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Association Between Daily Commute and Low Back Pain Among Students Using Local Transportation

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ABSTRACT

Background: Low back pain (LBP) is increasingly prevalent among young adults, with prolonged sitting and environmental exposures emerging as important contributors. University students in urban settings often experience extended daily commutes, yet evidence linking commute characteristics with LBP in this population remains limited. Objective: To examine the association between daily commuting patterns and low back pain among university students using local transportation. Methods: A cross-sectional study was conducted among 195 students at the University of Lahore who used bus-based local transport. Pain intensity was assessed using the Numeric Pain Rating Scale and functional disability using the Oswestry Disability Index. Daily commute duration and weekly commuting days were recorded. Associations were analyzed using chi-square tests and odds ratios with 95% confidence intervals. Results: The mean age was 20.51 ± 2.19 years, and 66.2% of participants reported LBP in the previous 12 months. Commute duration was significantly associated with LBP ($\chi^2 = 19.295$, $p < 0.001$). Compared with students commuting 1–2 hours daily, the odds of LBP were higher for 2–3 hours (OR 4.02; 95% CI 1.94–8.33) and 3–4 hours (OR 10.08; 95% CI 1.25–81.33). No significant association was found between LBP and the number of commuting days per week. LBP was strongly associated with higher functional disability ($p < 0.001$). Conclusion: Prolonged daily commute duration is a significant risk factor for low back pain and related disability among university students. Interventions targeting commute duration and ergonomic conditions may help reduce the early burden of LBP in young adults.

Keywords
Low back pain, commuting, university students, local transport, functional disability.

INTRODUCTION

Low back pain (LBP), typically defined as pain or discomfort between the inferior margin of the 12th rib and the gluteal folds with or without lower-limb radiation, is a leading cause of disability and healthcare utilization worldwide, yet it remains etiologically heterogeneous and difficult to attribute to a single causal pathway in most populations (1,2). Although LBP is often conceptualized as an adult condition, population evidence indicates a high lifetime burden with substantial recurrence, and epidemiologic patterns show that onset and escalation commonly occur in early adulthood—an age window that overlaps with university enrollment and the transition to prolonged sitting, academic stress, and reduced movement variability (3,4). In Pakistan, youth-focused evidence also suggests a growing burden of back and neck pain, reinforcing the relevance of studying modifiable exposures in younger cohorts rather than treating LBP as a late-onset phenomenon (5).

Multiple determinants—biological, behavioral, and environmental—have been associated with LBP. These include psychosocial stressors, reduced workplace or social support, lifestyle behaviors (e.g., smoking), and mechanical factors such as sustained postures, vibration exposure, and repetitive loading, with evidence that females and individuals with greater cumulative exposure to risk contexts can exhibit higher prevalence and functional impact (4,6). Postural behaviors established in adolescence and early adulthood, including prolonged static sitting and suboptimal seated alignment, have been linked with developing musculoskeletal symptoms and may plausibly contribute to persistent spinal discomfort through altered motor control and tissue loading over time (7). Body composition also matters; obesity and central adiposity have been associated with higher LBP prevalence in young adults, suggesting that even in relatively young groups, mechanical and metabolic factors can interact with lifestyle exposures to influence symptoms (8).

Commuting is a particularly relevant exposure in urban settings because it combines prolonged sitting, constrained postures, psychosocial stress, and—when travel occurs on uneven road networks—whole-body vibration that can increase lumbar loading and muscle activation demands (9,10). Time trade-offs attributable to long commutes may also displace sleep and health-promoting activities, which can indirectly amplify pain susceptibility and reduce recovery capacity (11). In Pakistan, commuting conditions are frequently shaped by infrastructure limitations and congestion, with substantial daily travel times reported in time-use research, making commute-related exposures a practical and contextually important target for student health research (12). Despite growing international literature linking longer commutes with musculoskeletal complaints, local evidence in Lahore focusing specifically on university students using local/university transportation—and differentiating commute frequency (days/week) from commute dose (duration/day)—remains limited, leaving uncertainty about which component of commuting most strongly relates to LBP occurrence and disability in this population.

