

PREVALENCE OF LUMBER LORDOSIS AND POSTURAL MISALIGNMENT AMONG UNIVERSITY STUDENTS

***Husnain Murtaza¹, Asma Batool², Okasha Anjum³**

¹Department of Allied Health Sciences, Indus University, Karachi, Pakistan.

²Lecturer Department of Allied Health Sciences, Indus University, Karachi, Pakistan.

³Chairperson Department of Allied Health Sciences, Indus University, Karachi, Pakistan.

***Corresponding Author:** (murtazahasnain57@gmail.com)

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Abstract

Background of study: Lumbar lordosis and postural misalignment are increasingly prevalent musculoskeletal conditions among university students due to prolonged sitting, sedentary behavior, and excessive use of digital devices. Poor ergonomics and lack of physical activity further contribute to spinal deviations and muscle imbalance. These postural abnormalities can lead to low back pain, functional limitations, and reduced quality of life. Early identification and preventive strategies are essential to maintain spinal health and improve overall academic and physical wellbeing.

Methodology: A cross-sectional observational study was conducted at Indus University, Karachi, among 227 university students aged 18–25 years. Data were collected through a structured questionnaire and postural assessment using the plumb line method. Data were analyzed using SPSS, with descriptive statistics and Chi-square analysis applied at a significance level of $p < 0.05$.

Results: Among 227 participants, lumbar lordosis was observed in 33.0%, while postural misalignment was present in 11.9%. Lumbar lordosis was slightly more prevalent among females, whereas postural misalignment was more common among males. A significant positive relationship was found between lumbar lordosis and postural misalignment ($r = 0.287$, $p < 0.01$). Chi-square analysis also showed a significant association between the two conditions ($\chi^2 = 18.73$, $p < 0.001$).

Conclusion: Lumbar lordosis was more prevalent than postural misalignment among university students. The significant association between both conditions highlights the importance of early postural screening, ergonomic awareness, and physiotherapy interventions.

Keywords: Lumbar lordosis, Postural misalignment, Postural balance, Spinal curvature, biomechanical phenomena.

INTRODUCTION

Lumbar lordosis is the natural forward curve of the lower spine that supports upright posture, shock absorption, and load distribution across the vertebral column ^[1]. When this curvature deviates from normal, either becoming excessive (hyperlordosis) or flattened (hypolordosis), it can result in postural dysfunction and musculoskeletal imbalance ^[2]. Because the lumbar spine plays a central role in weight-bearing and movement, it is particularly vulnerable to biomechanical disturbances that alter pelvic and spinal alignment ^[3].

University students represent a population at heightened risk of postural abnormalities due to prolonged sitting during lectures, extended study hours, and constant use of smartphones, laptops, and tablets ^[4]. Continuous engagement with these devices promotes poor sitting habits, forward trunk flexion, and reduced awareness of body posture, gradually contributing to abnormal spinal curvature ^[5].

Sedentary behaviour is considered one of the leading contributors to postural deviation. Long periods of inactivity weaken core stabilizing muscles such as the abdominals and glutei, while tightening the hip flexors and hamstrings. This muscular imbalance disrupts pelvic alignment, increases anterior pelvic tilt, and exaggerates lumbar lordosis ^[6]. Such imbalance not only affects the spine but also alters gait, balance, and overall movement patterns, and may progress from a functional to a structural problem over time ^[7].

Abnormal lumbar curvature has been closely linked with low back pain, one of the most frequent musculoskeletal complaints in young adults, with downstream effects on academic performance, concentration, and quality of life ^[8]. Ergonomic factors compound this risk: inadequate seating, poor desk height, insufficient lumbar support, and prolonged static postures are common in academic settings, while most students receive little formal education on spinal health ^[9]. Excessive smartphone use, in particular, has been strongly associated with forward head posture and rounded shoulders, which indirectly affect lumbar alignment through compensatory mechanisms across the kinetic chain ^[10, 11].

