

**Prevalence and Association of Upper Limb Musculoskeletal Problems and Low Back Pain
with Prolonged Sketching Among Architecture Students: A Cross-Sectional Study**

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ABSTRACT

Background: Architecture students engage in prolonged sketching that requires sustained bending, repetitive upper-limb movement, and static postures. Although international literature links prolonged drafting to musculoskeletal disorders, data on architecture students in Pakistan, particularly Karachi, remain scarce.

Objective: To determine the prevalence of upper limb musculoskeletal problems and low back pain (LBP) among architecture students and to examine their association with prolonged sketching.

Methods: A cross-sectional study was conducted among 169 undergraduate architecture students recruited via non-probability convenience sampling from institutions across Karachi. Data were collected using the Extended Nordic Musculoskeletal Questionnaire (NMQ) over six months. Descriptive statistics, Pearson correlation, and chi-square tests were used for analysis (SPSS v29; $p < 0.05$).

Results: Upper limb musculoskeletal problems were reported by 93.5% of participants, and 68.64% reported LBP. Among students with LBP, 95.7% also had upper limb symptoms, indicating substantial symptom clustering. Sketching duration and years of experience showed no significant independent association with symptom prevalence. However, gender ($\chi^2 = 5.78$, $p = 0.02$) and exercise routine ($\chi^2 = 8.11$, $p = 0.02$) were significantly associated with LBP: females reported higher prevalence (74.4%) than males (55.8%), and daily exercisers reported lower prevalence (43.5%) than non-exercisers (73.8%).

Conclusion: Architecture students carry a substantial, multi-site musculoskeletal burden from prolonged sketching, yet 88.8% had never sought professional consultation. Findings support incorporating ergonomic education, adjustable workstations, structured rest breaks, and exercise promotion into architecture curricula.

Keywords: Musculoskeletal pain; Low back pain; Prevalence; Architecture students; Sketching; Nordic Musculoskeletal Questionnaire

INTRODUCTION

Architects and architecture students form a distinct occupational group whose creative work exposes them to a cluster of musculoskeletal risk factors. Hours of static sitting, repetitive hand and wrist movement,

and awkward upper-limb and spinal postures accumulate during the process of translating a design vision onto paper. While the finished work aims to enhance human comfort, the process of producing it often exacts a physical toll on its creators.

Cross-sectional evidence from undergraduate architecture cohorts indicates that students aged 19–25 years who engage in extended design sessions involving sustained sitting and repetitive upper-limb activity are particularly vulnerable to musculoskeletal strain, and that practicing architects with more than a year of experience show comparable exposure through continuous project-based drafting. The most affected anatomical regions are typically the cervical spine, lumbar spine, shoulders, and upper extremities, all of which are subjected to continuous static loading during sketching and drafting.

Global prevalence estimates for musculoskeletal pain among architects and related professions often exceed 80–90% for at least one body region annually, with Saudi Arabian architecture students reporting a 94.3% annual prevalence. Regional data from Pakistan are more limited: a Lahore-based study of practicing architects reported neck pain in 65.9%, wrist/hand pain in 49.3%, and shoulder pain in 27.0% of participants, while Indian data report roughly 80% prevalence among practicing architects.

Despite this evidence base, most existing studies examine drafting or computer-assisted design broadly rather than isolating sketching as a distinct exposure, and few explore the co-occurrence of upper-limb dysfunction and low back pain within the same population. Understanding whether these conditions cluster together may offer more actionable insight for ergonomic intervention. This study therefore aimed to determine the prevalence of upper limb musculoskeletal problems and low back pain among architecture students in Karachi engaged in prolonged sketching, and to examine the association between prolonged sketching and these two conditions.

Hypotheses: H_0 — there is no significant association between prolonged sketching and the prevalence of upper limb musculoskeletal dysfunction and low back pain among architecture students; H_a — a significant association exists.