Accordingly, in students (Population) who rely on local/university bus transportation (Context), this study evaluates whether commuting dose measured as duration per day and frequency measured as days per week (Exposure) are associated with LBP occurrence and related functional disability (Outcomes). The primary research question was: among university students using local transportation, is longer daily commute duration and/or a greater number of commuting days per week associated with higher prevalence of LBP and greater LBP-related disability?

MATERIALS AND METHODS

An observational cross-sectional study was conducted at the University of Lahore, Lahore, Pakistan, with data collection completed within a defined academic-period window consistent with the approved research timeline. The target population comprised university students who routinely used bus-based local/university transportation as their primary commuting mode. Participants were recruited using a non-probability convenience approach by inviting eligible students at common pickup/drop points and campus locations and through survey distribution channels. All participants provided informed consent prior to enrollment, and the study procedures were implemented after institutional ethical approval in accordance with human-subject research standards.

Eligibility criteria were specified to enrich the sample for students with meaningful commuting exposure while limiting competing clinical causes of back pain. Students of either sex aged <30 years were eligible, consistent with epidemiologic framing that LBP risk begins to rise in early adulthood (13). Participants were required to use bus-based local/university transport as the primary commute mode, commute at least 5 days per week to reflect routine exposure, and report ≥40 minutes of daily commuting duration to ensure sufficient exposure intensity for analysis (14,15). To reduce confounding by extremes of body composition, only students within the healthy BMI range (18.5–24.9 kg/m²) were included (16). Exclusion criteria comprised a history of LBP clearly attributable to non-commute causes, recent trauma or surgery, and known pre-existing metabolic or musculoskeletal disorders that could independently explain pain and disability patterns.

Data were collected using standardized patient-reported outcome measures alongside a structured commute-focused questionnaire developed for this study. Pain intensity was assessed using the 11-point Numeric Pain Rating Scale (NPRS), anchored from 0 (“no pain”) to 10 (“worst imaginable pain”), a widely used measure with established psychometric performance for musculoskeletal pain severity reporting (17). Functional disability attributable to LBP was measured using the Oswestry Disability Index (ODI), a validated instrument capturing limitations across daily activities and yielding interpretable disability categories based on summed item scoring (18). The study-specific questionnaire captured commuting characteristics (daily duration in minutes and weekly commuting days), and contextual commute factors relevant to exposure characterization (e.g., usual posture during commute and perceived comfort), collected either via paper forms or online submission using identical item wording to maintain measurement consistency.

The primary exposure variables were (i) daily commute duration, recorded in minutes and categorized into clinically interpretable time bands for association testing, and (ii) number of commuting days per week. The primary outcome was the presence of LBP within the preceding 12 months, operationalized as a binary variable (yes/no) derived from participant report. Secondary outcomes included pain frequency and NPRS-derived pain severity groupings, and ODI-derived disability categories. To mitigate information bias, participants received standardized instructions for completing NPRS and ODI items, and the data collection team applied uniform administration procedures across formats. Data integrity checks were performed at the point of entry to minimize transcription errors, and responses were screened for completeness and internal consistency prior to analysis.

A priori, potential confounding by age, sex, and BMI was considered because these variables may influence both commuting experience and pain reporting. The statistical analysis plan therefore included both unadjusted and adjusted approaches. Descriptive statistics were summarized as mean ± standard deviation for continuous variables and frequencies (percentages) for categorical variables. For primary unadjusted associations, Pearson’s chi-square test was used to examine relationships between LBP presence and commute-duration categories as well as commute-days categories. Effect size metrics for categorical associations were planned using odds ratios (ORs) with 95% confidence intervals derived from contingency tables and, where appropriate, from regression models. For adjusted inference, binary logistic regression was planned with LBP presence as the dependent variable and commute duration and commute days as key predictors, adjusting for age, sex, and BMI; adjusted odds ratios (aORs) with 95% CIs were specified as the primary interpretable effect estimates. Missing data handling was prespecified using complete-case analysis for primary models, accompanied by sensitivity checks comparing distributions of key variables between complete and incomplete records to assess potential missingness-related bias. Statistical significance was evaluated using a two-sided alpha threshold of 0.05. Analyses were performed in IBM SPSS Statistics (version 27.0).

