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Association Between Forward Head Posture, Perceived Stress, and Neck Disability in University Students: A Cross-Sectional Study

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ABSTRACT
Background: Forward head posture (FHP) is increasingly prevalent among university students due to prolonged device use, sedentary study routines, and suboptimal ergonomics, and may contribute to neck pain and functional limitation while interacting with psychosocial stress. Objective: To determine the association between forward head posture, perceived stress, and neck disability among university students. Methods: A cross-sectional study was conducted among 267 University of Lahore students (18–25 years) with self-reported neck pain and ≥3 hours/day of study-related laptop or smartphone use. FHP was assessed using the craniovertebral angle (CVA) and categorized as present/absent, neck disability was measured using the Neck Disability Index (NDI), and perceived stress was assessed using the Perceived Stress Scale (PSS-10). Associations between categorical variables were tested using chi-square analyses with effect sizes and odds ratios. Results: Mean age was 21.53 ± 2.25 years and mean CVA was 48.25° ± 3.24°. FHP prevalence was 58.8% (157/267). At least mild neck disability was reported by 89.5% (239/267), including severe disability in 30.3% (81/267). Moderate-to-high stress was present in 72.3% (193/267). FHP was not significantly associated with stress level ($\chi^2(2)=2.411$, $p=0.300$; Cramér's $V=0.095$) or disability category ($\chi^2(3)=2.837$, $p=0.417$; Cramér's $V=0.103$). Conclusion: FHP, perceived stress, and neck disability were highly prevalent, but categorical associations between FHP and stress or disability were weak and non-significant in this dataset, supporting the need for multifactorial, exposure-sensitive analyses and integrated prevention strategies.

Keywords
Forward head posture; Craniovertebral angle; Perceived stress; Neck Disability Index; Ergonomics

INTRODUCTION
Posture is a multidimensional neuromusculoskeletal phenomenon maintained through continuous integration of skeletal alignment, muscle activity, and central nervous system control to optimize balance, stability, and movement efficiency. These mechanisms work in coordination with craniofacial and cervical structures, and disturbances in this integrated system can alter loading patterns across the cervical spine and shoulder girdle, predisposing individuals to pain and functional limitation (1). In contemporary university environments, prolonged static sitting, frequent laptop-based study, and sustained smartphone use have become dominant daily behaviors, creating prolonged cervical flexion moments, reduced postural variability, and increased cumulative loading of cervical soft tissues. These exposures appear particularly relevant in young adults, where the rising burden of neck pain has been increasingly recognized as a public health concern requiring early detection and targeted prevention strategies (2).

Forward head posture (FHP), commonly quantified using the craniovertebral angle (CVA), represents anterior translation of the head relative to the trunk, typically accompanied by upper cervical extension and lower cervical flexion-extension compensation patterns. This posture has mechanical consequences that include increased compressive and shear forces on cervical structures and altered activation of deep and superficial neck musculature, contributing to reduced neuromuscular control and endurance over time (3,4). Evidence indicates that individuals with neck pain often demonstrate reduced neck muscle endurance and morphological changes, including reduced cross-sectional area and degenerative changes, supporting a pathophysiologic link between prolonged postural stress and persistent symptoms (5,6). Prolonged FHP may also influence proprioception and pain sensitization, lowering the nociceptive threshold and increasing vulnerability to chronicity and functional restrictions (7).

The prevalence of FHP among university students is consistently high across diverse educational contexts. Cross-sectional data indicate that more than half of students demonstrate measurable FHP, with estimates ranging from approximately 50% to over 70%, reflecting the strong contribution of sustained academic sitting and screen-based learning behaviors (8–10). Smartphone dependence and excessive device use further amplify postural deviations, with studies linking prolonged smartphone exposure to reduced CVA, protracted shoulders, thoracic kyphosis, impaired joint position sense, reduced cervical muscle endurance, and greater musculoskeletal symptom burden (11,12). Importantly, these patterns are also observed in health sciences students, suggesting that knowledge alone does not sufficiently protect against ergonomic risk exposures and habitual postural adaptation (9).

