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Original Article

Prevalence of Neurological Symptoms of the Upper Limb in Relation to Daily Screen Time and Desk Ergonomics: A Cross-Sectional Study

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ABSTRACT

Background: With the rapid expansion of digital screen use and the growing shift toward remote and computer-based work, work-related musculoskeletal disorders have become increasingly common. However, the neurological component of screen-related occupational exposure, particularly neuropathic pain in relation to prolonged screen time and workstation ergonomics, remains insufficiently explored. Objective: This study aimed to determine the prevalence of neuropathic pain among individuals with high daily screen exposure and to examine the relative contribution of cumulative screen time and desk ergonomic factors to neuropathic symptom burden. Methods: A cross-sectional observational study was conducted among 385 participants, including students, teaching staff, and administrative employees at the University of Lahore, Pakistan. Neuropathic pain was screened using the validated Self-Administered Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS), with a cut-off score of ≥12 indicating likely neuropathic pain. Ergonomic and postural characteristics were assessed using a structured proforma. Data were analysed using IBM SPSS version 27, and associations were examined through chi-square tests, odds ratios, and binary logistic regression. Results: Likely neuropathic pain was identified in 42.3% of participants. Forward head posture showed the strongest association with neuropathic pain (OR = 4.89, 95% CI: 3.09–7.74, p < .001), followed by deviated wrist posture (OR = 4.41), use of a non-adjustable workstation (OR = 4.15), and resting the elbows on a hard surface (OR = 1.79). Daily screen time was also significantly associated with neuropathic pain, with each additional hour of screen exposure increasing the odds by 24% (OR = 1.24, 95% CI: 1.15–1.34, p < .001). Conclusion: Neuropathic pain was prevalent among individuals with prolonged screen exposure, with poor posture, inadequate workstation ergonomics, and increased daily screen time emerging as important associated factors. These findings highlight the need for targeted ergonomic education, workstation modification, and postural correction strategies to reduce neuropathic symptom burden in screen-based academic and occupational populations. Keywords: neuropathic pain; S-LANSS; forward head posture; ergonomics; screen time; upper limb; cross-sectional study.

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INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) represent a substantial and growing occupational health burden in the digital era, particularly among populations engaged in prolonged computer and smartphone use. A systematic review of work-related musculoskeletal disorders among computer users identified sustained static postures, repetitive motion, and inadequate workstation ergonomics as principal risk determinants (1). The biomechanical evidence linking smartphone use to musculoskeletal complaints of the neck, shoulder, and upper extremities has been comprehensively documented (2), with cross-sectional data confirming that device-specific postural variations, including sustained neck flexion, single-handed grip, and lateral recumbent use, are significantly associated with regional musculoskeletal pain (3). The COVID-19 pandemic precipitated an unprecedented global transition to remote and hybrid working arrangements, with studies estimating that approximately 30–40% of the European workforce adopted telework during the pandemic period (4,5). This transition introduced novel occupational ergonomic challenges, as domestic environments frequently lacked the adjustable workstation infrastructure of traditional office settings, thereby amplifying exposure to suboptimal postures and sustained static loading (6,7). Studies conducted during the pandemic documented significantly elevated prevalence of postural deviations and musculoskeletal symptoms among university communities working from home (8), while a systematic review and meta-analysis confirmed that online learning environments were associated with increased musculoskeletal symptom prevalence attributable to prolonged static posture, inadequate ergonomics, and physical inactivity (9,10).

The contribution of workstation ergonomics to musculoskeletal health has been established across diverse occupational and educational settings. An evaluation of computer workstations in a Bangladeshi university identified ergonomic deficiencies as significant correlates of musculoskeletal symptoms, with 47% of participants reporting shoulder pain and 25% reporting neck pain (11). Systematic reviews have demonstrated significant associations between sedentary behavior and the prevalence of neck and shoulder disorders in adults (12,13), while studies among college students confirmed that daily computer usage duration and device type predict musculoskeletal discomfort in the cervical, shoulder, and lumbar regions (14,15). Postural kinematics differ substantially across device types, with laptop use inducing greater cervical flexion and shoulder protraction than desktop computer configurations (16). Among remote computer workers, musculoskeletal disorder prevalence has been associated with prolonged daily screen duration, non-ergonomic workstation setups, and absence of scheduled microbreaks (17).