RESULTS

A total of 195 students were included. The mean age was 20.51 ± 2.19 years (range 18–29), with a near-equal sex distribution (48.7% male, 51.3% female).

Table 1. Participant Characteristics (N = 195)

Variable	n / Mean ± SD	% / Range
Age (years)	20.51 ± 2.19	18–29
Sex (Male)	95	48.7
Sex (Female)	100	51.3
Body Mass Index (kg/m²)	21.43 ± 2.32	18.5–24.9
Commute days/week (5)	185	94.9
Commute days/week (6)	8	4.1
Commute days/week (7)	2	1.0
Commute duration (minutes/day)	125.54 ± 46.55	45–300
LBP in last 12 months (Yes)	129	66.2
LBP in last 12 months (No)	66	33.8

Table 2. Pain Frequency and Pain Severity Distribution 2.A. Frequency of pain among those with LBP (n = 129)

Pain Frequency	n	% (of total N=195)	% (of LBP group n=129)
Rarely	35	17.9	27.1
Occasionally	32	16.4	24.8
Frequently	39	20.0	30.2
Constantly	23	11.8	17.8
No pain / not applicable	66	33.8	—

2.B. NPRS-derived pain intensity categories (N = 195)

Pain Intensity Category	n	%
No pain	66	33.8
Mild pain	30	15.4
Moderate pain	66	33.8
Severe pain	33	16.9

The mean BMI was 21.43 ± 2.32 kg/m². Most participants commuted 5 days/week (94.9%), while 4.1% commuted 6 days/week and 1.0% commuted 7 days/week. The mean daily commute duration was 125.54 ± 46.55 minutes (range 45–300 minutes). Overall, 66.2% (129/195) reported LBP in the last 12 months. Among participants reporting LBP, the most frequent pattern was "frequently" (30.2% of LBP cases), followed by "rarely" (27.1%), "occasionally" (24.8%), and "constantly" (17.8%). In the full sample, moderate pain and no pain were equally represented (each 33.8%), while 16.9% reported severe pain and 15.4% reported mild pain.

Table 3. Association Between LBP Presence and Commute Days per Week (Chi-square)

Commute Days/Week	LBP Yes n (%)	LBP No n (%)	Total	Pearson χ^2	p-value	Cramer's V
5 days	119 (64.3)	66 (35.7)	185			
6 days	8 (100.0)	0 (0.0)	8			
7 days	2 (100.0)	0 (0.0)	2	5.393	0.067	0.166
Total	129 (66.2)	66 (33.8)	195			

Effect size (Odds ratio; reference = 5 days/week; Haldane correction applied due to zero cells):

Comparison (vs 5 days/week)	OR	95% CI
6 days/week vs 5 days/week	9.46	0.54–166.51
7 days/week vs 5 days/week	2.78	0.13–58.82

LBP prevalence was 64.3% among students commuting 5 days/week, while 100% of those commuting 6 or 7 days/week reported LBP. However, the overall association did not reach statistical significance ($\chi^2 = 5.393$, $p = 0.067$), though the effect suggested a possible trend. The effect estimates for 6–7 commuting days had wide confidence intervals due to very small subgroup sizes, limiting precision.

Table 4. Association Between LBP Presence and Daily Commute Duration (Chi-square + ORs)

Daily Commute Duration	LBP Yes n (%)	LBP No n (%)	Total	Pearson χ^2	p-value	Cramer's V
< 1 hour	11 (64.7)	6 (35.3)	17			
1–2 hours	48 (52.2)	44 (47.8)	92			
2–3 hours	57 (81.4)	13 (18.6)	70			
3–4 hours	11 (91.7)	1 (8.3)	12			
4–5 hours	2 (50.0)	2 (50.0)	4	19.295	<0.001	0.315
Total	129 (66.2)	66 (33.8)	195			

4.A Effect size (Odds ratio; reference = 1–2 hours):

Duration Category	OR vs 1–2 hours	95% CI
< 1 hour	1.68	0.57–4.93
2–3 hours	4.02	1.94–8.33
3–4 hours	10.08	1.25–81.33
4–5 hours	0.92	0.12–6.79

