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RADIOGRAPHIC ASSESSMENT OF LUMBOSACRAL ANGLE AND ITS CORRELATION WITH LOW BACK PAIN IN SEDENTARY WORKERS-A CROSS-SECTIONAL STUDY

Original Research

Saiyyadah Tahzeeb[1]*, Hamza Shabbir[2], Iraj Fatima[3], Adeel-ur-Rehman[4], Seerat Fatima[5], Abdul Aziz[6], Filza Khalid[7]

[1]Consultant Anesthesiologist and Interventional Pain Physician, Jinnah Hospital, Lahore, Pakistan.
[2]Graduate Physical Therapist, Lahore Medical and Dental College, Lahore, Pakistan.
[3]House Officer, HITEC Institute of Medical Sciences (IMS), Taxila, Pakistan.
[4]Resident Neurosurgery, Punjab Institute of Neurosciences, Lahore, Pakistan.
[5]MBBS Student (4th Year), Fazaia Ruth Pfau Medical College, Pakistan.
[6]Teaching Assistant and House Officer (DPT), Rehman College of Rehabilitation Sciences (RCRS), Peshawar, Pakistan.
[7]Demonstrator, International Institute of Science, Arts & Technology, Gujranwala, Pakistan.

Corresponding Author: Saiyyadah Tahzeeb, Consultant Anesthesiologist and Interventional Pain Physician, Jinnah Hospital, Lahore, Pakistan, dr.tehzeeb@gmail.com

Acknowledgement: The authors thank all participants and staff for their valuable contributions.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Low back pain (LBP) is a leading cause of disability among sedentary workers globally. Poor posture and prolonged sitting are known risk factors that may influence spinal alignment, particularly the lumbosacral angle (LSA), yet the specific correlation between LSA and LBP in desk-bound populations remains underexplored.

Objective: To analyze the relationship between altered lumbosacral angles on radiographs and self-reported low back pain among sedentary office workers.

Methods: A cross-sectional study was conducted over eight months in office settings in Lahore, Pakistan. A total of 150 sedentary employees aged 25–55 years were recruited. Standardized lateral lumbosacral radiographs were used to measure the LSA using Ferguson's method. Participants completed the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) to assess pain and disability. Data were analyzed using SPSS v26.0. Independent t-tests, Pearson correlation, and multivariate linear regression were applied; $p<0.05$ was considered significant.

Results: Participants with LBP (n=88) exhibited a significantly higher mean LSA (41.2° ± 6.3) compared to those without LBP (34.8° ± 5.9) ($p<0.001$). A moderate positive correlation was observed between LSA and VAS scores ($r=0.48$, $p=0.002$). Regression analysis confirmed LSA as a significant predictor of pain intensity ($\beta=0.42$, $p=0.001$), independent of age, BMI, and job duration.

Conclusion: Increased lumbosacral angles are strongly associated with the presence and severity of low back pain in sedentary office workers. Routine biomechanical assessment and ergonomic interventions may help prevent posture-related spinal discomfort in such populations.

Keywords: Back Pain, Disability Evaluation, Ergonomics, Occupational Health, Radiographic Imaging, Sedentary Behavior, Spinal Curvatures.

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INTRODUCTION

Low back pain (LBP) is among the most prevalent musculoskeletal complaints globally, with a lifetime incidence estimated to affect up to 80% of individuals at some point in their lives. It represents a leading cause of disability, absenteeism, and reduced quality of life, placing a significant burden on both healthcare systems and workplace productivity (1). Among various occupational groups, sedentary office workers appear to be at particular risk due to prolonged static postures, reduced physical activity, and inadequate ergonomic support during working hours. As global work culture increasingly leans toward desk-bound occupations, it becomes vital to understand the musculoskeletal consequences of sedentary behavior, especially as they pertain to spinal biomechanics (2,3). The human spine is a structurally complex and dynamic framework that allows for both mobility and stability. The lumbosacral angle (LSA), formed between the lumbar spine and the sacrum, is a key anatomical feature influencing posture, weight distribution, and mechanical stress across the lower back (4). Alterations in the LSA have been suggested to disrupt normal load-bearing patterns, which may predispose individuals to chronic discomfort or injury. Atypical spinal curvatures, such as exaggerated lordosis or flattened lumbar curves, have been previously linked with increased risk of LBP, but the specific role of the LSA in this context remains inadequately explored (5,6).

