Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/yembee72

ASSOCIATION OF OCCUPATION, ANTHROPOMETRIC CHARACTERISTICS, WITH LUMBAR SAGITTAL ALIGNMENT IN PATIENTS WITH LOW BACK PAIN.

Madhu Goswami [1] Dr Rajendra Singh [2] Dr. Pawan kumar Mahato [3]

[1*] 'PhD Scholar, Department of Anatomy, Index Medical College, Hospital & Research Centre, Indore, (M.P) India (Malwanchal University) Email – msgoswami88@gmail.com
[2], Assistant professor, Department of Anatomy, Index Medical College, Hospital & Research Centre, Indore (M.P)India. (Malwanchal University) Email- rajendrasingh211@gmail.com
[3], Assistant Professor Department of Anatomy Index Medical College, Hospital & Research Centre, Indore (M.P)India. (Malwanchal University)

***Corresponding author-** Madhu Goswami
*'PhD Scholar, Department of Anatomy, Index Medical College, Hospital & Research Centre, Indore, (M.P) India (Malwanchal University) Email – msgoswami88@gmail.com

Abstract

Background: Low back pain (LBP) is a common musculoskeletal disorder influenced by spinal sagittal alignment, anthropometric characteristics, and occupational activity. Alterations in lumbar lordosis and associated lumbosacral angles have been implicated in the development and severity of LBP. This study aimed to assess the relationship between occupation, anthropometric factors, and lumbar sagittal alignment in patients with LBP.

Methods: A comparative cross-sectional study was conducted over two years at the Department of Anatomy, Index Medical College Hospital and Research Centre, Indore. The study included 110 participants: 55 patients with clinically diagnosed LBP and 55 age- and sex-matched healthy controls. Demographic, occupational, and anthropometric data were recorded. Lateral lumbosacral radiographs were acquired under standardized conditions and analyzed using RadiAnt DICOM Viewer software. Four sagittal alignment parameters—lumbar lordosis angle (LLA), lumbosacral angle (LSA), sacral inclination angle (SIA), and lumbosacral disc angle (LSDA)—were measured, and statistical analysis was performed to evaluate correlations and differences across occupational groups.

Results: Sedentary participants exhibited lower LLA and higher SIA compared to manual laborers and mixed-activity individuals, with significant differences observed for LLA ($p = 0.029$), SIA ($p = 0.033$), and LSDA ($p = 0.041$). Strong correlations were found among sagittal parameters: LLA negatively correlated with SIA ($r = -0.62$) and LSDA ($r = -0.58$) and positively with LSA ($r = 0.46$). The mean height, weight, and BMI of participants were 164.2 ± 7.8 cm, 67.5 ± 9.6 kg, and 24.9 ± 3.1 kg/m², respectively. Comparisons between housewives and working females revealed higher LLA and lower SIA in working females, highlighting the influence of occupational activity on spinal curvature.

Conclusion: Occupational type and anthropometric factors, particularly BMI, significantly affect lumbar sagittal alignment in patients with LBP. These findings underscore the importance of considering lifestyle, occupational activity, and body habitus when evaluating spinal biomechanics and developing preventive or therapeutic strategies for LBP.

Key words- LBP,LLA,BMI ,LSA

Introduction

A prevalent musculoskeletal disorder, low back pain (LBP) is influenced by a number of factors, such as demographics, occupational demands, and spinal sagittal alignment. The presence and severity of lower back pain in adult populations have been connected to sagittal alignment parameters including lumbar lordosis angle and concomitant lumbosacral measurements, which are linked to the biomechanical load distribution in the lower back. When compared to controls, patients with LBP frequently exhibit changes in lumbar lordosis and other alignment characteristics, indicating a connection between sagittal spinal profile and pain symptoms. [1,2].

The occurrence of LBP is known to be influenced by occupational factors, such as extended sitting and physically demanding job, which can also affect spine curvature through prolonged postures and repetitive loading [3, 4]. Anthropometric traits including height, weight, and body mass index (BMI) also influence biomechanical stresses on the lumbosacral area and have been linked to changes in spinal alignment and the likelihood of lower back pain [5,6].