Beyond musculoskeletal manifestations, accumulating evidence indicates that sustained screen use combined with poor ergonomic conditions generates compressive and tensile mechanical loads capable of producing peripheral neuropathies of the upper limb (18,19). Carpal tunnel syndrome (CTS), the most prevalent compressive neuropathy of the upper extremity, has been linked to repetitive and sustained nonneutral wrist postures during keyboard and mouse use, with biomechanical studies demonstrating acute morphological changes in the median nerve following keyboarding tasks (20). A meta-analysis confirmed that non-neutral wrist postures during occupational tasks increase CTS risk by up to twofold (21), supported by sonographic reference data documenting increased median nerve cross-sectional area among symptomatic populations (22). Among computer-using bankers in Ethiopia, a significant dosedependent association between CTS prevalence and cumulative computer use duration has been reported (23). Cubital tunnel syndrome (CuTS), the second most common compressive neuropathy of the upper extremity, has been associated with occupational activities involving repetitive or sustained elbow flexion (24), with population-based epidemiological data identifying significant associations with occupations requiring prolonged upper limb positioning (25). Electrodiagnostic evidence confirms that ulnar nerve strain increases substantially at elbow flexion angles exceeding 135 degrees, a posture frequently adopted during mobile device use (26).

Forward head posture (FHP), a postural deviation highly prevalent among screen users, has been established as an independent risk factor for neck pain through systematic review and meta-analytic evidence (27). Cross-sectional studies from diverse populations have confirmed associations between smartphone use intensity and neck pain prevalence (28), between cumulative screen time and both visual disorders and cervical pain among university students (29), and between habitual screen exposure and neck and shoulder pain across age groups (30). Postural correction strategies, including standing desk use, have demonstrated measurable improvements in craniovertebral angle in individuals with established FHP (31). Critically, the neurological implications of FHP extend beyond musculoskeletal pain: a controlled study demonstrated that one hour of sustained computer use produced statistically significant decreases in sensory conduction velocity of both the ulnar and median nerves in office workers with symptomatic neck pain, establishing a direct pathophysiological link between cervical postural loading and peripheral nerve compromise (32).

Despite this expanding body of evidence, the existing literature has predominantly addressed the musculoskeletal consequences of prolonged screen exposure. The specific neurological dimension, the prevalence of neuropathic pain in relation to daily screen duration and workstation ergonomic conditions, remains insufficiently quantified. This knowledge gap carries substantial clinical and public health implications: if neurological symptoms are driven primarily by cumulative screen exposure, populationlevel messaging to reduce screen time is warranted; conversely, if workstation ergonomic failure constitutes the dominant risk driver, targeted structural interventions at the organizational level offer greater preventive potential. The validated Self-report Leeds Assessment of

Neuropathic Symptoms and Signs (S-LANSS) provides a standardized screening instrument for identifying pain of predominantly neuropathic origin in epidemiological settings (33).

This study therefore aimed to determine the prevalence of neuropathic pain, as identified by the S-LANSS screening tool, among students, teaching staff, and administrative employees with high daily screen exposure at a university setting in Lahore, Pakistan, and to examine the relative contributions of cumulative daily screen time and workstation ergonomic conditions (workstation adjustability, head posture, elbow position, and wrist alignment) to this symptom burden.

MATERIALS AND METHODS

A quantitative cross-sectional observational study was conducted at the University of Lahore, Pakistan, encompassing students, teaching staff, and administrative employees across four faculties and associated administrative centers. The institutional population at the time of data collection comprised approximately 1,045 eligible individuals. Data collection was completed within a six-month period following institutional ethics approval. The study was designed to estimate the prevalence of neuropathic pain among screen-based workers and to examine the associations between daily screen time, workstation ergonomic conditions, and neuropathic symptom burden.