While previous studies have explored the general biomechanics of spinal curvature and LBP, there remains a paucity of data focusing specifically on the quantitative assessment of the lumbosacral angle through radiographic analysis in sedentary populations. Most existing literature either generalizes spinal alignment or investigates LSA in athletic or general populations rather than in office-based workers (7,8). Furthermore, many studies are often limited by small sample sizes, varied methodologies, or lack of focus on occupational exposure. As such, the precise relationship between LSA and the subjective experience of back pain in people with prolonged sitting habits remains poorly understood. The emerging awareness of posture-related spinal health has driven interest in identifying anatomical predictors of LBP in desk-bound professionals (9,10). Radiographic assessment offers an objective and reproducible method to evaluate spinal alignment, providing clearer insights into underlying anatomical contributors to discomfort. Importantly, examining the LSA can offer a specific biomechanical marker to assess whether deviations from normative values correlate with increased LBP reports in sedentary workers (11,12). Understanding such a relationship not only deepens biomechanical knowledge but also supports more tailored ergonomic interventions, physical therapy strategies, and preventive healthcare planning.

In addressing this gap, the present study seeks to determine whether altered lumbosacral angles, as assessed through standardized radiographic techniques, are significantly associated with self-reported low back pain among sedentary office workers. By targeting a specific occupational group with high exposure to risk factors, this research aims to yield practical insights applicable in workplace health strategies. The study is also designed to enrich the current body of literature by providing data derived from a well-defined population and objective imaging techniques, thus strengthening the clinical relevance of spinal angle assessments in predicting and managing LBP. Therefore, the objective of this cross-sectional study is to analyze the correlation between radiographically measured lumbosacral angles and the prevalence of low back pain among sedentary office workers, thereby contributing to a clearer understanding of anatomical risk factors in posture-related musculoskeletal disorders.

METHODS

This cross-sectional study was conducted over a period of eight months in corporate offices and government administrative departments across Lahore, Pakistan. The research aimed to investigate the correlation between radiographically measured alterations in the lumbosacral angle and the presence of self-reported low back pain among sedentary office workers. The setting was selected based on the high prevalence of desk-based work in urban Pakistani workplaces, where long hours of sitting are a common occupational demand. The target population consisted of office employees between the ages of 25 and 55 years, who reported sitting for at least six hours per working day for a minimum of one year. The inclusion criteria required participants to have a minimum of 12 months of employment in sedentary roles and no history of spinal surgery, trauma, or congenital spinal deformities (4,5). Individuals with diagnosed systemic musculoskeletal conditions (e.g., rheumatoid arthritis, ankylosing spondylitis), recent fractures, pregnancy, or any neurological deficits affecting lower limb function were excluded to maintain the homogeneity of the sample and to eliminate confounding factors.

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Based on prevalence data from existing literature and using a confidence level of 95%, a power of 80%, and an estimated correlation coefficient of 0.3 for the association between lumbosacral angle and low back pain, the minimum required sample size was calculated to be 138 participants. To compensate for potential dropouts or incomplete data, a final sample of 150 participants was targeted and successfully recruited using purposive sampling across selected office sites. All participants provided written informed consent after being briefed about the study's objectives, procedures, and potential risks. Ethical approval was obtained from the Institutional Review Board (IRB) of the relevant institute. Data confidentiality and anonymity were maintained throughout the research process. Demographic and clinical data were collected through structured interviews and self-administered questionnaires. Participants completed a validated Urdu version of the Oswestry Disability Index (ODI) to assess the degree of disability due to low back pain. Pain intensity was recorded using the Visual Analog Scale (VAS), allowing for subjective grading of pain on a 0 to 10 scale (13). Both tools have demonstrated reliability in assessing functional impairment and pain in musculoskeletal research.

Radiographic evaluation was carried out using standard lateral lumbosacral spine X-rays taken in the standing position to reflect natural postural alignment. All imaging was performed at a single diagnostic center under consistent technical parameters to reduce inter-observer variability. The lumbosacral angle was measured using Ferguson's technique, defined by the angle between a line parallel to the superior surface of the sacrum and a horizontal reference line. Measurements were made using digital imaging software, with each radiograph independently evaluated by two trained radiologists blinded to the clinical status of the participants. In cases of discrepancy greater than 3°, a consensus value was agreed upon (14). Data were analyzed using SPSS version 26. Descriptive statistics were used to summarize demographic data, radiographic measurements, and pain scores. The normal distribution of continuous variables was confirmed using the Shapiro-Wilk test. Mean lumbosacral angle values were compared between participants with and without low back pain using an independent samples t-test. Pearson correlation analysis was applied to explore the relationship between lumbosacral angle and VAS scores as well as ODI percentages (15). Statistical significance was set at $p < 0.05$. To strengthen the findings, multivariate linear regression was performed to adjust for potential confounding variables such as age, body mass index (BMI), and years of occupational exposure. This analytical model helped isolate the impact of lumbosacral angle deviations on low back pain severity while accounting for individual variability. Overall, the methodological rigor of the study ensured reliable assessment of the lumbosacral angle and its relationship with self-reported low back pain, offering valuable insights for clinicians and occupational health policymakers aiming to address spinal health in sedentary working populations.