Table 5. Association Between LBP Presence and ODI Disability Level (Chi-square)

ODI Disability Level	LBP Yes n (%)	LBP No n (%)	Total	Pearson χ^2	p-value	Cramer's V
No disability	14 (29.8)	33 (70.2)	47			
Mild disability	64 (73.6)	23 (26.4)	87			
Moderate disability	36 (81.8)	8 (18.2)	44			
Severe disability	15 (88.2)	2 (11.8)	17	38.418	<0.001	0.444
Total	129 (66.2)	66 (33.8)	195			

There was a statistically significant association between commute duration and LBP ($\chi^2 = 19.295$, $p < 0.001$), with a moderate association strength (Cramer's V = 0.315). LBP prevalence increased from 52.2% in the 1–2 hour group to 81.4% in the 2–3 hour group and peaked at 91.7% in the 3–4 hour group. Compared with the 1–2 hour reference category, the odds of LBP were approximately 4-fold higher for 2–3 hours (OR 4.02; 95%

CI 1.94–8.33) and 10-fold higher for 3–4 hours (OR 10.08; 95% CI 1.25–81.33). The 4–5 hour category showed unstable estimates because only four participants were in that group.

A strong association was found between LBP presence and functional disability category ($\chi^2 = 38.418$, $p < 0.001$; Cramer's V = 0.444). Among those reporting LBP, 49.6% were classified as mild disability and 27.9% as moderate disability, while 11.6% had severe disability. In contrast, among students without LBP, half fell into the "no disability" category and only 3.0% were classified as severe disability. This demonstrates clinically meaningful functional consequences associated with LBP in the student commuter population.

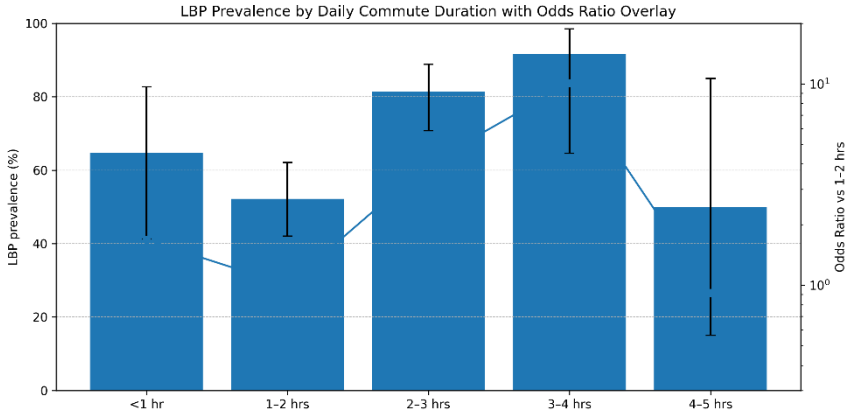

Figure 1. LBP Prevalence by Daily Commute Duration with Odds Ratio Overlay

This integrated figure demonstrates a nonlinear dose-response pattern between commute duration and LBP. LBP prevalence was lowest in the 1–2 hour category (52.2%; 48/92), increased sharply in the 2–3 hour category (81.4%; 57/70), and peaked in the 3–4 hour category (91.7%; 11/12). Relative to the 1–2 hour reference group, the odds of LBP rose approximately fourfold for 2–3 hours (OR 4.02; 95% CI 1.94–8.33) and approximately tenfold for 3–4 hours (OR 10.08; 95% CI 1.25–81.33), reinforcing a clinically important threshold effect beyond 2 hours of daily commuting, with widening uncertainty in extreme-duration groups due to low subgroup sizes.

DISCUSSION

This study investigated the association between daily commuting characteristics and low back pain among university students using local transportation in Lahore, Pakistan. The principal finding was a strong, statistically significant relationship between daily commute duration and the presence of low back pain, whereas the number of commuting days per week showed no independent association. These findings highlight commute duration as the dominant exposure influencing musculoskeletal health in this young population, supporting the hypothesis that cumulative daily mechanical and postural load rather than weekly frequency is more relevant to low back pain development.