The sample size was calculated using Cochran's formula for finite populations, applying a 95% confidence level, a 5% margin of error, and an assumed prevalence proportion of 50% to maximize the required sample size in the absence of prior local prevalence data, with finite population correction applied for the known institutional population of N = 1,045. This calculation yielded a minimum required sample of 281 participants; however, to enhance statistical power and accommodate potential incomplete responses, a total of 385 participants were recruited. Non-probability convenience sampling was employed to enroll participants meeting the eligibility criteria through institutional communication channels.

Participants were eligible for inclusion if they were currently enrolled students, teaching staff, or administrative employees at the University of Lahore; reported a minimum of four hours of daily screen use for academic or occupational purposes; were aged 18 years or older; and provided written informed consent. Participants were excluded if they had a previously diagnosed neurological condition, including peripheral neuropathy, multiple sclerosis, or cervical myelopathy; a history of upper limb trauma or surgical intervention within the preceding 12 months; were currently receiving physiotherapy or medical treatment for upper limb musculoskeletal or neurological conditions; or were unable to complete the study questionnaire independently.

Data were collected through a self-administered online questionnaire distributed to eligible participants via institutional communication channels. The questionnaire comprised two validated components. Neuropathic pain was assessed using the Self-report Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS), a validated 7-item screening instrument with a total scoring range of 0–24, in which a score of ≥12 indicates that pain is likely to be predominantly neuropathic in origin (33). Ergonomic and postural data were collected via a structured self-assessment proforma adapted from established computer workstation ergonomic assessment guidelines. The proforma captured the following variables: primary digital device used for work or study (laptop, desktop, or tablet/smartphone), structural type of workstation setup (dedicated adjustable or non-adjustable/improvised), presence or absence of forward head posture, biomechanical elbow position during device use (resting on a hard surface or neutral/supported), and biomechanical wrist posture during device use (neutral or deviated). Participants also reported their average daily screen time in hours and their primary work environment (office-based, remote/hybrid, or other). Demographic variables including age and gender were recorded.

Statistical analyses were performed using IBM SPSS Statistics version 27.0. Descriptive statistics were computed for all study variables: frequencies and percentages were reported for categorical variables, while continuous variables were expressed as mean ± standard deviation (SD). The S-LANSS outcome was dichotomized as neuropathic pain likely (score ≥12) versus neuropathic pain unlikely (score <12). Chisquare tests of independence were used to examine bivariate associations between categorical ergonomic and postural variables (forward head posture, workstation type, elbow position, and wrist posture) and SLANSS screening category. Crude odds ratios (OR) with 95% confidence intervals (CI) were calculated from the resulting 2 × 2 contingency tables to quantify the strength of each association. The phi coefficient (φ) was computed as a measure of effect size for dichotomous associations. Binary logistic regression was performed to model the independent effect of average daily screen time, entered as a continuous predictor, on the likelihood of neuropathic pain. Model performance was assessed using the Wald statistic and overall classification accuracy. Statistical significance was set at $\alpha = 0.05$ for all analyses.

The study was conducted in accordance with the principles of the Declaration of Helsinki and the guidelines of the Institute Research Ethics Board (IREB) of the University of Lahore. Ethical approval was obtained from the IREB prior to commencement of data collection. Written informed consent was obtained from all participants, who were informed that participation was entirely voluntary and that withdrawal was permitted at any stage without consequence. Anonymity and confidentiality of all participant data were maintained throughout the study.

RESULTS

A total of 385 participants were included in the study, comprising 165 males (42.9%) and 220 females (57.1%), with a mean age of 28.55 ± 6.99 years (range: 18–40 years). The majority of participants worked in an office-based setting (51.7%), followed by remote or hybrid arrangements (41.6%). Laptops were the primary digital device used for work or study (65.7%), and the majority of participants reported using nonadjustable or improvised workstations (65.2%). Forward head posture was present in 57.9% of participants, deviated wrist posture in 77.1%, and hard-surface elbow resting in 56.9%. Neuropathic pain was classified as likely (S-LANSS ≥12) in 163 participants, yielding an overall prevalence of 42.3% (Table 1).

