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Original Article

Association Between Stress and Cervicogenic Headache Among Young Adults in Karachi, Pakistan: A Cross-Sectional Analytical Study

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ABSTRACT

Background: Cervicogenic headache is a secondary headache disorder linked with cervical musculoskeletal dysfunction, posture-related aggravation, and functional limitation. Young adults in urban settings may be vulnerable because of academic pressure, occupational demands, prolonged screen exposure, physical inactivity, and perceived stress. Objective: To determine the association between perceived stress and cervicogenic headache-related symptoms among young adults in Karachi, Pakistan, and to evaluate occupational and lifestyle predictors of cervicogenic headache. Methods: A cross-sectional analytical study was conducted among 150 adults aged 18–35 years residing in Karachi. Participants were recruited through convenience sampling from universities, offices, and public settings. Data were collected using a structured questionnaire assessing demographic and lifestyle factors, perceived stress using the PSS-10, and cervicogenic headache-related symptom indicators. Chi-square tests assessed bivariate associations, and binary logistic regression evaluated independent predictors. Results: More than half of participants reported cervicogenic headache-related symptoms, including frequent headaches (55.3%), headache starting from the neck and radiating (51.3%), associated neck pain (52.0%), posture- or movement-triggered headache (60.0%), and improvement with massage or physiotherapy (53.3%). Perceived stress was associated with headache presence in bivariate analysis (χ^2 = 14.514, p = 0.006), while inability to cope was also significant (χ^2 = 15.402, p = 0.004). Screen time was associated with posture-triggered headache (χ^2 = 21.321, p < 0.001). In regression analysis, occupation (OR = 2.346, p < 0.001) and physical activity (OR = 2.227, p = 0.003) were independent predictors, whereas PSS total score was not (OR = 1.004, p = 0.911). Conclusion: Cervicogenic headache-related symptoms were common among young adults in Karachi. Stress was associated with headache in bivariate analysis, but occupation and physical activity were stronger independent predictors, supporting integrated ergonomic, physical activity, and stress-management strategies. Keywords: Cervicogenic headache, stress, young adults, posture, physical inactivity, screen time, occupational health, Karachi.

INTRODUCTION

Headache disorders represent a major public health concern because of their high prevalence, recurrent nature, functional burden, and contribution to disability among working-age populations. Cervicogenic headache is a secondary headache disorder arising from dysfunction of cervical musculoskeletal structures, with pain commonly originating in the neck and referring to the head through shared

cervical-trigeminal nociceptive pathways. Unlike primary headache disorders, cervicogenic headache is frequently associated with restricted cervical movement, neck pain, postural aggravation, mechanical loading, and improvement after physical or manual therapeutic interventions. Accurate identification of cervicogenic headache is clinically important because its management differs from migraine and tension-type headache and often requires targeted cervical assessment, ergonomic modification, therapeutic exercise, and physical therapy-based rehabilitation (1).

The development and persistence of cervicogenic headache are increasingly understood within a biopsychosocial framework in which cervical biomechanics, occupational posture, sedentary behavior, psychosocial stress, sleep quality, and physical activity interact to influence pain perception and symptom recurrence. Prolonged screen exposure, sustained forward head posture, reduced spinal postural variability, and inadequate movement breaks can increase cervical loading and muscular fatigue, thereby contributing to posture-triggered headache symptoms. Previous evidence has shown that individuals with cervicogenic headache may demonstrate altered pain processing, lower pressure pain thresholds, lifestyle-related risk factors, and psychosocial contributors, supporting the need to examine both mechanical and psychological exposures when evaluating headache symptoms in young adults (2,3).

Stress is a clinically relevant and modifiable exposure because it may increase cervical and shoulder muscle tension, heighten pain sensitivity, disturb sleep, and reduce coping capacity. Studies on headache disorders have shown that work-related and psychosocial stressors can contribute to headache frequency and severity, although the independent role of perceived stress in cervicogenic headache remains less clearly established than its role in migraine and tension-type headache. This distinction is important because stress may be directly associated with headache symptoms in unadjusted analysis but may not remain independently predictive after accounting for occupational demands, physical inactivity, posture, screen exposure, and sleep-related factors. Therefore, examining stress alongside lifestyle and occupational variables is necessary to avoid overestimating its isolated effect (4,5).