METHODOLOGY

Study Design and Setting

A cross-sectional design was used to estimate the prevalence and association of upper limb musculoskeletal disorders and low back pain with prolonged sketching among architecture students. Data were collected across multiple architecture institutions of varying scale in Karachi over a six-month period following synopsis approval, to enhance the generalizability of findings.

Sample Size and Sampling

The minimum required sample size of 169 was calculated using Raosoft software, based on a finite population of 300, an expected response distribution of 50%, a 95% confidence level, and a 5% margin of error. A non-probability convenience sampling technique was used to recruit eligible undergraduate architecture students.

Eligibility Criteria

Inclusion: Age 18–40 years; both genders; involvement in sketching for more than 2 hours daily; willingness to participate.

Exclusion: History of trauma or fracture of the upper limb or spine; diagnosed musculoskeletal or neurological disorders; recent surgery (within 6 months); pregnancy.

Variables and Data Collection

The independent variable was sketching duration; dependent variables were upper limb pain (elbow, shoulder, neck, wrist/hand) and low back pain. Data were collected in person using a structured, self-administered Extended Nordic Musculoskeletal Questionnaire (NMQ), assessing discomfort across nine body regions over the preceding 12 months and 7 days, alongside a demographic section (age, gender, years of experience, hand dominance, working hours).

Data Analysis

Data were analyzed in SPSS version 29. Descriptive statistics (means, standard deviations, frequencies, percentages) summarized demographic and exposure variables. Pearson correlation examined inter-relationships among the nine NMQ body regions. Chi-square tests assessed associations between exposure/demographic variables and reported musculoskeletal outcomes, with $p < 0.05$ considered significant. Diagnostic checks included Cronbach's alpha (reliability), variance inflation factor (multicollinearity), Shapiro-Wilk (normality), and Levene's test (homogeneity of variance).

RESULTS

Sample Characteristics

A total of 169 architecture students participated. The sample was predominantly young (46.7% aged ≤ 20 years, 45.0% aged 21–23 years) and female (69.2%, $n=117$). Most participants were in their second (24.9%) or third (25.4%) year of study, with 1–3 years (35.5%) or 3–5 years (30.8%) of sketching experience. Daily sketching duration was concentrated in the 1–2 hour range (43.8%). The sample was overwhelmingly right-handed (98.2%). Most participants (63.3%) followed no regular exercise routine, and only 11.2% had ever consulted a doctor for their symptoms.

Prevalence of Upper Limb Musculoskeletal Problems and Low Back Pain

Upper limb musculoskeletal problems were reported by 158 of 169 participants (93.5%), while 116 participants (68.64%) reported low back pain. Symptom clustering was pronounced: among students with low back pain, 95.7% (111/116) also reported upper limb problems, and among students with upper limb problems, 70.3% (111/158) also reported low back pain.

Outcome	n/N	Prevalence (%)
Upper limb musculoskeletal problems	158/169	93.5
Low back pain (LBP)	116/169	68.64
Upper limb problems among those with LBP	111/116	95.7
LBP among those with upper limb problems	111/158	70.3
Never sought doctor/professional consultation	150/169	88.8

Correlation Between Body Regions

Pearson correlation analysis showed moderate positive associations between neck and shoulder pain ($r=0.5$) and between neck and upper back pain ($r=0.4$), consistent with the biomechanical demands of sustained forward-head posture during sketching. Hip/thigh pain correlated moderately with knee pain ($r=0.4$), and wrist pain showed positive associations with broader upper-limb complaints ($r=0.2-0.4$), supporting the role of repetitive hand movement and sustained gripping in cumulative upper-limb strain. Overall, symptoms tended to occur in anatomically related clusters rather than in isolation.