Table 1. Sociodemographic, Work-Related, and Ergonomic Characteristics of Participants (N = 385)

Variable	n (%) or Mean ± SD
Age (years), Mean ± SD	28.55 ± 6.99
Gender	
Male	165 (42.9)
Female	220 (57.1)
Work Environment Office-based	199 (51.7)
Remote/Hybrid	160 (41.6)
Other	26 (6.8)
Primary Digital Device Laptop	253 (65.7)
Desktop	107 (27.8)
Tablet/Smartphone	25 (6.5)
Workstation Type	
Dedicated Adjustable	134 (34.8)
Non-adjustable/Improvised	251 (65.2)
Forward Head Posture Present	223 (57.9)
Absent	162 (42.1)
Elbow Position During Device Use Resting on Hard Surface	219 (56.9)
Neutral/Supported	166 (43.1)
Wrist Posture During Device Use Neutral	88 (22.9)
Deviated	297 (77.1)
S-LANSS Screening Category Neuropathic Pain Likely (≥12)	163 (42.3)
Neuropathic Pain Unlikely (<12)	222 (57.7)

Table 2. Association of Ergonomic and Postural Factors with Neuropathic Pain (S-LANSS ≥12)

Factor	Pain Unlikely n (%)	Pain Likely n (%)	OR (95% CI)	χ^2	ϕ	p
FHP Present	95 (42.6)	128 (57.4)	4.89 (3.09–7.74)	49.245	0.358	<.001
FHP Absent	127 (78.4)	35 (21.6)	Ref	–	–	–
Non-adjustable WS	117 (46.6)	134 (53.4)	4.15 (2.57–6.70)	36.061	0.306	<.001
Adjustable WS	105 (78.4)	29 (21.6)	Ref	–	–	–
Deviated Wrist	150 (50.5)	147 (49.5)	4.41 (2.45–7.94)	27.265	0.266	<.001
Neutral Wrist	72 (81.8)	16 (18.2)	Ref	–	–	–
Hard Surface Elbow	113 (51.6)	106 (48.4)	1.79 (1.18–2.72)	7.651	0.141	.006
Neutral Elbow	109 (65.7)	57 (34.3)	Ref	–	–	–

Abbreviations: FHP, forward head posture; WS, workstation; OR, odds ratio; CI, confidence interval; φ, phi coefficient; Ref, reference category. Chi-square test of independence used for all comparisons.