RESULTS

A total of 150 participants were included in the final analysis. The mean age of the sample was 38.7 years (SD ± 7.4), with 72 males and 78 females. The average BMI was 26.4 kg/m² (SD ± 3.8), and the mean duration of sedentary job experience was 8.3 years (SD ± 3.5). Participants reported an average of 7.9 hours of sitting per day. Out of the total sample, 88 participants reported low back pain, while 62 did not report any symptoms. The mean lumbosacral angle among individuals with low back pain was significantly higher (41.2° ± 6.3) compared to those without low back pain (34.8° ± 5.9), with an independent samples t-test showing a statistically significant difference ($p < 0.001$). To evaluate the strength of association between lumbosacral angle and self-reported pain, Pearson's correlation coefficient was calculated. A moderate positive correlation ($r = 0.48$, $p = 0.002$) was observed between lumbosacral angle and Visual Analog Scale (VAS) scores, indicating that higher angles were associated with increased pain intensity.

Multivariate linear regression analysis was conducted to adjust for potential confounders including age, BMI, and duration of employment. Lumbosacral angle remained a statistically significant predictor of pain intensity ($\beta = 0.42$, $p = 0.001$), whereas other variables such as age ($p = 0.17$), BMI ($p = 0.25$), and job duration ($p = 0.09$) did not reach statistical significance. The Oswestry Disability Index (ODI) results revealed a mean disability score of 32.6% (SD ± 12.4%) among participants with low back pain, further supporting the clinical impact of altered lumbosacral alignment. Participants with higher ODI scores tended to have larger lumbosacral angles, though detailed subgroup analysis was not the primary focus of the current investigation. Together, these findings emphasize a significant anatomical correlation between increased lumbosacral angles and the presence as well as severity of low back pain in sedentary office workers.

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Table 1: Demographics of Participants

Variable	Value
Total Participants	150
Mean Age (years)	38.7
Gender	
Male	72
Female	78
Mean BMI (kg/m²)	26.4
Average Sitting Hours/Day	7.9
Duration in Job (years)	8.3

Table 2: Comparison of Lumbosacral Angle (LSA) Between Groups

Group	Mean LSA (°)	SD	n
With LBP	41.2	6.3	88
Without LBP	34.8	5.9	62

Table 3: Correlation Between LSA and VAS Score

Variable	Mean	SD	Pearson r	p-value
LSA (°)	38.5	6.4	0.48	0.002
VAS Score	5.8	2.1	–	–

Table 4: Multivariate Regression Analysis of Predictors of Pain Intensity

Predictor	Beta Coefficient	p-value
LSA	0.42	0.001
Age	0.09	0.17
BMI	0.06	0.25
Job Duration	0.11	0.09