Young adults living in rapidly urbanizing South Asian cities are exposed to a combination of academic pressure, employment-related stress, financial strain, prolonged digital device use, reduced physical activity, and limited ergonomic awareness. Karachi, one of Pakistan's largest metropolitan cities, represents a high-density urban environment where these exposures may converge among students, office workers, and early-career professionals. Although headache disorders have been widely studied in general populations, local evidence specifically addressing cervicogenic headache and its relationship with perceived stress, screen time, occupation, physical activity, and sleep remains limited. This gap is clinically and public-health relevant because cervicogenic headache is potentially preventable and manageable through non-pharmacological strategies, including posture education, ergonomic correction, regular physical activity, stress management, and physiotherapy referral when indicated (6,7).

This study was therefore conducted to determine the association between perceived stress and cervicogenic headache-related symptoms among young adults in Karachi, Pakistan, and to evaluate whether occupational and lifestyle factors independently predicted the presence of cervicogenic headache. The study hypothesized that perceived stress would be associated with cervicogenic headache symptoms; however, the strength of this association may be influenced by occupational status, physical activity, screen exposure, sleep quality, and other lifestyle-related factors.

MATERIALS AND METHODS

This cross-sectional analytical study was conducted among young adults residing in Karachi, Pakistan, to examine the association between perceived stress and cervicogenic headache-related symptoms and to identify occupational and lifestyle predictors of cervicogenic headache. A cross-sectional design was selected because the study aimed to estimate the frequency of cervicogenic headache-related symptoms and assess associations between stress, demographic characteristics, and lifestyle exposures at a single

point in time. The target population consisted of adults aged 18–35 years who had been residing in Karachi for at least one year, as this age group is commonly exposed to academic, occupational, digital, and lifestyle-related stressors relevant to cervicogenic headache risk.

A total sample of 150 participants was recruited through convenience sampling from universities, offices, and public settings across Karachi. Participants were eligible for inclusion if they were aged between 18 and 35 years, had resided in Karachi for at least one year, and provided voluntary informed consent. Participants were excluded if they reported known neurological disorders, previously diagnosed migraine, previous cervical spine injury or surgery, or medication use that could substantially confound headache reporting. The recruitment process involved approaching eligible participants, explaining the purpose and procedures of the study, and obtaining informed consent before questionnaire completion. Participation was voluntary, and respondents were informed that they could withdraw at any stage without penalty.

The sample size was determined using the standard single-population proportion formula with finite population correction. A 95% confidence level, corresponding to a Z value of 1.96, an assumed prevalence of 50% to maximize sample size, a margin of error of 8%, and an estimated accessible population of 10,000 were used. Based on these assumptions, the required sample size was approximately 150 participants. The use of an assumed prevalence of 50% was appropriate because local prevalence estimates for cervicogenic headache among young adults in Karachi were not available.

Data were collected using a structured, self-administered questionnaire divided into three sections. The first section recorded demographic and lifestyle characteristics, including age, gender, occupation, socioeconomic status, physical activity level, sleep pattern, smoking status, and daily screen-time exposure. The second section assessed perceived stress using the Perceived Stress Scale-10, a widely used instrument for measuring the degree to which respondents perceive situations in their lives as stressful. The total perceived stress score was treated as an exposure variable in the association and regression analyses. The third section assessed cervicogenic headache-related symptoms using criteria derived from recognized cervicogenic headache diagnostic features, including headache beginning in the neck, radiation from the neck to the head, associated neck pain, aggravation by neck movement or sustained posture, and improvement with massage or physiotherapy. In this study, cervicogenic headache status was considered questionnaire-based and symptom-defined rather than clinically confirmed by diagnostic blocks or physical examination.

The primary outcome variable was the presence of cervicogenic headache-related symptoms. Symptom indicators included frequent headache, headache starting from the neck and radiating to the head, neck pain associated with headache, headache triggered by neck movement or posture, and improvement with massage or physiotherapy. The main exposure variable was perceived stress as measured by the Perceived Stress Scale-10. Additional independent variables included gender, occupation, physical activity, sleep quality, and screen-time exposure. Occupation and physical activity were included because they were clinically relevant lifestyle variables and potential confounders in the relationship between stress and cervicogenic headache. Screen time was examined because prolonged digital device exposure may contribute to sustained cervical loading and posture-related headache symptoms.