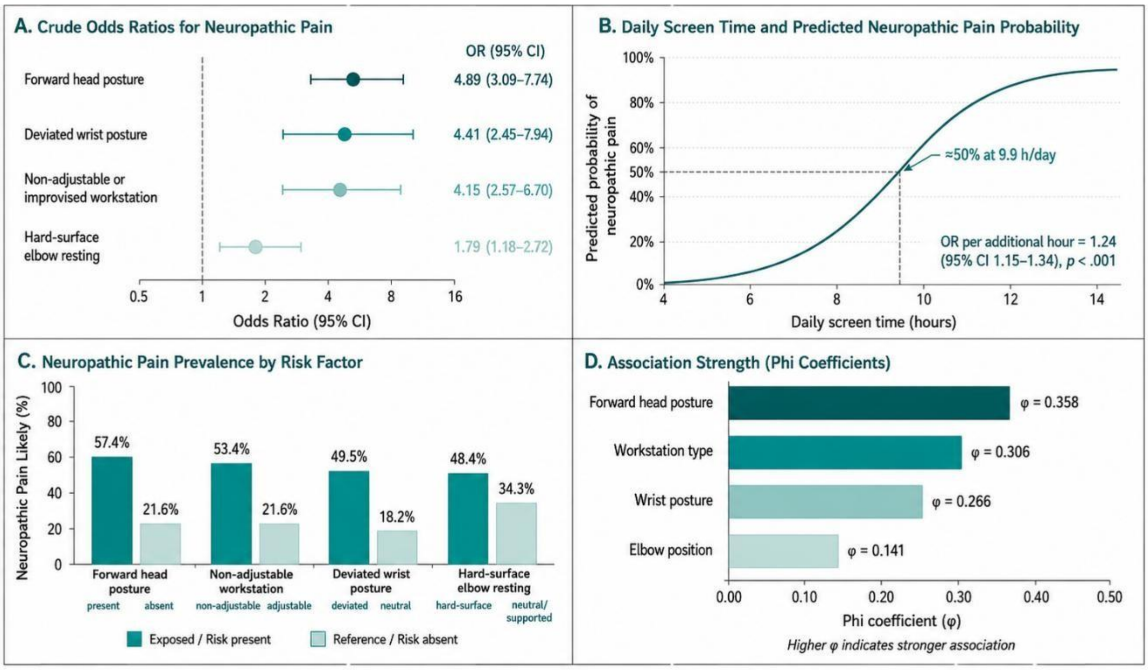

Figure 1 presents a four-panel visualization of the associations between ergonomic risk factors and neuropathic pain. Panel A displays a forest plot of crude odds ratios with 95% confidence intervals, demonstrating that forward head posture (OR = 4.89), deviated wrist posture (OR = 4.41), and non-adjustable workstation use (OR = 4.15) exhibited the strongest associations, while hard-surface elbow resting showed a more modest effect (OR = 1.79). Panel B illustrates the dose–response relationship between daily screen time and predicted probability of neuropathic pain derived from binary logistic regression, with the probability crossing 50% at approximately 9.9 hours of daily screen exposure. Panel C compares neuropathic pain prevalence between participants with and without each risk factor, with the largest absolute difference observed for forward head posture (57.4% vs. 21.6%). Panel D presents the phi coefficients as measures of association strength, confirming that forward head posture (φ = 0.358) and workstation type (φ = 0.306) demonstrated the largest effect sizes.

All four ergonomic and postural factors demonstrated statistically significant associations with neuropathic pain likelihood (Table 2). Forward head posture exhibited the strongest association: participants with FHP had 4.89 times the odds of screening positive for neuropathic pain compared to those without FHP (OR = 4.89, 95% CI: 3.09–7.74, $\chi^2 = 49.245$, $p < .001$, $\varphi = 0.358$). Use of a non-adjustable or improvised workstation was associated with a fourfold increase in neuropathic pain odds (OR = 4.15, 95% CI: 2.57–6.70, $\chi^2 = 36.061$, $p < .001$). Deviated wrist posture demonstrated a similarly strong association (OR = 4.41, 95% CI: 2.45–7.94, $\chi^2 = 27.265$, $p < .001$). Hard-surface elbow resting demonstrated a statistically significant but comparatively modest association with neuropathic pain (OR = 1.79, 95% CI:
1.18–2.72, $\chi^2 = 7.651$, $p = .006$, $\varphi = 0.141$).

Table 3. Binary Logistic Regression: Daily Screen Time as Predictor of Neuropathic Pain

Variable	B	SE	Wald	p	OR (95% CI)
Daily Screen Time (hours)	0.215	0.038	32.857	<.001	1.24 (1.15–1.34)
Constant	−2.130	0.341	39.066	<.001	0.12

Dependent variable: S-LANSS ≥12 (neuropathic pain likely). Overall model classification accuracy: 60.5%. Binary logistic regression confirmed daily screen time as a statistically significant independent predictor of neuropathic pain (Table 3). Each additional hour of daily screen use was associated with a 24% increase in the odds of screening positive for neuropathic pain (OR = 1.24, 95% CI: 1.15–1.34, Wald = 32.857, $p < .001$). The model correctly classified 60.5% of cases overall, with a specificity of 73.0% for neuropathic pain unlikely cases and a sensitivity of 43.6% for neuropathic pain likely cases.