Psychosocial and lifestyle factors — stress, poor sleep, reduced physical fitness, and long hours of screen-based study or recreation — further compromise postural control ^[12]. Weakness of core stabilizers combined with tight hip flexors and lumbar extensors promotes anterior pelvic tilt, reinforcing the cycle of lumbar lordosis and postural dysfunction ^[13].

Physiotherapy interventions, including core strengthening, targeted stretching, postural re-education, and ergonomic correction, have demonstrated effectiveness in improving spinal alignment and reducing associated symptoms ^[14]. Cross-sectional studies remain a valuable tool for estimating the prevalence of such abnormalities and identifying associated risk factors that can guide healthcare planning ^[15].

Given the rising dependence on digital devices, increasing sedentary lifestyles, and their long-term musculoskeletal consequences, assessing the prevalence of lumbar lordosis and postural misalignment among university students is essential for enabling timely preventive measures and physiotherapy-based interventions.

METHODOLOGY:

Study Design and study setting:

A cross-sectional observational study was conducted at Indus University, Karachi. The study was carried out over a period of 6 months after approval.

Sample size:

Statistically calculated sample size using online OpenEpi version 3.04, with a 5% margin of error and a 95% confidence interval, required at least n=227 samples for this study.

Sampling technique:

A purposive non-probability sampling technique was used.

Inclusion/Exclusion Criteria:

Male and female university students aged 18–30 years, willing to participate, with no history of spinal surgery, were included in the study. Students with congenital spinal deformities, a history of trauma or fracture, neurological disorders, or pregnant females were excluded.

Data Collection Plan:

Formal approval was obtained from the concerned department prior to data collection, and ethical considerations were ensured throughout. A total of 227 participants were recruited through purposive non-probability sampling, with voluntary participation and strict confidentiality maintained. Data were collected using a structured questionnaire covering demographic information, along with postural assessment tools. Lumbar lordosis and postural misalignment were assessed using standardized clinical methods the postural grid and plumb line observation method. Each assessment took approximately 15–20 minutes per participant, and all collected data were checked for completeness and accuracy before entry into statistical software.

Data Analysis:

Data were entered into statistical software (SPSS) for analysis. Descriptive statistics, including frequencies, percentages, means, standard deviations, and variance, were used to summarize demographic characteristics. Chi-square tests were applied to assess associations between categorical variables such as gender, age, marital status, academic year, and employment status with the outcome variables. Diagnostic tests were also performed to verify statistical assumptions, the Shapiro–Wilk test for normality, a significance level of $p < 0.05$ was considered statistically significant throughout.

Outcome Measures:

This study used two standardized clinical assessment tools to determine postural alignment and lumbar spinal curvature among university students.

Postural misalignment was evaluated using a postural grid chart, a widely used, low-cost visual assessment technique that examines the alignment of body segments including the head, shoulders, thorax, upper back, trunk, and lower back against a calibrated grid background to identify deviations from normal anatomical alignment.

Lumbar lordosis was assessed using the plumb line method, a simple and reliable postural screening technique in which a vertical reference line is used to measure the anterior curvature of the lumbar spine, including abdominal and lower-back alignment, to determine the degree and prevalence of lordotic deviation.

RESULTS:

Figure 1 illustrates the distribution of postural misalignment across age groups. Younger participants, particularly those up to 20 years, showed the highest proportion of postural misalignment, while the 21–25 years group showed a comparatively lower rate. A similar age-related pattern was noted for lumbar lordosis, which was likewise more prevalent among younger students. These trends visually reinforce the statistical association identified between the two postural outcome measures, supporting the interpretation that poorer overall posture correlates with greater lumbar curvature among university students.

