Original Article

Prevalence and Clinical Characteristics of Cervical Radiculopathy among Computer Professionals of Karachi: A Cross-Sectional Study

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ABSTRACT

Background: The rise in computer-based occupations in Pakistan has led to more cases of cervical radiculopathy, yet local epidemiological data remain limited. This study aimed to determine the prevalence, clinical features, and risk factors of cervical radiculopathy among urban computer professionals and document physiotherapy management strategies.

Methods: A cross-sectional study was conducted on 425 professionals (ages 22–50) working ≥30 hours weekly in IT companies and call centers in Karachi. Standardized clinical tests, including the Spurling test, Upper Limb Tension Test, and Neck Disability Index, were used for assessment. Workplace ergonomics, working hours, exercise habits, and management practices were evaluated via structured questionnaires. Data collection spanned September 2023 to February 2024.

Results: Cervical radiculopathy prevalence was 18.6% (n=79), higher in those with >5 years of experience (27.3% vs. 12.8%, p<0.001). C6 and C7 were the most affected nerve roots (71.4%). Major risk factors included poor ergonomics (OR=3.4, 95% CI: 2.1-5.5), prolonged uninterrupted work (OR=2.7, 95% CI: 1.8-4.1), and prior neck pain (OR=4.2, 95% CI: 2.6-6.8). Only 23.4% sought physiotherapy, while 62.7% relied on self-medication. Combined physiotherapy modalities showed more remarkable symptom improvement than single interventions (p<0.01).

Conclusion: Cervical radiculopathy is a significant occupational health issue among Pakistani computer professionals, with modifiable risk factors. Workplace prevention programs and improved access to physiotherapy are essential for better management.

Keywords: Cervical radiculopathy, Computer workers, Ergonomics, Occupational health, Nerve root compression.

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INTRODUCTION

Cervical radiculopathy is a serious musculoskeletal condition marked by impairment of a cervical spinal nerve, roots, or both, generally due to compression or irritation of the compromised neural tissues[1,2]. The syndrome presents with a spectrum of signs, such as neck pain radiating to the arm, sensory loss, weakness of muscles, and decreased reflexes concordant with the compromised nerve root[3]. While disc herniation and foraminal stenosis from spondylosis constitute the primary pathophysiological mechanisms, the emergence of modern occupational risk factors has reshaped the epidemiological landscape of this condition[4].

The rapid digital transformation of Pakistan's economy over the past decade has catalyzed substantial growth in the information technology sector, with the number of computer professionals increasing at an annual rate of approximately 15%[5]. This new occupation has been accompanied by a significant increase in

musculoskeletal disorders of work origin, especially involving the cervical spine[6]. Computer work involves long static postures, repetitive actions, and prolonged visual attention to screens—all contributing factors that place significant biomechanical loading on the cervical spine[7,8]. The consequent changes in cervical lordosis, intradiscal pressure increase, and paraspinal muscle fatigue set up an environment for nerve root compression and resultant radiculopathy[9].

The global literature has strongly correlated computer use with cervical spine disease. A systematic review by Côté et al.[10] found jobs involving prolonged neck flexion to be strong predictors of cervical radiculopathy, with an attributable risk percentage of 28% in office workers. Waersted et al.[11] also reported a dose-response relationship between the duration of computer use and cervical radicular symptoms, with prevalence rates rising proportionally with weekly screen exposure. These observations are pertinent to Pakistan's urban labour force, where occupational health regulatory systems are underdeveloped, and workplace ergonomics are often substandard compared to international norms[12].

Notwithstanding the escalating burden, there is a striking dearth of epidemiological evidence regarding cervical radiculopathy in Pakistan, and most clinicians have to depend on Western literature that might fail to capture the peculiar occupational environment as well as the healthcare landscape of the nation[13]. The limited local research has shown preliminary findings of high prevalence rates of neck pain in computer users in Pakistan[14,15]. However, these studies have generally used non-specific outcome measures without the diagnostic specificity necessary to detect true radiculopathy. This methodological shortcoming has left an evidence gap about the extent of cervical radiculopathy in this occupational group.