To reduce information bias, all participants completed the same structured questionnaire with uniform response options. Eligibility criteria were defined before data collection to reduce misclassification related to migraine, neurological disorders, and previous cervical injury. Potential confounding was addressed analytically by including perceived stress, gender, occupation, physical activity, and sleep quality in the binary logistic regression model. The interpretation of findings was limited to association rather than causation because the cross-sectional design did not establish temporal sequence between stress exposure, lifestyle factors, and cervicogenic headache symptoms.

Data were entered and analyzed using SPSS version 25. Categorical variables were summarized as frequencies and percentages, while continuous variables were planned to be summarized using means and standard deviations where applicable. Chi-square tests were used to assess bivariate associations between cervicogenic headache-related variables and categorical exposures, including perceived stress responses, coping difficulty, screen time, and occupation. Binary logistic regression was performed to evaluate the independent predictive value of perceived stress score, gender, occupation, physical activity, and sleep quality for cervicogenic headache status. Odds ratios were used to express the strength of association in the regression model. A p-value of less than 0.05 was considered statistically significant.

Ethical conduct was guided by the principles of the Declaration of Helsinki and standard research ethics for studies involving human participants (8,9). Participants were informed about the study objectives, voluntary participation, confidentiality, and their right to withdraw. Written informed consent was obtained before data collection. Personal identifiers were not included in the analytical dataset, and collected information was kept confidential and used only for research purposes. The study involved non-invasive questionnaire-based data collection and did not expose participants to physical risk. Institutional ethical approval was obtained before data collection. Data integrity was supported by standardized questionnaire administration, predefined eligibility criteria, careful data entry, and statistical analysis using a consistent analysis plan.

RESULTS

A total of 150 young adults from Karachi, Pakistan, were included in the analysis. The results are presented according to participant characteristics, cervicogenic headache-related symptom profile, perceived stress responses, bivariate associations, and multivariable logistic regression findings.

Table 1. Gender Distribution of Study Participants

Gender	n	%
Male	89	59.3
Female	53	35.3
Other	8	5.3
Total	150	100.0

The study sample included 89 male participants, representing 59.3% of the total sample, followed by 53 female participants, representing 35.3%. Eight participants, representing 5.3%, were categorized as other. These findings describe the gender composition of the sample and provide the demographic context for interpretation of cervicogenic headache-related symptoms and associated factors.

Table 2. Cervicogenic Headache-Related Symptom Profile

Symptom Indicator	Yes, %	No, %
Frequent headaches	55.3	44.7
Headache starts from neck and radiates	51.3	48.7
Neck pain associated with headache	52.0	48.0
Headache triggered by neck movement or posture	60.0	40.0
Headache improved with massage or physiotherapy	53.3	46.7

More than half of the participants reported symptoms compatible with a cervicogenic headache pattern. The most frequently reported symptom indicator was headache triggered by neck movement or posture, reported by 60.0% of participants. Frequent headaches were reported by 55.3%, improvement with massage or physiotherapy by 53.3%, neck pain associated with headache by 52.0%, and headache starting from the neck with radiation by 51.3%. This symptom distribution supports the presence of a clinically relevant mechanical and cervical component in the headache profile of the surveyed population.

Perceived stress was commonly reported among the participants. The largest proportion of respondents reported feeling stressed sometimes, accounting for 44.7% of the sample. Fairly often and very often responses were reported by 20.0% and 16.0%, respectively. In contrast, 8.7% reported never feeling stressed and 10.7% reported almost never feeling stressed. These findings indicate that perceived stress

was frequent in the study population and justified its inclusion as a main exposure variable in the association and regression analyses.

Table 3. Perceived Stress Frequency Among Study Participants

Response Category	n	%
Never	13	8.7
Almost never	16	10.7
Sometimes	67	44.7
Fairly often	30	20.0
Very often	24	16.0
Total	150	100.0

Bivariate analysis showed statistically significant associations between stress-related responses, lifestyle exposures, occupational status, and headache-related outcomes.