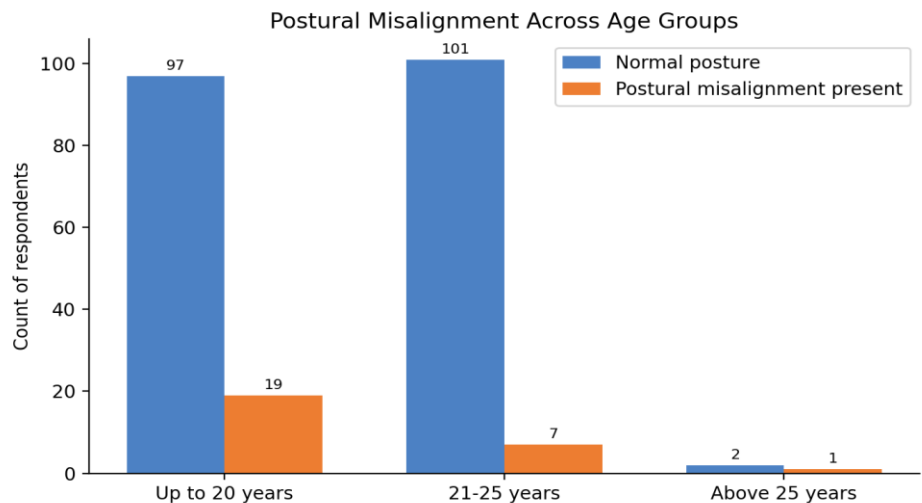


Figure 1: Distribution of Postural Misalignment across Age Groups among Participants

Figure 2 demonstrates the prevalence of lumbar lordosis in relation to gender and academic year. Female participants showed a marginally higher prevalence of lumbar lordosis compared to males, and prevalence was noticeably higher among students in the earlier academic years (1st and 2nd year) compared to senior students. This pattern aligns with the inferential findings, reinforcing that postural and spinal alignment issues are more concentrated among younger, junior-level students.

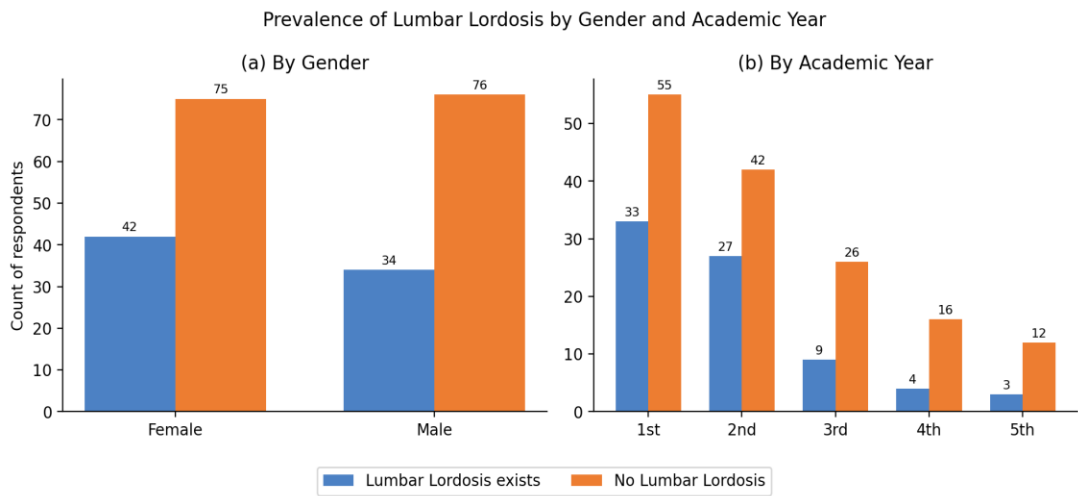


Figure 2: Prevalence of Lumbar Lordosis by Gender and Academic Year

A total of 227 university students participated in this study, and all completed the postural assessment and demographic questionnaire. The sample comprised 117 females (51.5%) and 110 males (48.5%). Regarding age, 116 participants (51.1%) were up to 20 years old, 108 (47.6%) fell within the 21–25 years bracket, and only 3 (1.3%) were above 25 years. The majority of respondents were single (98.2%), while 1.8% were married. In terms of academic level, most participants were enrolled in the 1st year (38.8%), followed by the 2nd year (30.4%), with progressively fewer in the 3rd, 4th, and 5th years. Only 12.3% of participants were employed, while 87.7% were unemployed. Assessment of the two primary outcome variables showed that postural misalignment was present in 27 participants (11.9%), while the majority (88.1%) displayed normal postural alignment. Lumbar lordosis, on the other hand, was identified in 76 participants (33.0%), while 151 (67.0%) showed no lordotic deviation. (Table 1)