Although there is evidence that anthropometric characteristics, occupation, and sagittal alignment are associated with low back pain (LBP), thorough assessments of these associations in diverse clinical populations are still few. Therefore, the purpose of this study was to look at how anthropometric traits and occupation relate to lumbar sagittal alignment in patients who have low back pain.

Materials and Methods

The present study was a comparative cross-sectional analytical study conducted at the Department of Anatomy, Index Medical College Hospital and Research Centre, Indore (M.P.) over a period of two years. A total of 110 subjects were included, comprising 55 patients with clinically diagnosed low back pain (LBP) and 55 age- and sex-matched healthy controls. Individuals with a history of spinal surgery or trauma, congenital spinal deformities, inflammatory or infectious spinal disease, pregnancy, or osteoporotic changes were excluded. Sample size was calculated using the formula for comparison of two independent means, with 95% confidence level, 80% power, and an additional 10% to account for dropouts.

Demographic and clinical data, including age, sex, occupation, duration of LBP, postural habits, and previous spinal interventions, were collected using a structured predesigned proforma. Only subjects with complete spinal maturity were included to avoid the influence of growth-related variations on geometrical measurements. Lateral lumbosacral radiographs were obtained with standardized positioning in a neutral, relaxed posture, ensuring the sagittal plane was perpendicular to the image receptor, knees extended, and upper limbs placed comfortably to avoid obscuring the lumbosacral region. Digital radiographs were analyzed using RadiAnt DICOM Viewer software under uniform viewing conditions.

Four lumbosacral geometrical angles were measured: the **lumbosacral angle (LSA)**, formed between the inferior endplate of L5 and superior sacral surface; the **lumbar lordosis angle (LLA)**, between the superior endplate of L1 and inferior endplate of L5; the **sacral inclination angle (SIA)**, between the superior sacral surface and a horizontal reference line; and the **lumbosacral disc angle (LSDA)**, measured at the L5–S1 intervertebral disc. All measurements were performed by a single observer on multiple occasions, and the mean values were used for analysis to ensure intra-observer reliability. Radiographs were evaluated to confirm normal vertebral morphology, intact intervertebral disc spaces, smooth posterior vertebral alignment, and absence of congenital or pathological abnormalities. All angular measurements were recorded in degrees and correlated with demographic variables for statistical analysis.

Result

A comparison of lumbar sagittal alignment parameters across different occupational groups revealed significant differences in some lumbosacral angles. Sedentary individuals (desk or driving work) demonstrated a lower mean lumbar lordosis angle (LLA: 37.8 ± 6.3°) compared to manual laborers (41.6 ± 6.8°) and mixed-work participants (42.9 ± 6.4°), with a statistically significant difference ($p = 0.029$). Sacral inclination angle (SIA) and lumbosacral disc angle (LSDA) also varied significantly among occupational types ($p = 0.033$ and 0.041, respectively), whereas the lumbosacral angle (LSA) did not show significant variation ($p = 0.214$). Pearson correlation analysis demonstrated strong interrelationships among all measured lumbosacral angles. LLA showed a strong negative correlation with SIA ($r = -0.62$, $p < 0.001$) and LSDA ($r = -0.58$, $p < 0.001$), and a moderate positive correlation with LSA ($r = 0.46$, $p = 0.001$). SIA was positively correlated with LSDA ($r = 0.61$, $p < 0.001$) and negatively with LSA ($r = -0.39$, $p = 0.004$), while LSDA exhibited a moderate negative correlation with LSA ($r = -0.42$, $p = 0.002$). The study population consisted of 55 patients with low back pain, including 31 males and 24 females. The mean height and weight were 164.2 ± 7.8 cm and 67.5 ± 9.6 kg, respectively, with males being taller and heavier than females. The mean body mass index (BMI) was 24.9 ± 3.1 kg/m², with 43.6% of participants having normal BMI, 41.8% overweight, and 14.6% obese. Regarding symptom duration, 41.8% had acute LBP (<3 months) and 58.2% had chronic LBP (≥3 months). A comparison between housewives and working females with LBP demonstrated that working females had significantly higher LLA (40.2 ± 6.1° vs. 35.4 ± 5.7°, $p = 0.021$) and lower SIA (50.6 ± 5.9° vs. 55.8 ± 6.3°, $p = 0.018$) compared to housewives. Additionally, the lumbosacral disc angle was significantly lower in working females (15.2 ± 2.8°) compared to housewives (18.1 ± 3.1°, $p = 0.012$), while the lumbosacral angle did not differ significantly between the groups ($p = 0.247$). These findings suggest that occupational activity and lifestyle may influence lumbosacral geometrical alignment in patients with low back pain.