DISCUSSION

This cross-sectional study examined the prevalence and correlates of neuropathic pain among 385 university-based screen users in Lahore, Pakistan. The principal findings indicate that neuropathic pain, as screened by the S-LANSS (score ≥12), was likely in 42.3% of participants, underscoring the neurological dimension of screen-based occupational exposure. All four ergonomic and postural factors assessed, forward head posture, non-adjustable workstation use, deviated wrist posture, and hard-surface elbow resting, demonstrated statistically significant associations with neuropathic pain likelihood, with crude odds ratios ranging from 1.79 to 4.89. Furthermore, daily screen time emerged as an independent dosedependent predictor, with each additional hour increasing the odds of neuropathic pain by 24% (OR = 1.24, 95% CI: 1.15–1.34).

The observed 42.3% neuropathic pain prevalence is substantially higher than estimates typically reported in general working populations, likely reflecting the enriched risk exposure profile of this sample: the inclusion criterion of ≥4 hours daily screen use, predominantly laptop-based work (65.7%), and the high prevalence of non-adjustable workstations (65.2%) collectively established an elevated baseline exposure. The predominantly young adult composition (mean age 28.55 years) aligns with systematic review evidence documenting that young adults engaged in prolonged screen-based activities are particularly susceptible to musculoskeletal and neurological complaints due to sustained non-optimal postures and limited ergonomic awareness (1,14). The high prevalence of multiple concurrent ergonomic risk factors in this sample, forward head posture (57.9%), deviated wrist posture (77.1%), and hard-surface elbow resting (56.9%), suggests that neuropathic pain risk in screen-based populations reflects a cumulative ergonomic burden rather than exposure to any single factor.

Forward head posture, present in 57.9% of participants, demonstrated the strongest association with neuropathic pain (OR = 4.89, 95% CI: 3.09–7.74, φ = 0.358). This prevalence exceeds estimates from prior systematic review data on FHP among screen users (27), and the magnitude of association observed extends beyond the well-established musculoskeletal consequences of FHP to confirm its role as a neurological risk factor. The pathophysiological basis for this finding is supported by evidence that sustained cervical flexion generates compressive loads on the cervical nerve roots and brachial plexus, with experimental data demonstrating that even one hour of computer use produces statistically significant decreases in sensory conduction velocity of both the ulnar and median nerves in office workers with symptomatic neck pain (32). Postural correction interventions, including standing desk use, have demonstrated measurable improvements in craniovertebral angle in individuals with established FHP (31), suggesting that FHP-mediated neuropathic risk is potentially modifiable.

Non-adjustable workstation use was associated with a fourfold increase in neuropathic pain odds (OR = 4.15, 95% CI: 2.57–6.70, φ = 0.306), consistent with literature identifying workstation adjustability as a critical determinant of postural alignment and peripheral nerve compression risk (6,7). The finding that 65.2% of participants used non-adjustable or improvised workstations highlights a substantial and modifiable structural risk factor, particularly relevant to remote and hybrid workers who lack dedicated office infrastructure (5,17). Deviated wrist posture, present in 77.1% of participants, demonstrated a strong association with neuropathic pain (OR = 4.41, 95% CI: 2.45–7.94, φ = 0.266), supported by biomechanical evidence that non-neutral wrist postures during keyboard use induce acute morphological changes in the median nerve (20) and increase carpal tunnel syndrome risk by up to twofold (21). Hard-surface elbow resting, while demonstrating a significant but comparatively modest association (OR = 1.79, 95% CI: 1.18– 2.72, φ = 0.141), is consistent with evidence linking sustained elbow compression and flexion beyond 135 degrees to ulnar neuropathy at the cubital tunnel (24,26).

