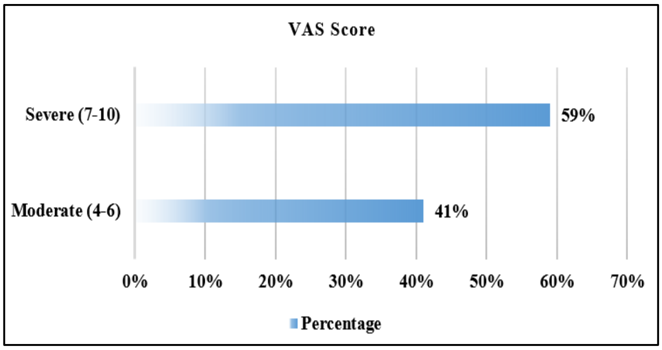

Figure 1: VAS score for foot pain

Figure 1 shows 41% had moderate foot pain (VAS 4-6), 59% had severe pain (VAS 7-10). No significant difference observed (p=0.072).

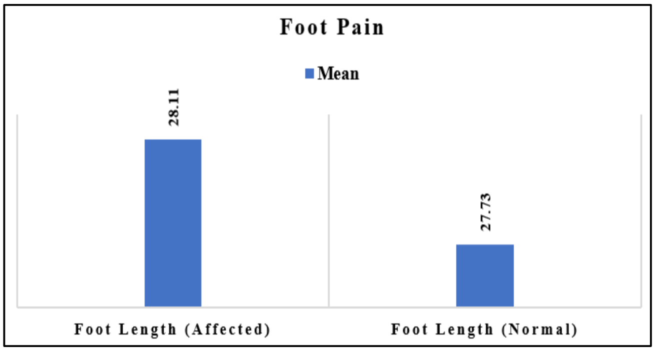

Figure 2: Foot length (Affected & Normal)

Figure 2 shows mean foot length: affected side 28.11 ± 2.84 cm, normal side 27.73 ± 2.82 cm. No significant difference observed (p=0.342).

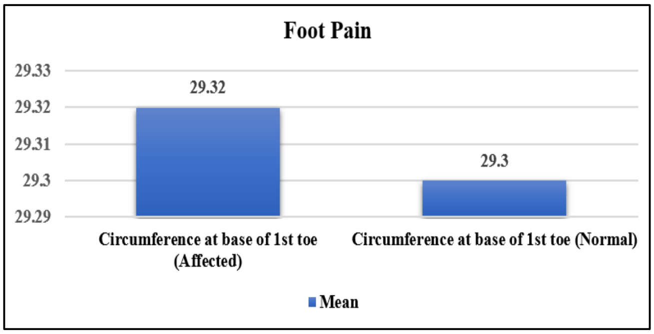

Figure 3: Circumference at base of 1st toe (Affected & Normal)

Figure 3 shows mean circumference at the first toe base: affected 29.32 ± 2.91 mm, normal 29.30 ± 2.91 mm. No significant difference observed (p=0.96).

Table 3 shows LBP severity by pelvic incidence and tilt. Severe pain was more common in high pelvic incidence (>61) cases (44) than borderline high (≤60) cases (17). High pelvic tilt (>8) was exclusively associated with both moderate (39) and severe (61) pain, while no cases were observed in the borderline high tilt group (≤8), indicating their role in exacerbating LBP severity.

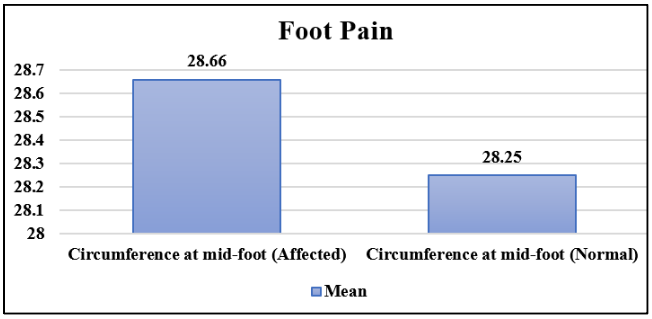

Figure 4: Circumference at base of 1st toe (Affected & Normal)

Figure 4 shows mean mid-foot circumference: affected foot 28.66 ± 2.92 cm, normal foot 28.25 ± 3.07 cm. No significant difference observed (p=0.334).