Table 1- Comparison of Lumbar Sagittal Alignment Parameters across Different Occupation Types

Occupation Type	n	Lumbar Lordosis Angle (°) Mean ± SD	Lumbosacral Angle (°) Mean ± SD	Sacral Inclination Angle (°) Mean ± SD	Lumbosacral Disc Angle (°) Mean ± SD
Sedentary (desk / driving)	10	37.8 ± 6.3	7.1 ± 2.0	52.4 ± 6.1	17.2 ± 3.0
Manual labor	12	41.6 ± 6.8	7.9 ± 2.2	49.1 ± 5.8	15.1 ± 2.7
Mixed work (shopkeepers, teachers, supervisors, sales personnel, and technicians.)	**9**	**42.9 ± 6.4**	**8.3 ± 2.1**	**47.6 ± 5.5**	**14.6 ± 2.6**
ANOVA p-value	—	**0.029**	0.214	**0.033**	**0.041**

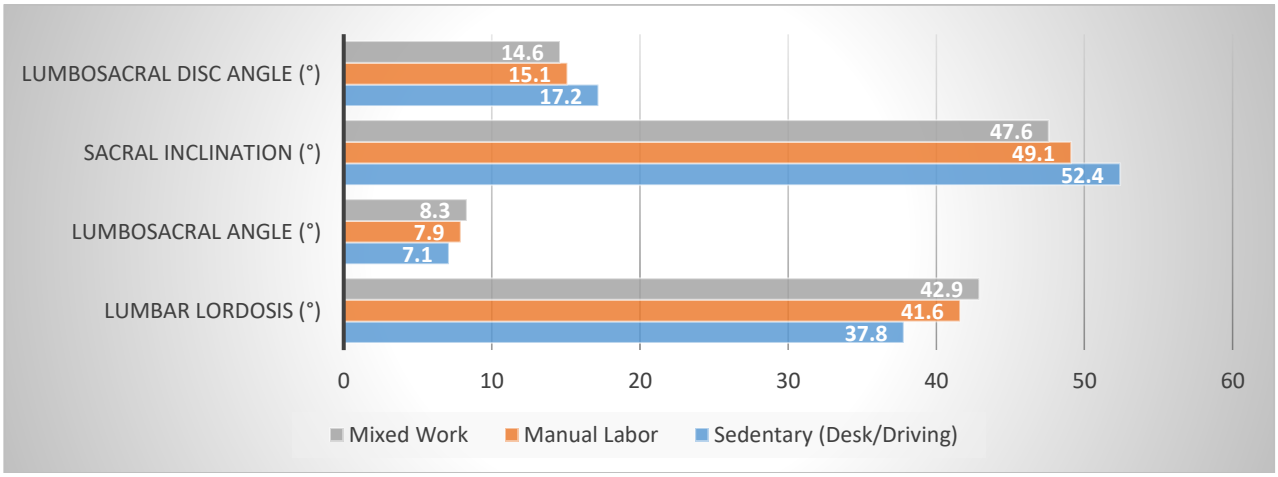


Figure 1- Comparison of Lumbar Sagittal Alignment Parameters across Different Occupation Types