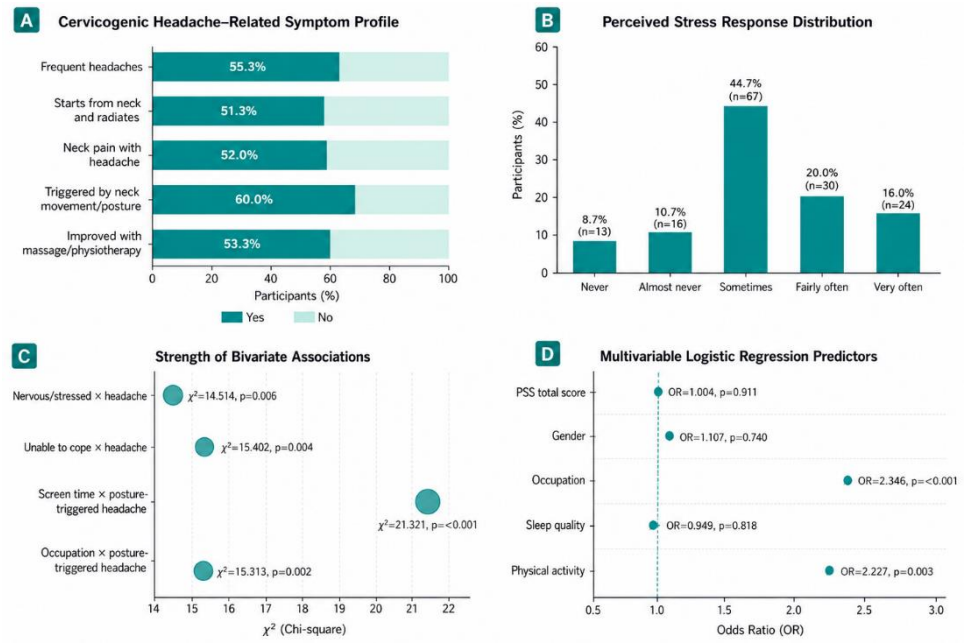

Figure 1 Aggregated cervicogenic headache indicators, stress burden, and associated predictors among young adults in Karachi. Cervicogenic headache-related symptoms were reported by more than half of participants, with posture- or neck movement-triggered headache being the most frequent indicator at 60.0%, followed by frequent headaches at 55.3%, improvement with massage or physiotherapy at 53.3%, neck pain associated with headache at 52.0%, and headache starting from the neck with radiation at 51.3%. Perceived stress was common, with 44.7% reporting stress sometimes, 20.0% fairly often, and 16.0% very often. Bivariate analysis showed the strongest reported association for screen time with posture-triggered headache ($\chi^2 = 21.321$, $p < 0.001$), followed by inability to cope with tasks and headache presence ($\chi^2 = 15.402$, $p = 0.004$), occupation with posture-triggered headache ($\chi^2 = 15.313$, $p = 0.002$), and nervousness/stress with headache presence ($\chi^2 = 14.514$, $p = 0.006$). In the multivariable model, occupation (OR = 2.346, $p < 0.001$) and physical activity (OR = 2.227, $p = 0.003$) showed the strongest independent associations with cervicogenic headache, whereas PSS total score was not independently associated (OR = 1.004, $p = 0.911$).

Feeling nervous or stressed was associated with headache presence, with $\chi^2 = 14.514$ and $p = 0.006$. Difficulty coping with tasks was also associated with headache presence, with $\chi^2 = 15.402$ and $p = 0.004$. Screen time demonstrated the strongest reported association with posture-triggered headache, with $\chi^2 = 21.321$ and $p < 0.001$. Occupation was also associated with posture-triggered headache, with $\chi^2 = 15.313$ and $p = 0.002$. These findings indicate that stress-related and lifestyle variables were associated with headache-related outcomes at the bivariate level.