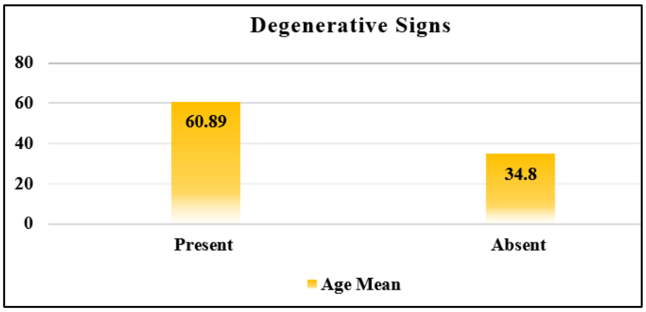

Figure 5: Comparison of degenerative signs with age

Figure 5 shows a significant age difference: degenerative signs present (60.89 ± 6.92 years), absent (34.80 ± 7.15 years). The difference is highly significant (p<0.001).

Table 2: Comparison of VAS score with LBP and foot pain

VAS Score	Serum Uric Acid		P-Value
	4 - 4.9	5 - 5.9	
LBP	7.64 ± 1.23	5.77 ± 1.03	<0.001
Foot pain	6.49 ± 0.18	6.88 ± 0.62	

Table 2 shows VAS scores for LBP and foot pain by serum uric acid levels. LBP scores were significantly higher in the 4-4.9 group (7.64 ± 1.23) than in the 5-5.9 group (5.77 ± 1.03, p<0.001). Foot pain scores showed no significant difference.

Table 3: Comparison of pain characteristics with VAS Score (LBP)

Pain Characteristic		VAS Score (LBP)	
		Moderate (4-6)	**Severe (7-10)**
Pelvic Incidence	Border Line High (≤ 60)	19	17
	High (> 61)	20	44
Pelvic tilt	Border Line High (≤ 8)	0	0
	High0020(> 8)	39	61

Table 4: Comparison of occupation with VAS score

Occupation	VAS Score (LBP)		Vas score (Foot Pain)	
	Moderate (4-6)	**Severe (7-10)**	**Moderate (4-6)**	**Severe (7-10)**
Labourer	10	19	19	10
housewife	0	27	8	19
Teacher	0	8	8	0
Tailor	5	0	0	5
house help	10	1	0	11
Driver	7	0	0	7
Nurse	1	2	2	1
Watchmen	2	1	1	2
Retired	0	1	1	0
Maid	0	1	1	0
Farmer	1	0	0	1
Carpenter	1	0	0	1
Coolie	2	0	0	2
Guard	0	1	1	0

Table 5: Correlation coefficients and p-values for various measures with pelvic incidence and pelvic tilt

Comparison	Correlation Coefficient	P-Value
Pelvic Incidence vs. Kites Angle	0.53	<0.001
Pelvic Incidence vs. Calcaneal Pitch	0.06	<0.001
Pelvic Incidence vs. 2nd MT - Navicular Distance	-0.217	<0.001
Pelvic Tilt vs. Kites Angle	0.042	<0.001
Pelvic Tilt vs. Calcaneal Pitch	0.067	<0.001
Pelvic Tilt vs. 2nd MT - Navicular Distance	0.037	<0.001

Table 6: Correlation between foot length on the affected side and various measures of pes planus development

Comparison	Correlation Coefficient	P-value
Foot Length (affected) vs. Kites Angle	0.445	0.365
Foot Length (affected) vs. 2nd MT - Navicular distance	0.159	<0.001
Foot Length (affected) vs. Calcaneal Pitch	-0.375	<0.001
Foot Length (affected) vs. Calcaneus -5th MT angle	0.586	<0.001

Table 7: Correlation between mid-foot circumference and 2nd MT-navicular distance on affected and normal sides

Comparison	Correlation Coefficient	P-Value
Mid-Foot Circumference (affected) vs. 2nd MT - Navicular Distance	0.207	<0.001
Mid-Foot Circumference (normal) vs. 2nd MT - Navicular Distance	0.21	<0.001

Table 8: Distribution of VAS Scores for LBP and foot pain by presence of Dr. Kabre Chandanwale's sign