Beyond biomechanics, psychosocial stress is a prominent determinant of musculoskeletal symptom experience in university populations. Perceived stress—a person's appraisal of life demands as unpredictable and overwhelming—has been associated with anxiety-related symptoms and poor health outcomes (13,14). Stress-related neuroendocrine and sympathetic activation can increase cervical and shoulder muscle tension, reduce recovery capacity, and intensify pain perception, thereby worsening disability even in the absence of structural pathology (15). Among undergraduates, academic stressors have been reported as significant predictors of neck disability, and higher stress levels are associated with greater functional limitation as measured using validated tools such as the Neck Disability Index (NDI) (16). Prior work also suggests that students with FHP may report higher perceived stress, supporting a potential bidirectional relationship in which stress increases muscle tension and maladaptive postures, while chronic discomfort and impaired function contribute to psychological strain (17,18).

Despite growing evidence that posture, stress, and disability co-occur in student populations, many studies evaluate these factors in isolation or without concurrent measurement using standardized instruments. In addition, the extent to which perceived stress co-varies with FHP severity and functional neck disability remains insufficiently characterized in university cohorts experiencing neck pain and high daily screen exposure. A clearer understanding of these interrelationships is essential for developing integrated preventive strategies combining ergonomics, posture correction, and stress-management approaches. Therefore, this study aimed to determine the association between forward head posture, perceived stress, and neck disability among university students. The study hypothesized that forward head posture would be associated with higher perceived stress levels and greater neck disability (16–18).

MATERIALS AND METHODS

A cross-sectional observational study was conducted among undergraduate students at the University of Lahore. Participants were recruited using convenience sampling. Eligibility criteria included university students aged 18–25 years who reported neck pain or discomfort and who used a laptop or smartphone for study purposes for at least three hours per day. Students were excluded if they had a history of cervical spine surgery, fracture, or trauma; neurological disorders affecting movement, balance, or posture; systemic musculoskeletal conditions; congenital spinal deformities (such as scoliosis or kyphosis); severe vestibular or visual impairments affecting posture; current use of medications that could meaningfully alter musculoskeletal function; or active enrollment in physical therapy, chiropractic care, or ergonomic interventions specifically targeting neck or postural problems.

After confirming eligibility, participants provided written informed consent prior to participation. Data were collected in a standardized manner using structured questionnaires and postural assessment. Forward head posture was quantified using the craniovertebral angle (CVA), defined as the angle formed by the intersection of a horizontal line through the spinous process of the seventh cervical vertebra (C7) and a line connecting C7 to the tragus of the ear (19,20). CVA has been widely used as a valid and reliable photogrammetric measure for head and cervical posture assessment in clinical and research settings (21). In the present study, a smaller CVA indicated a greater degree of forward head posture, and participants were categorized as having FHP (Yes/No) based on the study's operational criterion.

Neck-related functional disability was assessed using the Neck Disability Index (NDI), a 10-item questionnaire assessing difficulty in daily activities such as reading, lifting, work, and sleep, with each item scored from 0 to 5 (22). The total score ranges from 0 to 50 and can be expressed as a percentage disability score to classify disability severity (22). The NDI has established reliability and validity for evaluating neck-related disability and tracking changes over time (22). Perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10), which measures the degree to which life circumstances are appraised as stressful, with scores ranging from 0 to 40 and higher scores indicating greater perceived stress (13). The PSS-10 has demonstrated acceptable reliability and construct validity across populations (14). Stress severity was categorized into low, moderate, and high levels.

To reduce measurement variability, standardized instructions were provided prior to questionnaire completion, and consistent assessment procedures were applied across participants. The sample size of 267 was determined using Epitool and was considered adequate to estimate prevalence and test associations among categorical variables with conventional statistical power assumptions for cross-sectional analyses.

Data were analyzed using SPSS version 21. Continuous variables were summarized as mean and standard deviation (SD), with minimum and maximum values. Categorical variables were reported as frequencies and percentages. Associations between forward head posture (Yes/No) and stress level (low/moderate/high), as well as forward head posture and disability category (no/mild/moderate/severe), were evaluated using Pearson's chi-square test. Effect size for chi-square analyses was quantified using Cramér's V. For clinically interpretable contrasts, odds ratios (ORs) with 95% confidence intervals (CIs) were computed for binary comparisons derived from the contingency tables (high stress vs non-high stress; severe disability vs non-severe disability). Statistical significance was set at $p < 0.05$. Ethical conduct was maintained in accordance with institutional requirements and the principles of the Declaration of Helsinki, including confidentiality safeguards and voluntary participation with the right to withdraw at any time.