Table 4. Bivariate Associations Between Stress, Coping, Lifestyle, Occupation, and Headache-Related Outcomes

Association Tested	χ^2	df	p-value
Nervous or stressed × Headache presence	14.514	4	0.006
Unable to cope with tasks × Headache presence	15.402	4	0.004
Screen time × Headache triggered by posture	21.321	3	<0.001
Occupation × Headache triggered by posture	15.313	3	0.002

Table 5. Binary Logistic Regression Analysis for Predictors of Cervicogenic Headache

Predictor	p-value	Odds Ratio
PSS total score	0.911	1.004
Gender	0.740	1.107
Occupation	<0.001	2.346
Sleep quality	0.818	0.949
Physical activity	0.003	2.227

The binary logistic regression model showed that occupation and physical activity were independently associated with cervicogenic headache status. Occupation had an odds ratio of 2.346 with $p < 0.001$, while physical activity had an odds ratio of 2.227 with $p = 0.003$. In contrast, PSS total score was not independently associated with cervicogenic headache in the regression model, with an odds ratio of 1.004 and $p = 0.911$. Gender and sleep quality were also not independently associated with cervicogenic headache, with p-values of 0.740 and 0.818, respectively. These findings suggest that although perceived stress was associated with headache presence in bivariate analysis, occupational and physical activity-related factors were the stronger independent predictors in the adjusted model.

DISCUSSION

This cross-sectional analytical study examined the association between perceived stress and cervicogenic headache-related symptoms among young adults in Karachi, Pakistan, and evaluated whether occupational and lifestyle factors independently predicted cervicogenic headache status. The findings showed that cervicogenic headache-related symptoms were common in this urban young-adult sample, with more than half of participants reporting frequent headaches, headache beginning in the neck and radiating to the head, associated neck pain, improvement with massage or physiotherapy, and posture- or neck movement-triggered headache. The highest reported symptom indicator was headache triggered by neck movement or posture, affecting 60.0% of participants. This pattern supports the clinical relevance of cervical mechanical loading, sustained posture, and musculoskeletal dysfunction in headache presentation among young adults. These findings are consistent with previous evidence showing that cervicogenic headache is commonly associated with cervical neuromusculoskeletal impairments, altered cervical mobility, reduced muscle performance, and pain provocation related to mechanical or postural factors (10).

A key finding of this study was that perceived stress showed a statistically significant bivariate association with headache presence, but it did not remain an independent predictor in the multivariable logistic regression model. Participants who reported feeling nervous or stressed had a significant association with headache presence, and difficulty coping with tasks was also significantly associated with headache. However, after adjustment for gender, occupation, physical activity, and sleep quality, the PSS total score was not independently associated with cervicogenic headache. This suggests that perceived stress may be linked with headache symptoms at the unadjusted level, but its apparent influence may overlap with or be explained by occupational and lifestyle-related factors. This interpretation is consistent with the biopsychosocial understanding of cervicogenic headache, in which psychological distress, pain sensitivity, posture, activity behavior, and work-related exposures may interact rather than operate as isolated determinants (2,4).

Occupation emerged as the strongest independent predictor in the regression model, with participants in occupational categories showing more than twice the odds of cervicogenic headache. This finding is clinically plausible because occupational routines often involve prolonged sitting, sustained screen use, static neck posture, limited movement breaks, and inadequate ergonomic arrangements. The significant bivariate association between occupation and posture-triggered headache further supports the role of work- or study-related physical loading in cervicogenic headache symptoms. Previous evidence indicates that cervical posture, mechanosensitivity, and disability are interrelated in cervicogenic headache, particularly when sustained postural demands contribute to cervical strain and symptom provocation (3). Therefore, occupational exposure should not be treated merely as a demographic variable; rather, it

represents a modifiable context for prevention through ergonomic education, workstation correction, movement scheduling, and early physiotherapy referral.

Physical activity was also independently associated with cervicogenic headache, with physically inactive participants showing more than twice the odds of cervicogenic headache in the regression model. This supports the interpretation that sedentary behavior and reduced movement may contribute to cervical muscle deconditioning, reduced postural endurance, and greater vulnerability to posture-related headache symptoms. The finding aligns with systematic review evidence suggesting that exercise-based and multimodal physiotherapy interventions may reduce headache intensity, frequency, and disability in individuals with cervicogenic headache, although evidence quality varies across studies (11,12). In the present study, physical activity was not simply a general wellness variable but an independent predictor, indicating that activity promotion may be a key prevention and management target in young urban adults.