Table 1: Demographic and descriptive characteristics of the participants.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	110	48.5
	Female	117	51.5
Age	Up to 20 years	116	51.1
	21–25 years	108	47.6
	Above 25 years	3	1.3
Marital Status	Single	223	98.2
	Married	4	1.8
Employment	Employed	28	12.3
	Unemployed	199	87.7
Postural Misalignment	Present	27	11.9
	Absent	200	88.1
Lumbar Lordosis	Present	76	33.0
	Absent	151	67.0

Relationship between postural misalignment and lumbar lordosis (Postural Misalignment x Lumbar Lordosis):

The chi-square value (χ^2) was 18.73 with a p-value less than 0.001. Since the p-value is below the 0.05 threshold, this association is considered highly statistically significant. This indicates that students exhibiting postural misalignment are considerably more likely to also present with lumbar lordosis, pointing toward a meaningful biomechanical relationship between overall posture and lumbar spinal curvature. (Table 2)

Relationship between marital status and postural misalignment (Marital Status x Postural Misalignment):

A statistically significant association was also found between marital status and postural misalignment ($\chi^2 = 5.64$, $p = 0.02$), suggesting that postural deviation patterns may differ across marital-status groups, although the married subgroup was small. In contrast, gender, academic year, and employment status showed no significant association with either outcome variable ($p > 0.05$). (Table 2)

Table 2: Association of postural misalignment and lumbar lordosis with demographic variables.

Association	Chi-Square Value (χ^2)	df	p-value	Result
Postural Misalignment x Lumbar Lordosis	18.73	1	<0.001	Significant
Marital Status x Postural Misalignment	5.64	1	0.02	Significant
Gender x Postural Misalignment	0.62	1	0.43	Not significant
Gender x Lumbar Lordosis	0.63	1	0.43	Not significant
Year of Education x Postural Misalignment	5.24	4	0.26	Not significant
Employment x Postural Misalignment	1.08	1	0.30	Not significant

DISCUSSION:

The present study investigated the prevalence of lumbar lordosis and postural misalignment among 227 university students, along with their association with selected demographic variables. The findings revealed a moderate burden of postural dysfunction in this population, with lumbar lordosis identified in 33.0% of participants and postural misalignment in 11.9%. These figures align with existing literature indicating that postural abnormalities are common among young adults, particularly those exposed to prolonged sitting and sedentary academic routines^[8].

A key finding of this study was the significant positive association between postural misalignment and lumbar lordosis ($\chi^2 = 18.73$, $p < 0.001$), suggesting that the two conditions share a common biomechanical pathway rather than occurring independently. This is consistent with previous research demonstrating that prolonged sitting directly disturbs pelvic alignment and increases lumbar curvature, particularly when seating posture is not ergonomically supported^[5]. Similarly, muscular imbalances, including weak abdominal and gluteal muscles paired with tight hip flexors, are central to the development of both pelvic tilt and exaggerated lumbar lordosis, which may in turn manifest as broader postural misalignment across the spine^[6].

The higher prevalence of both conditions among younger students (up to 20 years) and those in earlier academic years is noteworthy. This pattern may reflect greater dependence on smartphones and digital devices among younger cohorts, which has been linked to compensatory postural changes extending from the cervical region down through the lumbar spine^[7]. Previous research has similarly reported a high prevalence of postural abnormalities among university-aged populations, attributing this largely to sedentary lifestyle, and prolonged screen exposure, and insufficient physical activity, factors highly relevant to the present sample, in which the vast majority of participants (87.7%) were unemployed, full-time students likely to spend extended hours in academic sitting^[8].