Dr. Kabre Chandanwale's Sign	VAS Score (LBP)		Vas score (Foot Pain)	
	Moderate (4-6)	Severe (7-10)	Moderate (4-6)	Severe (7-10)
Present	28(71.80%)	41(67.22%)	31(75.60)	38(64.40%)
Absent	11(28.20%)	20(32.78%)	10(24.40%)	21(35.60%)
Total	39	61	41	59

Table 4 shows occupation-related pain patterns. Housewives (27) and labourers (19) reported the most severe LBP cases, while teachers and retirees had minimal. Similarly, housewives (19) and labourers (10) had the highest severe foot pain. Manual and domestic labour occupations correlated with greater pain severity.

Table 5 shows correlations between Pelvic Incidence, Pelvic Tilt, and pes planus measures. Pelvic Incidence moderately correlates with Kites Angle ($r=0.53$, $p<0.001$) but weakly with Calcaneal Pitch ($r=0.06$) and 2nd MT-Navicular Distance ($r=-0.217$). Pelvic Tilt exhibits minimal correlations with all variables.

Table 6 shows foot length correlations with pes planus measures. No significant correlation with Kite Angle ($r=0.445$, $p=0.365$). Significant correlations include 2nd MT-Navicular distance ($r=0.159$, $p<0.001$), Calcaneal Pitch ($r=-0.375$, $p<0.001$), and Calcaneus-5th MT angle ($r=0.586$, $p<0.001$).

Table 7 shows a weak but significant positive correlation between Mid-Foot Circumference and 2nd MT-Navicular Distance on both affected ($r=0.207$, $p<0.001$) and normal ($r=0.21$, $p<0.001$) sides, indicating a slight increase in distance with circumference.

Table 8 shows VAS scores for LBP and foot pain relative to Dr. Kabre Chandanwale's sign. Individuals with the sign reported higher severe pain levels (67.22% LBP, 64.40% foot pain), indicating an association between the sign and increased pain severity.

4. Discussion

The current study found that the majority of patients (52%) were aged between 51 and 70 years, with a nearly equal gender distribution (51% male, 49% female). These findings are consistent with existing research, which suggests that musculoskeletal issues, particularly lower back pain (LBP) and foot pain, become more prevalent with advancing age due to degenerative changes and cumulative stress on the musculoskeletal system. For example, Hicks GE et al. reported a similar trend, with the highest incidence of LBP occurring in the 50-70 age group.[10] Additionally, studies by Kahraman BO et al. have indicated no significant gender differences in the prevalence of LBP and foot pain, aligning with our findings.[11]

Occupationally, labourers and housewives constituted the largest proportion of affected individuals, comprising 29% and 27% of the sample, respectively. These groups also reported higher instances of severe pain, likely due to repetitive movements, prolonged standing, and heavy lifting. Similar research by Silva C et al. found that workers in physically demanding jobs had a 1.5 times higher risk of developing LBP than those in less strenuous roles, emphasizing occupational risk factors in musculoskeletal disorders.[12]

A significant association was found between BMI and pain severity, with normal-weight individuals reporting higher mean pain scores compared to overweight and obese counterparts ($p=0.004$). This contradicts literature that associates higher BMI with increased pain due to greater mechanical load. Silva C et al. suggested that obesity exacerbates LBP and foot pain, but our findings may reflect behavioural adaptations among overweight individuals to manage pain more effectively.[12]

Serum uric acid levels were another key variable, with most patients having levels between 4 and 4.9 mg/dL. A significant association ($p<0.001$) was observed between uric acid levels and musculoskeletal pain severity. Anderson HI et al. and Kim SK et al. found similar results, highlighting serum uric acid as a potential biomarker for assessing musculoskeletal pain risk and severity.[13,14] Monitoring these levels may help predict and manage pain more effectively.