Screen time showed the strongest bivariate association with posture-triggered headache, with $\chi^2 = 21.321$ and $p < 0.001$. Although screen time was not included in the reported logistic regression table, the strength of its bivariate relationship indicates that prolonged digital exposure may be an important behavioral marker of cervicogenic headache risk. Extended screen use commonly involves forward head posture, reduced cervical movement variability, sustained visual attention, and prolonged sitting, all of which may increase cervical loading and symptom provocation. This finding is particularly relevant for students and office-based young adults in Karachi, where academic and occupational demands often require prolonged mobile phone and computer use. Digital wellness strategies, such as structured breaks, screen-height adjustment, visual rest intervals, and neck mobility routines, may therefore have practical value in reducing posture-related headache burden (13,14).

The distinction between bivariate and multivariable findings is important for interpretation. Stress-related variables were significantly associated with headache presence in chi-square analysis, but perceived stress did not independently predict cervicogenic headache after adjustment. This does not mean that stress is clinically irrelevant; rather, it suggests that stress may operate indirectly through behavioral and physiological pathways such as reduced physical activity, poor posture, prolonged sedentary behavior, sleep disruption, or increased muscle tension. However, because formal mediation analysis was not conducted, the present study cannot confirm a mediating pathway. The findings should therefore be interpreted as showing an association between stress and headache at the bivariate level, with occupation and physical activity demonstrating stronger independent associations in the regression model.

The study has several clinical and public-health implications. First, young adults presenting with recurrent headache symptoms should be assessed not only for headache frequency and pain location but also for neck-related symptom patterns, posture-triggered aggravation, occupational routines, screen exposure, physical activity, and coping difficulty. Second, cervicogenic headache prevention in urban settings should include ergonomic awareness, physical activity promotion, posture education, and access to physiotherapy-based screening and intervention. Third, stress management may still be beneficial as part of a multidimensional program, particularly when psychological distress coexists with sedentary behavior, poor coping, and cervical muscle tension. Psychological and behavioral interventions for chronic headache have shown implementation challenges, but integrated care models that combine education, activity modification, and self-management may be more feasible for community and workplace settings (15).

This study also has limitations that should be considered when interpreting the findings. The cross-sectional design prevents causal inference and does not establish whether stress, occupation, screen time, or inactivity preceded cervicogenic headache symptoms. Cross-sectional studies can identify associations and generate hypotheses, but temporal direction and causal pathways require longitudinal or interventional designs (16). The use of convenience sampling may limit generalizability to all young

adults in Karachi. Cervicogenic headache status was based on questionnaire-reported symptom indicators rather than clinical examination, diagnostic nerve blocks, or standardized physical assessment, which may introduce misclassification. The study also relied on self-reported stress, activity, sleep, and screen-time variables, creating the possibility of recall and response bias. Finally, the available regression output did not include 95% confidence intervals, standard errors, or reference categories, limiting the precision and interpretability of the reported odds ratios.

Future studies should use larger multi-center samples, probability-based or stratified sampling, clinically confirmed cervicogenic headache criteria, validated posture and disability measures, and complete multivariable reporting with confidence intervals. Longitudinal designs are needed to determine whether stress, occupational posture, physical inactivity, and screen exposure predict future development or persistence of cervicogenic headache. Interventional studies should evaluate whether combined ergonomic correction, structured physical activity, cervical exercise, and stress-management programs reduce headache frequency, disability, and healthcare burden in young urban populations. Such evidence would strengthen the clinical and public-health basis for targeted cervicogenic headache prevention in Pakistan and comparable South Asian urban contexts.

CONCLUSION

Cervicogenic headache-related symptoms were common among young adults in Karachi, with more than half of participants reporting headache patterns consistent with cervical involvement, particularly posture- or neck movement-triggered headache. Perceived stress and poor coping were significantly associated with headache presence in bivariate analysis; however, perceived stress did not independently predict cervicogenic headache in the multivariable model. Occupation and physical activity were the strongest independent predictors, indicating that occupational exposure, sedentary behavior, and reduced physical activity may play a more direct role in cervicogenic headache presentation than perceived stress alone. These findings support a multidimensional prevention and management approach that combines ergonomic education, movement breaks, structured physical activity, cervical posture awareness, stress-management strategies, and timely physiotherapy referral for young adults in urban settings.

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