Binary logistic regression confirmed daily screen time as an independent dose-dependent predictor of neuropathic pain (OR = 1.24 per additional hour, 95% CI: 1.15–1.34, Wald = 32.857, $p < .001$). This doseresponse relationship is consistent with experimental evidence demonstrating that sustained computer use produces progressive electrophysiological changes in both the ulnar and median nerves (32) and with epidemiological data linking cumulative screen exposure to musculoskeletal and neurological symptom burden (1,17). The model demonstrated an overall classification accuracy of 60.5%, with a specificity of 73.0% for neuropathic pain unlikely cases but a sensitivity of only 43.6% for neuropathic pain likely cases. This limited sensitivity indicates that screen time alone, while a significant predictor, does not fully account for neuropathic pain variance; the substantial contribution of postural and ergonomic factors identified in the bivariate analyses suggests that a multivariable model incorporating both exposure duration and ergonomic conditions would likely yield superior predictive accuracy.

These findings carry important clinical and public health implications. The convergence of multiple modifiable risk factors, forward head posture, workstation non-adjustability, wrist deviation, and cumulative screen exposure, indicates that neuropathic pain in screen-based populations is amenable to targeted intervention at both individual and organizational levels. At the individual level, postural correction programs, ergonomic education, and scheduled microbreak protocols may reduce neurological symptom burden (8,31). At the organizational level, provision of adjustable workstations, external monitors positioned at appropriate eye levels, and padded elbow supports represent structural interventions with the potential to address multiple risk pathways simultaneously (6,11). The identification of FHP as the strongest correlate supports the integration of postural screening into occupational health surveillance programs, particularly in educational and administrative settings with intensive screen-based work.

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference; the observed associations, while statistically significant, cannot establish temporal precedence of ergonomic exposures over neuropathic pain onset. Second, self-reported measures for screen time, posture, and work environment introduce potential recall and social desirability bias; objective measurement tools such as inertial measurement units, digital activity monitors, and clinical postural assessment would strengthen future investigations. Third, the S-LANSS is a screening instrument, not a diagnostic tool; electrodiagnostic confirmation of peripheral nerve dysfunction was not performed. Fourth, the study employed non-probability convenience sampling from a single university in Lahore, limiting generalizability to other occupational and geographic populations. Fifth, the logistic regression model included screen time as the sole continuous predictor; a multivariable model adjusting for all significant ergonomic factors simultaneously was not performed, precluding assessment of independent contributions and potential interactions. Finally, potentially relevant confounders, including body mass index, physical activity levels, psychological stress, and subclinical musculoskeletal conditions, were not measured.

Future research should employ longitudinal and prospective designs to establish temporal relationships between ergonomic exposures and neurological outcomes. Incorporation of electrodiagnostic testing, including nerve conduction studies and ultrasound assessment of nerve cross-sectional area (22), would provide objective neurophysiological outcome data to complement screening instruments. Multivariable analytical approaches incorporating all significant ergonomic predictors alongside screen time are needed to identify independently contributing risk factors and potential interaction effects. Extension to diverse occupational populations, including information technology professionals, healthcare workers, and industrial settings, would enhance the generalizability and external validity of these findings.

CONCLUSION

In conclusion, this cross-sectional study demonstrates that neuropathic pain, as screened by the SLANSS, is prevalent among university-based screen users (42.3%) and is significantly associated with forward head posture (OR = 4.89, 95% CI: 3.09–7.74), non-adjustable workstation use (OR = 4.15, 95% CI: 2.57–6.70), deviated wrist posture (OR = 4.41, 95% CI: 2.45–7.94), hard-surface elbow resting (OR = 1.79, 95% CI: 1.18–2.72), and cumulative daily screen time (OR = 1.24 per hour, 95% CI: 1.15–1.34). These findings support the implementation of targeted ergonomic interventions including workstation adjustability, postural screening programs for forward head posture, institutional digital health literacy initiatives promoting microbreaks and postural variation, and further longitudinal and electrodiagnostic research to establish causal pathways. Neuropathic pain in screen-based working populations represents a predictable outcome of identifiable and modifiable ergonomic risk factors, and evidence-based interventions at both individual and organizational levels are warranted.

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