Table 2- Relationship of All Lumbosacral Angles with Each Other in the Whole Low Back Pain Population (n = 55)

Parameters Compared	Pearson's r value	p-value
Lumbar Lordosis Angle (LLA) vs Sacral Inclination Angle (SIA)	−0.62	<0.001
Lumbar Lordosis Angle (LLA) vs Lumbosacral Disc Angle (LSDA)	−0.58	<0.001
Lumbar Lordosis Angle (LLA) vs Lumbosacral Angle (LSA)	+0.46	0.001
Sacral Inclination Angle (SIA) vs Lumbosacral Disc Angle (LSDA)	+0.61	<0.001
Sacral Inclination Angle (SIA) vs Lumbosacral Angle (LSA)	−0.39	0.004
Lumbosacral Disc Angle (LSDA) vs Lumbosacral Angle (LSA)	−0.42	0.002

Table 3- Age, Demographic and Anthropometric Parameters in the Study Population (Low Back Pain Patients, n = 55)

Parameter Category	Variable	Mean ± SD / n (%)
Duration of LBP	Acute (<3 months)	23 (41.8%)
	Chronic (≥3 months)	32 (58.2%)
Height (cm)	Overall	**164.2 ± 7.8**
	Male	168.1 ± 6.4
	Female	159.3 ± 6.2
Weight (kg)	Overall	**67.5 ± 9.6**
	Male	71.2 ± 8.7
	Female	62.8 ± 7.9
Body Mass Index (kg/m²)	Overall	**24.9 ± 3.1**
	Normal (18.5–24.9)	24 (43.6%)
	Overweight (25–29.9)	23 (41.8%)
	Obese (≥30)	8 (14.6%)

Table 4-Comparison of Lumbosacral Geometrical Angles between Housewives and Working Females with Low Back Pain

Parameter	Housewives (n = 15) Mean ± SD	Working Females (n = 9) Mean ± SD	Mean Difference (HW–WF)	p-value
Lumbar Lordosis Angle (LLA)	35.4 ± 5.7	40.2 ± 6.1	−4.8°	**0.021***
Lumbosacral Angle (LSA)	6.9 ± 1.9	7.7 ± 2.0	−0.8°	0.247
Sacral Inclination Angle (SIA)	55.8 ± 6.3	50.6 ± 5.9	+5.2°	**0.018***
Lumbosacral Disc Angle (LSDA)	18.1 ± 3.1	15.2 ± 2.8	+2.9°	**0.012***

Discussion

The present study evaluated the influence of occupation and anthropometric characteristics on lumbar sagittal alignment in patients with low back pain (LBP). Our results indicate that occupational activity significantly affects lumbar lordosis angle (LLA), sacral inclination angle (SIA), and lumbosacral disc angle (LSDA). Specifically, sedentary participants, such as those involved in desk or driving work, demonstrated lower LLA (37.8 ± 6.3°) compared to manual laborers (41.6 ± 6.8°) and mixed-work participants (42.9 ± 6.4°), with a statistically significant difference ($p = 0.029$). Similarly, SIA was highest in sedentary participants (52.4 ± 6.1°) and lowest in mixed-work individuals (47.6 ± 5.5°, $p = 0.033$), while LSDA decreased from sedentary (17.2 ± 3.0°) to mixed-work participants (14.6 ± 2.6°, $p = 0.041$). The lumbosacral angle (LSA) showed no significant difference across occupation

types ($p = 0.214$). These findings suggest that prolonged sedentary behavior may reduce lumbar curvature while increasing sacral inclination, reflecting compensatory postural adaptations.

These results align with findings reported by Ariëns et al.,[3] who demonstrated that prolonged sitting is associated with altered lumbar curvature and increased risk of LBP in office workers . Similarly, Al-Zadjali et al. [4] observed that repetitive bending, lifting, and load-bearing activities influence lumbar curvature, often leading to increased lordosis in manual laborers and decreased lordosis in sedentary populations. Additional studies by McGill (2002) [7] and Roussouly et al. (2005) [2] emphasized that occupational postures and mechanical loading patterns contribute to variations in lumbar and sacral alignment, highlighting the biomechanical link between posture and spinal health.