Interestingly, demographic variables such as gender, academic year, and employment status showed no significant association with either outcome in this study, while marital status did ($\chi^2 = 5.64$, $p = 0.02$). This is broadly consistent with previous findings indicating that lifestyle and behavioral factors, particularly sedentary duration, tend to be stronger predictors of postural deviation than demographic characteristics alone^[14]. Similarly, ergonomic exposure and sitting duration, rather than age or gender per se, have been emphasized as primary drivers of postural change among students^[13].

The overall correlation between postural misalignment and lumbar lordosis ($r = 0.287$, $p < 0.01$), while statistically significant, was relatively weak in strength. This suggests that although the two conditions are meaningfully related, lumbar lordosis alone does not fully account for the variation seen in general postural misalignment. Previous research has indicated that alterations in lumbar curvature are associated with broader musculoskeletal pain patterns in sedentary populations, but such associations are typically multifactorial rather than governed by a single postural variable^[11]. Taken together, these findings reinforce that postural misalignment and lumbar lordosis in university students are shaped by an interacting set of behavioral and biomechanical factors, prolonged sitting, muscular imbalance, and digital device use, rather than demographic profile alone. This underscores the value of early postural screening and physiotherapy-based interventions, such as core strengthening and postural re-education, which have previously been shown to meaningfully improve spinal alignment in young adult populations^[16, 17].

Strengths and limitations of the study:

This study adds to the relatively limited local evidence on postural health among university students by using a statistically calculated sample size and standardized clinical assessment tools, namely the postural grid and plumb line method, to evaluate both outcome variables consistently across participants. The reasonably large sample ($n = 227$) allowed for meaningful statistical comparison across demographic subgroups.

However, several limitations should be acknowledged. The cross-sectional design restricts the ability to draw causal conclusions between postural misalignment, lumbar lordosis, and associated lifestyle factors. Reliance on a single institution limits the generalizability of findings to broader student populations. The plumb line and postural grid methods, while practical and low-cost, are subject to observer error and offer lower precision compared to imaging-based techniques such as radiographic Cobb angle assessment ^[18].

CONCLUSION:

The findings of this study reveal a notable burden of postural dysfunction among university students. Lumbar lordosis was identified in 33.0% of participants, while postural misalignment was present in 11.9%, with younger students showing comparatively higher rates of both conditions. Postural misalignment was slightly more common among male and employed participants, whereas demographic factors overall showed limited influence. A significant positive association was observed between postural misalignment and lumbar lordosis, indicating that the two conditions are meaningfully interconnected through shared biomechanical pathways rather than occurring in isolation. Overall, the data highlight those prolonged sitting, poor ergonomic habits, and sedentary academic routines are placing a considerable segment of the student population at risk, underscoring the need for early postural screening, ergonomic awareness, and physiotherapy-based interventions within university settings.

Recommendations:

Based on the findings of this study, several recommendations are proposed to guide future research and practice. Future studies should adopt probability-based sampling techniques, such as stratified or simple random sampling, and expand data collection to multiple universities to improve generalizability. Longitudinal or cohort designs are recommended to establish causal relationships, along with standardized measurement tools such as digital photogrammetry or radiographic Cobb angle assessment. Objective tracking of sitting duration and smartphone usage, along with controlling for confounders such as physical activity and BMI, would further strengthen future research.

Ethical Statement:

The study was conducted on sound ethical grounds, and the approval is obtained from Indus University, and the consent was taken from the participants before data collection and anonymity of participants were maintained.

Conflict of interest: There is no conflict of interest in the study.

Funding support: There was no funding source involved.

Author Contributions:

HM & AB: Conception and design of the study. HM: Acquisition of data and study execution. HM: Data analysis and interpretation. HM & AB: Critical review for intellectual content, proofreading, and final approval. OA: Facilitation and revision of the manuscript. All authors gave approval for the final manuscript.

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