Regarding pain severity, Visual Analog Scale (VAS) scores for LBP showed that 61% of patients experienced severe pain (scores of 7-10), while 39% had moderate pain (scores of 4-6). Although the differences in VAS scores were not statistically significant ($p=0.33$), the findings align with research by Harrisson SA et al. and Bunzli S et al., which reported severe pain prevalence of 55-65% in chronic LBP patients, emphasizing the high burden of LBP.[15,16]

In functional assessments, 52% of patients could bend below the knee without pain, while 48% could only bend to knee level. Pain during back extension was reported by 41% of patients, and 52% experienced pain during lateral bending, though neither finding was statistically significant. These results mirror previous studies, including work by Amila A et al. and Palsson TS et al., indicating consistent trends in mobility limitations among LBP patients.[17,18]

Midline axis abnormalities were present in 51% of patients, with degenerative signs observed in 59%. These findings suggest a link between aging and spinal degeneration, consistent with studies by Suri et al. and Gan Z et al., further emphasizing the role of degenerative changes in chronic LBP.[19,20]

4.1. SAP migration and its impact on spinal biomechanics

The presence of Superior Articular Process (SAP) migration was observed in 38% of the studied patients, with a statistically significant p-value of 0.016, indicating a strong correlation between SAP migration and back pain. SAP migration alters spinal biomechanics and increases stress on adjacent structures, contributing to pain and discomfort. This finding aligns with previous studies by Thiry P et al. and Zhang Y et al., who also reported a significant association between SAP migration and spinal pain, reinforcing the present study's conclusions.[21,22]

4.2. Pelvic incidence (PI) and its role in spinal pathology

Pelvic incidence (PI) is a crucial parameter in spinal biomechanics and its relationship with back pain. In this study, 64% of patients had a high PI (>60), while 36% had borderline high PI (≤60), with a significant p-value of 0.005. A high PI is associated with an increased risk of developing spinal disorders due to altered load distribution and spinal alignment. This result aligns with prior research by He S et al. and Yuan JJ et al., who found a significant correlation between high PI and conditions like spondylolisthesis and chronic low back pain (LBP).[23,24]

4.3. Pelvic tilt (PT) and its association with musculoskeletal pain

Pelvic tilt (PT) is another crucial measure influencing spinal alignment. In this study, all patients (100%) had a high PT (>8), suggesting a consistent pattern of abnormal pelvic orientation. High PT can lead to compensatory spinal mechanisms, increasing musculoskeletal pain risk. Similar findings were reported by Du SH et al. and Lee SH et al., emphasizing the importance of assessing pelvic parameters in chronic spinal conditions.[25,26]

4.4. MRI findings and their clinical significance

MRI evaluations highlighted the importance of specific disc levels in lumbar spine disorders (**Table 1**). The most prevalent findings were at the L4-5-S1 disc level, affecting 39% of patients, followed by the L3-4-5 level in 33% and the L3-4-5-S1 level in 20% of patients. The statistical significance ($p < 0.001$) underscores the critical role of these disc levels in lumbar pain. This observation is consistent with studies by Rahyussalim AJ et al. and Urits I et al., who reported strong correlations between disc degeneration at these levels and symptomatic lumbar pathology.[27,28]

4.5. Foot pain severity and visual analog scale (VAS) analysis

Foot pain severity, assessed using the Visual Analog Scale (VAS), showed that 59% of patients reported severe pain (VAS 7-10), while 41% experienced moderate pain (VAS 4-6) (**Figure 1**). Although the p-value of 0.072 lacks statistical significance, the predominance of severe pain necessitates comprehensive evaluation and management. This finding aligns with research by Alam MF et al., emphasizing the link between severe foot pains and underlying spinal disorders.[29]

4.6. Foot length and circumference measurements

Foot length and circumference at the base of the first toe were compared in patients with and without foot pain (**Figure 2** and **Figure 3**). The mean foot length for affected feet was 28.11 ± 2.84 cm, compared to 27.73 ± 2.82 cm for normal feet, with a p-value of 0.342, indicating no significant difference. Similarly, the circumference at the base of the first toe was 29.32 ± 2.91 cm for affected feet and 29.30 ± 2.91 cm for normal feet, with a p-value of 0.96, suggesting no significant difference. These findings align with studies by Daniels SP et al. and Rogers J et al., who reported that foot length variations and toe circumference are not reliable indicators of foot pathology.[30,31]