RESULTS

Table 1 summarizes the cohort's anthropometric and outcome-variable distributions (N = 267). Participants were young adults (mean age 21.53 ± 2.25 years; range 18–25), with mean height 170.17 ± 11.39 cm (150–189) and mean weight 66.18 ± 12.79 kg (45–89). The average craniovertebral angle (CVA) was 48.25° ± 3.24° (37.30–57.50), indicating an overall tendency toward anterior head translation. The mean NDI raw score was 15.16 ± 9.04 (0–30), corresponding to a mean NDI disability percentage of 30.31% ± 18.09% (0–60), reflecting a cohort-level burden in the mild-to-moderate disability range. Perceived stress was also notable, with a mean PSS score of 19.78 ± 8.69 (5–34), consistent with moderate stress on average.

Table 1. Participant Characteristics and Study Variables (N = 267)

Variable	N	Minimum	Maximum	Mean	SD
Age (years)	267	18	25	21.53	2.25

Variable	N	Minimum	Maximum	Mean	SD
Height (cm)	267	150	189	170.17	11.39
Weight (kg)	267	45	89	66.18	12.79
Craniovertebral angle (CVA, °)	267	37.30	57.50	48.25	3.24
NDI raw score (0–50)	267	0	30	15.16	9.04
NDI % disability	267	0	60	30.31	18.09
PSS score (0–40)	267	5	34	19.78	8.69

Table 2. Gender Distribution (N = 267)

Gender	Frequency	Percentage
Female	143	53.6%
Male	124	46.4%

Table 3. Prevalence of Forward Head Posture, Neck Disability Category, and Stress Level (N = 267)

Variable	Category	Frequency	Percentage
Forward head posture	Yes	157	58.8%
	No	110	41.2%
Neck disability category (NDI)	No disability	28	10.5%
	Mild	85	31.8%
	Moderate	73	27.3%
	Severe	81	30.3%
Perceived stress level (PSS-10)	Low	74	27.7%
	Moderate	123	46.1%
	High	70	26.2%

Table 4. Association Between Forward Head Posture and Stress Level

Stress level	No FHP (n = 110)	FHP (n = 157)	Total (N = 267)
Low	36 (32.7%)	38 (24.2%)	74
Moderate	48 (43.6%)	75 (47.8%)	123
High	26 (23.6%)	44 (28.0%)	70

Chi-square statistics: $\chi^2(2) = 2.411$, $p = 0.300$ Effect size: Cramér's V = 0.095 (small) Binary contrast (High vs Non-high stress): OR = 1.26, 95% CI 0.72–2.20

Table 2 shows the gender distribution, which was relatively balanced: 143 females (53.6%) and 124 males (46.4%). This near-even split supports comparability of descriptive estimates across sexes, although inferential sex-stratified results were not presented in the provided outputs. Table 3 reports prevalences of the main categorical variables. Forward head posture (FHP) was present in 157/267 students (58.8%). Neck disability was highly prevalent: only 28/267 (10.5%) reported no disability, while 85/267 (31.8%) had mild disability, 73/267 (27.3%) moderate disability, and 81/267 (30.3%) severe disability—meaning 239/267 (89.5%) reported at least mild disability. Stress burden was similarly high: low stress was reported by 74/267 (27.7%), moderate stress by 123/267 (46.1%), and high stress by 70/267 (26.2%), yielding 193/267 (72.3%) in the moderate-to-high stress strata.

Table 5. Association Between Forward Head Posture and Neck Disability Category

NDI category	No FHP (n = 110)	FHP (n = 157)	Total (N = 267)
No disability	14 (12.7%)	14 (8.9%)	28
Mild	31 (28.2%)	54 (34.4%)	85
Moderate	34 (30.9%)	39 (24.8%)	73
Severe	31 (28.2%)	50 (31.8%)	81

Chi-square statistics: $\chi^2(3) = 2.837$, $p = 0.417$ Effect size: Cramér's V = 0.103 (small)

Table 4 evaluates the association between FHP and stress categories. Among students without FHP (n = 110), 23.6% (26/110) had high stress, compared with 28.0% (44/157) among those with FHP. Despite this absolute difference of 4.4 percentage points, the overall association was not statistically significant by chi-square ($\chi^2(2) = 2.411$, $p = 0.300$), and the effect size was small (Cramér's V = 0.095). The derived binary contrast (high vs non-high stress) also indicated modestly higher odds of high stress in the FHP group (OR = 1.26), but the estimate was imprecise and compatible with no association (95% CI 0.72–2.20).