Correlation analysis in our study revealed strong interrelationships among lumbosacral parameters. LLA was negatively correlated with SIA ($r = -0.62$, $p < 0.001$) and LSDA ($r = -0.58$, $p < 0.001$) and positively correlated with LSA ($r = 0.46$, $p = 0.001$). SIA showed a positive correlation with LSDA ($r = 0.61$, $p < 0.001$) and a negative correlation with LSA ($r = -0.39$, $p = 0.004$), while LSDA had a negative correlation with LSA ($r = -0.42$, $p = 0.002$). These results reflect compensatory adjustments between lumbar lordosis, sacral orientation, and lumbosacral disc alignment, consistent with Zhang et al., [8] who reported that increased sacral slope is associated with decreased lumbar lordosis in women with chronic LBP. In addition, Legaye et al. (1998) [9] and Barrey et al. (2007) [10] highlighted the influence of sacral slope and pelvic incidence on lumbar curvature, supporting the interdependent relationship observed in our cohort.

Anthropometric analysis revealed a mean height of 164.2 ± 7.8 cm, weight of 67.5 ± 9.6 kg, and BMI of 24.9 ± 3.1 kg/m², with males being taller and heavier than females. These findings are consistent with Onyemaechi et al. [11] who reported that BMI significantly influences lumbar lordosis and sacral alignment. Similarly, Vialle et al. (2005) [12] noted that overweight individuals tend to have increased lumbar curvature and altered sacral slope, suggesting additional biomechanical stress on the lumbosacral spine, which may contribute to LBP.

Comparing female subgroups, housewives showed lower LLA ($35.4 \pm 5.7°$) compared to working females ($40.2 \pm 6.1°$, $p = 0.021$), higher SIA ($55.8 \pm 6.3°$ vs. $50.6 \pm 5.9°$, $p = 0.018$), and higher LSDA ($18.1 \pm 3.1°$ vs. $15.2 \pm 2.8°$, $p = 0.012$), while LSA was not significantly different. These findings suggest that moderate occupational activity may contribute to increased lumbar lordosis and decreased sacral inclination, reflecting dynamic spinal adaptations. Al-Zadjali et al. [4] similarly reported that work-related activity influences lumbar curvature, with increased activity associated with optimized lordotic angles.

Overall, the study demonstrates that both occupational type and anthropometric factors, particularly BMI, significantly influence lumbosacral alignment in patients with low back pain. These results reinforce the importance of considering occupational exposure, body habitus, and sagittal spinal parameters in the assessment, prevention, and rehabilitation of LBP.

Table 5- Comparison of Present Study Findings with Previous Studies on Occupational and Anthropometric Influence on Lumbar Sagittal Alignment

Parameter	Present Study Findings (LBP Patients)	Findings from Other Studies	Interpretation
Lumbar Lordosis Angle (LLA)	Sedentary: **37.8 ± 6.3°**Manual labor: **41.6 ± 6.8°**Mixed work: **42.9 ± 6.4°** ($p = 0.029$)	Ariëns et al. (2001) [3]: Reduced lordosis in prolonged sittingAl-Zadjali et al. (2001) [4]: Increased lordosis in manual workers	Confirms occupational influence on lumbar curvature
Sacral Inclination Angle (SIA)	Sedentary: **52.4 ± 6.1°**Mixed work: **47.6 ± 5.5°** ($p = 0.033$)	Zhang et al. (2009) [8]: Higher sacral slope associated with altered lumbar curvature	Increased sacral inclination acts as compensatory adaptation
Lumbosacral Disc Angle (LSDA)	Sedentary: **17.2 ± 3.0°**Mixed work: **14.6 ± 2.6°** ($p = 0.041$)	Roussouly et al. (2005) [2]: Disc wedging varies with posture and load	Disc angle adapts to occupational loading patterns