Chi-Square Analysis of Associations

Most demographic and exposure variables — including age, year of study, sketching experience, sketching duration, hand dominance, and doctor consultation — showed no statistically significant association with either upper limb problems or low back pain (all $p>0.05$). Two significant associations emerged for low back pain:

Variable	χ^2	p-value	Result
Gender – LBP	5.78	0.02	Significant (females 74.4% vs males 55.8%)
Exercise routine – LBP	8.11	0.02	Significant (daily exercisers 43.5% vs non-exercisers 73.8%)

Diagnostic Checks

The NMQ demonstrated good internal consistency (Cronbach's $\alpha = 0.814$ across 36 sub-scales). All variance inflation factors were below 10, indicating no problematic multicollinearity. Shapiro-Wilk testing confirmed non-normal distribution of variables, consistent with their categorical nature and supporting the use of non-parametric chi-square analysis. Levene's test showed mixed homogeneity of variance across subgroups, particularly for low back pain, reinforcing the appropriateness of non-parametric methods for this dataset.

DISCUSSION

This study found an exceptionally high prevalence of upper limb musculoskeletal problems (93.5%) and low back pain (68.64%) among architecture students in Karachi, figures that align with — and in the case of upper-limb complaints, exceed — prevalence rates reported among architecture students and architects in Saudi Arabia, India, and Lahore. The strong co-occurrence between upper-limb and low back symptoms (95.7% overlap) supports the hypothesis that prolonged sketching generates widespread biomechanical loading across multiple body segments simultaneously rather than isolated, single-region injury.

Notably, neither sketching duration nor years of sketching experience showed an independent statistical association with symptom prevalence. This suggests that once a student is enrolled in an architecture program, the risk of developing musculoskeletal symptoms is pervasive across virtually all exposure levels — an interpretation consistent with correlation findings showing symptom clustering across

anatomically linked regions such as the neck, shoulder, and upper back.

The significant association between gender and low back pain, with a higher prevalence among female students, mirrors findings in several regional studies and may reflect differences in posture, pain perception, or workload distribution during studio activities, though this study cannot isolate the underlying mechanism. Similarly, the protective association observed for daily exercise is consistent with established evidence that physical conditioning improves muscular endurance, spinal stability, and postural control, thereby reducing lumbar strain.

A particularly striking finding was that 88.8% of participants had never consulted a healthcare professional despite the high symptom burden, suggesting that architecture students may normalize musculoskeletal discomfort as an unavoidable part of their academic training. This pattern, if left unaddressed, risks the progression of manageable discomfort into chronic disability later in professional practice.

Limitations

The cross-sectional design precludes causal inference between sketching and musculoskeletal outcomes. Non-probability convenience sampling from selected institutions limits generalizability. Reliance on a self-administered questionnaire introduces potential recall and social desirability bias, particularly around exercise habits and health-seeking behavior. The study did not capture workstation ergonomics, psychosocial stress, or academic workload, all of which may independently contribute to musculoskeletal symptoms.

Recommendations

Future research should employ longitudinal designs and probability-based sampling to strengthen causal inference and generalizability, and should incorporate objective ergonomic assessment alongside self-report tools. Academic institutions should consider integrating ergonomic training, adjustable drafting furniture, structured rest breaks, and encouragement of regular physical activity into architecture curricula, alongside education to promote earlier symptom reporting and timely professional consultation.

CONCLUSION

Architecture students engaged in prolonged sketching experience a substantial and frequently co-occurring burden of upper limb musculoskeletal problems and low back pain. While exposure duration and experience did not independently predict symptom prevalence, gender and exercise routine emerged as significant correlates of low back pain. Despite high symptom prevalence, professional consultation remained rare, underscoring a systemic tendency to normalize occupational discomfort in architectural education. These findings support the introduction of ergonomic education, adjustable workstations, structured rest breaks, and physical activity promotion to protect the long-term musculoskeletal health of future architects.

DECLARATIONS

Ethical approval: Institutional permission was obtained from the Department of Allied Health Sciences, Indus University. Written informed consent was obtained from all participants prior to data collection; participation was voluntary and confidential.

Conflict of interest: The authors declare no conflict of interest.

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