Table 5 assesses the association between FHP and neck disability categories. Severe disability was observed in 28.2% (31/110) of students without FHP versus 31.8% (50/157) with FHP, an absolute difference of 3.6 percentage points. The global chi-square test did not support a significant association ($\chi^2(3) = 2.837$, $p = 0.417$), with a small effect size (Cramér's V = 0.103). The severe vs non-severe contrast suggested slightly higher odds of severe disability in the FHP group (OR = 1.19), again with uncertainty and no clear separation from the null (95% CI 0.70–2.03).

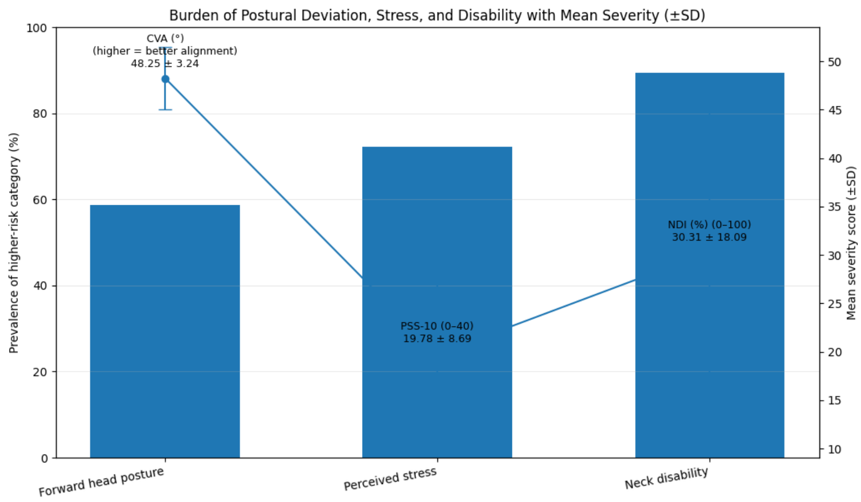

Figure 1 Burden of Postural Deviation, Stress and Disability with Men Severeity

This compound visualization demonstrates a high burden across all three domains, with the prevalence bars showing forward head posture in 58.8% of students, moderate-to-high perceived stress in 72.3%, and at least mild neck disability in 89.5%. The overlaid line with error limits (±SD) displays the cohort's mean severity for each construct: CVA 48.25° ± 3.24° (noting that higher CVA reflects better cervical alignment), PSS-10 19.78 ± 8.69, and NDI disability 30.31% ± 18.09%. Collectively, the figure highlights that disability prevalence is the most widespread outcome (nearly 9 in 10 students), while stress is also highly prevalent (nearly 3 in 4), alongside a substantial proportion with postural deviation, with notable dispersion in stress and disability scores suggesting meaningful heterogeneity in symptom burden within the cohort.

DISCUSSION

This cross-sectional study evaluated forward head posture, perceived stress, and neck disability among university students with self-reported neck pain and high daily study-related device use. The key finding was a high burden of all three conditions in this cohort: FHP was present in 58.8%, moderate-to-high stress in 72.3%, and at least mild neck disability in 89.5%. However, when examined as categorical associations, the relationships between FHP and stress (p = 0.300) and between FHP and disability category (p = 0.417) were weak in magnitude (Cramér's V ≈ 0.10) and statistically non-significant. The overall interpretation is therefore twofold: the prevalence signals an important student-health problem, yet the provided inferential outputs do not support strong categorical dependence of stress or disability levels on binary FHP status in this dataset.

The prevalence of FHP in the current cohort aligns with reports of frequent postural deviations in student populations exposed to prolonged sitting and screen time. Prior university-based work has documented FHP proportions often exceeding 50%, particularly where device use and sustained sitting are prominent, supporting the plausibility of the 58.8% estimate observed here (23–25). The high prevalence is also consistent with evidence linking prolonged smartphone and laptop use to reduced CVA, altered cervical biomechanics, and postural adaptations such as protracted shoulders and increased thoracic kyphosis (26,27). These exposures are reinforced by modern academic workflows and the broader shift toward sedentary behavior in young adults, which has been associated with musculoskeletal complaints and postural changes (28).