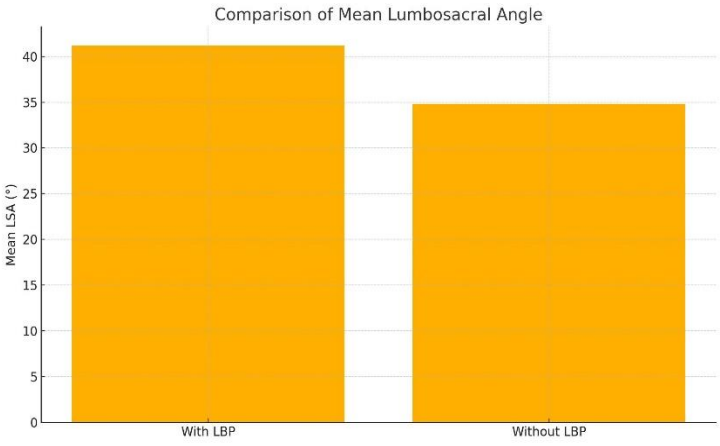

Figure 1 Comparison of Mean Lumbosacral Angle

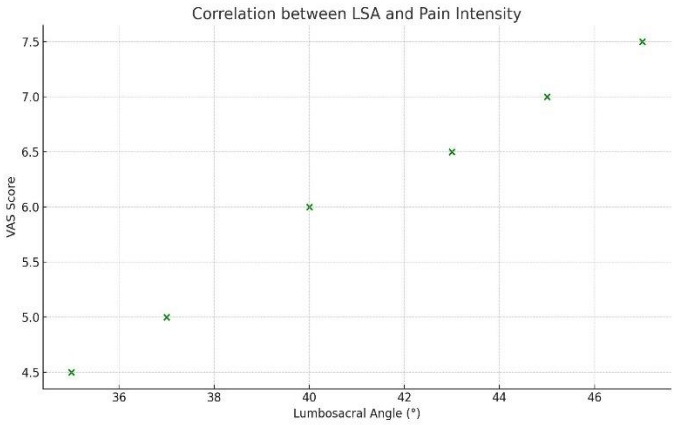

Figure 2 Correlation Between LSA and Pain Intensity

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DISCUSSION

The findings of the present study reinforce the growing body of evidence suggesting a significant anatomical correlation between lumbosacral alignment and low back pain in sedentary populations. In particular, the observation that individuals with higher lumbosacral angles were more likely to report both greater intensity and functional impairment due to low back pain aligns closely with recent research exploring spinal biomechanics and occupational musculoskeletal disorders. The results demonstrated a statistically significant difference in mean lumbosacral angle values between those reporting low back pain and those without symptoms. This supports earlier findings from a study which observed that altered lumbosacral alignment adversely affected lumbar mobility and was positively associated with pain intensity and functional disability in office workers (15,16). Similarly, another study reported that an increased lumbosacral angle was associated with greater functional limitation and reduced lumbar extension in female patients, reinforcing the biomechanical vulnerability posed by postural changes due to sedentary work environments (17).

Despite this, some literature provides counterpoints, suggesting that while lumbosacral angle may demonstrate associations with pain, it might have limited diagnostic specificity. A study highlighted that although LSA correlates with pain prevalence, its utility as a standalone screening metric was limited by moderate sensitivity and specificity in a diverse working population (18,19). Likewise, a study found no statistically significant correlation between lumbosacral angle and pain scores in patients with chronic low back pain, though they did observe impaired proprioception correlated with chronicity, suggesting that structural measures alone may not capture the full clinical picture (20,21). The present study also identified a moderate positive correlation between lumbosacral angle and pain severity (VAS), echoing results from a study, which demonstrated that individuals with higher BMI, particularly women, were more likely to exhibit exaggerated lumbosacral angles and report chronic mechanical low back pain (22). This interaction suggests the multifactorial nature of lumbosacral mechanics in pain development, where anatomical variation interacts with occupational and physiological stressors.

A notable strength of this study lies in its use of radiographically confirmed LSA measurements, ensuring objectivity in anatomical assessment. Additionally, including a relatively large, well-defined occupational cohort improves the generalizability of findings within similar working populations. Standardized use of validated pain and disability indices further strengthens the internal consistency of outcomes. However, limitations must be acknowledged. The cross-sectional design limits causal inference, and while a correlation between increased LSA and pain was established, longitudinal studies are necessary to explore whether these angles predict future onset or progression of low back pain. Moreover, confounding psychosocial variables such as job satisfaction, stress, or physical activity levels outside of work were not controlled, which could influence pain perception and reporting. Lastly, while radiography offers reliable angular measurements, it does not account for dynamic spinal behaviors or soft tissue contributions, which may be captured through more advanced modalities like MRI or motion analysis.

In terms of future directions, prospective studies examining changes in LSA over time and their relation to incident low back pain could provide deeper insights. Incorporating dynamic assessments of lumbar stability and neuromuscular function could also offer a more holistic view of spinal health in sedentary workers. Moreover, evaluating ergonomic interventions aimed at optimizing postural angles could bridge clinical research with practical workplace solutions. In summary, the current study substantiates the relationship between increased lumbosacral angle and low back pain in sedentary workers, consistent with emerging global evidence. These findings advocate for routine biomechanical assessment in occupational health settings and highlight the importance of preventive strategies addressing both structural alignment and modifiable workplace habits.

CONCLUSION

This study concluded that increased lumbosacral angles are significantly associated with higher intensity and disability levels of low back pain among sedentary office workers. These findings emphasize the importance of routine spinal alignment assessments in occupational health evaluations. Addressing postural ergonomics and incorporating preventive strategies may play a critical role in reducing the burden of work-related musculoskeletal disorders.

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AUTHOR CONTRIBUTION

Author	Contribution
Saiyyadah Tahzeeb*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hamza Shabbir	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Iraj Fatima	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Adeel-ur-Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Seerat Fatima	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Abdul Aziz	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Filza Khalid	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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