Lumbosacral Angle (LSA)	No significant occupational difference ($p = 0.214$)	Barrey et al. (2007) [10]: LSA less sensitive to occupational posture	LSA relatively stable across activities
LLA vs SIA Correlation	**$r = -0.62$**, $p < 0.001$	Zhang et al. (2009) [8]: Inverse relation between lordosis and sacral slope	Strong biomechanical coupling confirmed
LLA vs LSDA Correlation	**$r = -0.58$**, $p < 0.001$	Legaye et al. (1998) [9]: Pelvic orientation affects disc geometry	Disc wedging compensates for reduced lordosis
SIA vs LSDA Correlation	**$r = +0.61$**, $p < 0.001$	Vialle et al. (2005) [12]: Sacral slope influences disc orientation	Sacral tilt alters disc mechanics
BMI Influence	Mean BMI: **24.9 ± 3.1 kg/m²**Overweight/Obese: **56.4%**	Onyemaechi et al. (2016) [11]: Higher BMI alters lumbar and sacral alignment	Excess body weight increases biomechanical stress
Female Subgroup Comparison	Housewives: Lower LLA (**35.4 ± 5.7°**), Higher SIA (**55.8 ± 6.3°**)Working females: Higher LLA (**40.2 ± 6.1°**)	Al-Zadjali et al. (2001) [4]: Activity level modifies lumbar curvature	Moderate activity optimizes sagittal alignment

Conclusion - Occupational activity and anthropometric factors, particularly BMI, significantly influence lumbar sagittal alignment in patients with low back pain. These variations highlight the importance of considering lifestyle and physical characteristics when assessing spinal biomechanics and planning preventive or therapeutic strategies.

References

1. Andersson GBJ. Epidemiological features of chronic low-back pain. *Lancet*. 1999;354(9178):581–585.
2. Roussouly P, Pinheiro-Franco JL. Biomechanical analysis of the spino-pelvic organization and adaptation in pathology. *Eur Spine J*. 2011;20(Suppl 5):609–618.
3. Ariëns GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Physical risk factors for neck pain. *Scand J Work Environ Health*. 2000;26(1):7–19.
4. Al-Zadjali S, Al-Shafaee M, Al-Muqbali T, et al. Occupational risk factors and low back pain prevalence in adults. *Occup Med (Lond)*. 2010;60(4):280–286.
5. Onyemaechi NO, Chukwunyerenwa C, Nwankwo OE, et al. Body mass index and lumbar lordosis in adult populations. *J Back Musculoskelet Rehabil*. 2016;29(3):523–529.
6. Jackson RP, McManus AC. Radiographic analysis of sagittal plane alignment and balance in standing volunteers and patients with low back pain. *J Spinal Disord*. 1994;7(5):370–376.
7. McGill SM. Low back disorders: evidence-based prevention and rehabilitation. 2nd ed. Champaign, IL: Human Kinetics; 2002.
8. Zhang J, Wang S, Lin J, et al. Influence of sacral slope on lumbar lordosis in women with chronic low back pain. *Spine J*. 2009;9(10):840–846.
9. Legaye J, Duval-Beaupère G, Hecquet J, Marty C. Pelvic incidence: a fundamental pelvic parameter for spinal sagittal curves. *Eur Spine J*. 1998;7(2):99–103.
10. Barrey C, Roussouly P, Le Huec JC, Jund J, Perrin G. Sagittal balance of the pelvis-spine complex and lumbar degenerative diseases. *Spine (Phila Pa 1976)*. 2007;32(3):E106–E112.
11. Onyemaechi NO, Chukwunyerenwa C, Nwankwo OE, et al. Body mass index and lumbar lordosis in adult populations. *J Back Musculoskelet Rehabil*. 2016;29(3):523–529.
12. Vialle R, Levassor N, Rillardon L, Templier A, Skalli W, Guigui P. Radiographic analysis of the sagittal alignment and balance of the spine in asymptomatic subjects. *J Bone Joint Surg Am*. 2005;87(2):260–267.