Neck disability was strikingly common in this sample, with nearly one-third categorized as severe disability. The observed distribution is clinically meaningful because disability represents functional limitation rather than pain alone and is known to be influenced by both physical loading and psychosocial context. Meta-analytic evidence supports an association between forward head posture and neck pain outcomes, suggesting that postural deviation can contribute to symptom persistence through mechanical strain and altered muscle function (29). In addition, work on sagittal head-neck posture and neck pain relationships has suggested that posture-related effects may be context-dependent and moderated by measurement approaches, participant characteristics, and the chronicity of symptoms (30). These considerations may be relevant here because FHP was operationalized as a binary exposure; a dichotomous classification can attenuate detectable gradients if disability risk varies more strongly with continuous CVA severity than with a yes/no categorization.

Perceived stress was also highly prevalent, with 26.2% reporting high stress and an additional 46.1% reporting moderate stress. This pattern is consistent with evidence that university students experience substantial academic and psychosocial stress loads and that stress can interact with musculoskeletal symptoms through increased muscle tension, altered pain modulation, and reduced recovery (31). Empirical studies have identified academic stress as a predictor of neck disability and functional limitation in student populations, supporting the clinical rationale for evaluating stress alongside biomechanical factors (32). Moreover, cross-sectional literature indicates that stress and posture may be linked through reciprocal pathways: stress may promote protective or maladaptive postures via sustained muscle activation, while persistent discomfort and functional restrictions can serve as ongoing stressors (33,34).

Despite these mechanistic and epidemiologic expectations, the inferential results provided in this dataset do not demonstrate statistically significant categorical associations between FHP and stress or between FHP and disability. The direction of effect estimates was modestly positive—high stress was 28.0% in the FHP group vs 23.6% in the non-FHP group, and severe disability was 31.8% vs 28.2%—yet these differences were small and imprecise (ORs near 1.2–1.3 with confidence intervals spanning 1.0). A likely explanation is that neck disability and perceived stress are multifactorial outcomes, where the incremental contribution of posture status alone is limited unless important covariates are accounted for, such as total daily screen exposure, ergonomic setup quality, sleep, physical activity, and muscle endurance. Prior work has shown that smartphone addiction and prolonged exposure are associated with reduced CVA, reduced endurance, and proprioceptive impairment, suggesting that dose and physiological mediators may matter more than posture classification alone (27). Likewise, disability may depend on the interaction of posture with endurance deficits, psychosocial coping, and behavioral factors, which requires multivariable modeling and continuous-variable analysis to test more sensitively.

An important reporting consideration is that the narrative text in the provided thesis draft states that chi-square tests were "significant" with p-values (p = 0.017 and p = 0.001), whereas the actual chi-square output tables shown report p = 0.300 (FHP vs stress) and p = 0.417 (FHP vs disability). This internal inconsistency materially changes the study interpretation and must be corrected in the finalized manuscript to maintain statistical integrity and credibility. If the chi-square output values are accurate, the conclusions should reflect non-significant associations and emphasize prevalence burden and the need for more sensitive analyses (e.g., continuous CVA correlations, ordinal modeling for disability, and adjustment for confounding). If the p-values in the narrative were derived from different analyses (e.g., Spearman correlation or regression), those outputs must be reported transparently with full statistics and consistent tables.

From a clinical and preventive perspective, the high prevalence estimates still support the value of integrated campus-level interventions. Ergonomic education and workstation modifications have demonstrated benefit in improving posture-related outcomes and reducing musculoskeletal complaints in student and trainee populations, and broader ergonomic interventions have been emphasized as feasible preventive strategies where prolonged static work is unavoidable (35,36). In parallel, stress-management approaches may be justified given the high moderate-to-high stress proportion and the known stress–musculoskeletal interaction pathways, even if posture and stress were not strongly coupled in the present categorical analyses (31,32). Future studies in similar settings should preferentially use continuous CVA metrics, include objectively measured exposure variables (screen time, sitting duration), and apply multivariable models to estimate independent and combined contributions of posture and stress to disability, improving causal inference and clinical interpretability.

CONCLUSION

In this cohort of 267 university students with self-reported neck pain and high daily device use, forward head posture (58.8%), moderate-to-high perceived stress (72.3%), and at least mild neck disability (89.5%) were highly prevalent, indicating a substantial combined burden of postural deviation, psychosocial strain, and functional limitation; however, the provided categorical analyses showed weak, non-significant associations between FHP and stress (p = 0.300) and between FHP and disability category (p = 0.417), suggesting that neck disability and stress in this population likely reflect multifactorial influences beyond binary posture status alone and warrant multivariable, exposure-sensitive investigation alongside integrated preventive strategies.

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