The observed LBP prevalence of 66.2% aligns with prior reports indicating a rising burden of musculoskeletal pain among young adults and university students, particularly in low- and middle-income urban settings (19,20). Although LBP is traditionally viewed as an adult or occupational condition, epidemiological data increasingly show that symptom onset frequently occurs in early adulthood, often linked to lifestyle transitions involving prolonged sitting, reduced physical activity, and sustained postural strain (21). The high prevalence in this study may reflect the compounded effect of extended daily sitting, constrained seating postures, and limited opportunity for postural variation during long bus commutes.

Commute duration demonstrated a clear dose–response relationship with LBP. Students commuting 2–3 hours daily had approximately fourfold higher odds of LBP, while those commuting 3–4 hours daily exhibited nearly tenfold higher odds compared with the 1–2 hour reference group. This nonlinear escalation is consistent with international literature reporting that prolonged commuting is associated with musculoskeletal complaints, fatigue, and reduced well-being (22,23). Mechanistically, extended sitting increases lumbar disc pressure, reduces paraspinal muscle perfusion, and promotes sustained flexed postures, all of which may predispose individuals to pain through cumulative microtrauma and neuromuscular fatigue (24,25). In addition, exposure to whole-body vibration during bus travel on uneven road infrastructure—common in Lahore—may further amplify lumbar loading and muscle activation, accelerating symptom development (26,27).

In contrast, the number of commuting days per week was not significantly associated with LBP, despite a trend toward higher prevalence among students commuting more than five days weekly. This lack of statistical significance is likely attributable to limited variability in the exposure, as nearly 95% of participants commuted exactly five days per week, and very few students reported six or seven commuting days. Similar findings have been reported in other commuter studies, where duration and intensity of exposure outweighed frequency when variability in days was minimal (28). These results suggest that interventions aimed at reducing daily commute duration or mitigating its ergonomic impact may be more effective than reducing commute frequency in student populations.

The strong association between LBP and functional disability further underscores the clinical relevance of the findings. Nearly 40% of students with LBP experienced moderate-to-severe disability, whereas half of students without LBP reported no disability. This gradient mirrors findings from studies in undergraduate and working populations, where even non-specific LBP has been shown to substantially impair daily functioning, academic performance, and quality of life (29,30). Importantly, no participants fell into the "completely disabled" category, reflecting the relatively young and otherwise healthy nature of the cohort, yet the observed disability burden remains concerning given the long-term implications of early-onset musculoskeletal pain.

Comparisons with previous regional and international studies reinforce the external validity of the results. Studies from Korea, Bangladesh, and Europe have consistently demonstrated associations between longer commuting times and musculoskeletal pain, burnout, and reduced physical activity (14,22,31). While many of these investigations focused on workers rather than students, the underlying exposure pathways—prolonged sitting, vibration, stress, and time displacement—are shared, suggesting that students may represent an equally vulnerable group. The present study

contributes novel evidence from Lahore, addressing a contextual gap in South Asian student populations where commuting challenges are pronounced yet under-researched.

Several limitations should be considered when interpreting these findings. The cross-sectional design precludes causal inference, and reverse causation—where students with existing LBP perceive commuting as more burdensome—cannot be fully excluded. Self-reported measures may introduce recall bias, particularly for 12-month pain prevalence. Additionally, the use of convenience sampling and restriction to a single university may limit generalizability. However, strict inclusion criteria, validated outcome measures, and consistency with prior literature strengthen the internal validity and interpretability of the results.

Overall, the findings emphasize that prolonged daily commuting is not merely an inconvenience but a measurable health risk for university students, with tangible implications for pain and functional capacity. Addressing commute-related exposures should therefore be considered part of broader musculoskeletal health promotion strategies in academic institutions.

CONCLUSION

In conclusion, this study demonstrates that prolonged daily commute duration is significantly associated with increased prevalence of low back pain and greater functional disability among university students using local transportation, whereas the number of commuting days per week shows no independent association. These findings suggest that reducing daily commute duration or mitigating its ergonomic and mechanical impact may play a critical role in preventing early-onset low back pain and preserving functional health in young adult populations.

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