4.7. Mid-foot circumference and degenerative signs

Mid-foot circumference in patients with foot pain (**Figure 4** and **Figure 5**) showed a mean value of 28.66 ± 2.92 cm for affected feet and 28.25 ± 3.07 cm for normal feet, with a p-value of 0.334, indicating no statistical significance. These results align with findings by Richie DH and Rosenbloom KB, who reported that mid-foot circumference is not a strong indicator of foot pain.[32]

Patients with degenerative signs had a significantly higher mean age (60.89 ± 6.92 years) than those without (34.80 ± 7.15 years), with a p-value of <0.001, supporting findings by Lee et al., which showed that degenerative signs increase with age.[33]

4.8. VAS score and serum uric acid levels

VAS scores for LBP were significantly higher in patients with serum uric acid levels between 4-4.9 mg/dL (7.64 ± 1.23) compared to those with 5-5.9 mg/dL (5.77 ± 1.03), with a p-value of <0.001 (**Table 2**). This suggests an association between lower uric acid levels and severe LBP, consistent with findings by Harrisson SA et al. However, no significant difference was observed in foot pain severity based on uric acid levels.[15]

4.9. Impact of occupation on pain severity

Occupation influenced VAS scores for LBP and foot pain (**Table 4**). Laborers reported higher LBP severity (19 cases), while housewives also showed significant severe cases (27 cases). Foot pain severity was more prevalent among housewives than labourers. These findings align with research by Shiri R et al., highlighting manual labour as a risk factor for severe LBP.[34]

4.10. Correlation of pelvic incidence and tilt with various measures

Pelvic incidence correlated significantly with the Kite's angle ($r = 0.53$, $p < 0.001$), but only weakly with calcaneal pitch ($r = 0.06$, $p < 0.001$) and the 2nd metatarsal-navicular distance ($r = -0.217$, $p < 0.001$). Pelvic tilt had negligible correlations with Kite's angle ($r = 0.042$, $p < 0.001$), calcaneal pitch ($r = 0.067$, $p < 0.001$), and the 2nd metatarsal-navicular distance ($r = 0.037$, $p < 0.001$) (**Table 5**). These results are consistent with Bunzli S et al., who observed significant correlations between pelvic incidence and spinal alignment.[16]

4.10. Dr. Kabre Chandanwale's sign and its clinical significance

The presence of Dr. Kabre Chandanwale's sign was observed in 69% of cases (**Table 8**). Patients with the sign reported higher severe LBP (67.22%) and foot pain (64.40%) compared to those without it. Recent studies, including L-70966/2017, L-126024/2023, and L-138403/2023, highlight Dr. Kabre Chandanwale's New Pain Mechanism, suggesting pain is more localized near muscle attachment sites rather than at muscle spindle junctions.

Our study found a higher prevalence of Dr. Kabre Chandanwale's sign in patients with both back and foot pain. This sign may serve as an early predictor before foot deformities like pes planus develop. These findings align with El-Tallawy et al., who demonstrated that specific diagnostic signs correlate with pain severity.[35] Further research could improve diagnostic accuracy and treatment strategies for chronic back and foot pain, ultimately enhancing patient outcomes.

5. Conclusion

The study elucidates the significant association between LBP and foot disorders, emphasizing the interconnected nature of these conditions. Findings indicate that individuals exhibiting Dr. Kabre Chandanwale's Sign experience a higher severity of pain in both the lower back and foot, with a notable proportion reporting severe pain. Specifically, the data shows that 67.22% of participants with the sign experienced severe LBP, while 64.40% reported severe foot pain. This underscores the importance of considering foot health in the diagnosis and management of LBP.

The research highlights the necessity of a holistic approach in treating patients with concurrent low back and foot pain. Addressing anatomical misalignments and metabolic factors such as elevated serum uric acid levels could lead to better pain management and improved patient outcomes. Dr. Kabre Chandanwale's Sign serves as a valuable clinical indicator for identifying patients who may benefit from integrated treatment strategies focusing on both lower back and foot health.

Overall, this study advocates for a comprehensive evaluation of patients presenting with LBP to include assessments of foot disorders, thereby enabling targeted and effective therapeutic interventions. Future research should aim to validate these findings in larger, more diverse populations to further refine and enhance treatment protocols for patients suffering from these interconnected conditions.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Ethical Approval

Ethical No.: BJGMC/IEC/Pharmac/D 823258--258

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