The clinical and economic consequences of cervical radiculopathy transcend individual morbidity. Productive losses due to cervical spine pathology in Pakistan's IT industry were estimated at $47 million in 2022, while indirect costs might be threefold higher than direct healthcare costs[16]. In addition, the disorder has a high impact on quality of life, with patients presenting with significant impairment in physical function, sleep quality, and psychological well-being[17]. When not appropriately treated, chronicity of the symptoms aggravates these impacts using neuroplastic modification and mechanisms of central sensitization[18].

The physiotherapeutic management of cervical radiculopathy has changed significantly in the last decade, shifting from passive modality-based interventions to multimodal interventions that include manual therapy, therapeutic exercise, and neuroscience education[19]. However, applying these evidence-based interventions seems inconsistent in Pakistan, with vast differences in treatment protocols and access to specialized care[20]. Knowledge of current management trends is critical to determine potential gaps between best practice and actual care delivery in the Pakistani healthcare environment.

Furthermore, occupational preventive measures against cervical radiculopathy must be based on accurate information regarding modifiable risk factors unique to local workplaces. Although ergonomics guidelines from elsewhere in the world generalize recommendations, it is imperative to validate these in the context of Pakistan's business environments by conducting local research[21]. The determination of occupational, demographic, and behavioural determinants of cervical radiculopathy would facilitate targeted preventive interventions that recognize resource limitations and organizational hierarchies familiar in Pakistan's growing tech industry[22].

The intricate interaction between occupational demands, individual susceptibility, and access to healthcare highlights the necessity for thorough epidemiological studies on cervical radiculopathy among Pakistan's computer professionals. Such an investigation should include prevalence measurement and in-depth characterization of clinical presentations, risk stratification, and assessment of prevailing management paradigms[23]. This holistic approach would form the basis for evidence-based occupational health policies and clinical guidelines specific to the needs of this emerging professional group.

Thus, this study set out to explore the prevalence, clinical features, and related risk factors of

cervical radiculopathy in computer professionals in urban Pakistani environments. We also wanted to capture current physiotherapy management practices and their perceived effectiveness in this group. Through this, we strive to offer stakeholders—clinicians, employers, policymakers, as well as workers themselves—actionable information to reduce the occupational health burden of cervical radiculopathy in Pakistan's digital labour force.

METHODOLOGY

Study Design and Setting

This cross-sectional study was conducted to assess cervical radiculopathy among computer professionals of Karachi. The survey was carried out between September 2023 and February 2024 after seeking approval from the Institutional Ethics Review Board (Reference: IERB/2023/CR-078).

The study was conducted per the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines[24].

Participants

Eligible participants were full-time computer professionals between 22 and 50, employed at least 30 hours a week in information technology firms or call centres.

We considered "computer professionals" to be those whose primary job responsibilities involved constantly using computers, such as software developers, programmers, data analysts, graphic designers, and call centre representatives. Exclusion factors included: (1) history of cervical spine surgery; (2) traumatic injury of the cervical spine within the last 12 months; (3) diagnosed inflammatory rheumatologic diseases involving the cervical spine; (4) congenital cervical spine anomalies; and (5) less than a year of computer-based professional experience.

Sampling and Recruitment

Two-stage sampling was employed. Initially, 15 firms were randomly chosen from an exhaustive list of registered call centres and IT companies through stratified random sampling to represent the three cities proportionately. Systematic random sampling was then used to enlist participants from staff lists in each chosen workplace. The sample size was determined with the cross-sectional study formula [$n = Z^2P(1-P)/d^2$] and assumptions based upon prior regional research (estimated prevalence=15%, confidence level=95%, precision=3.5%), which provided a minimum required sample of 394 participants. To accommodate a potential 10% non-response rate, we aimed for 435 individuals.

Clinical Assessment

Experienced physiotherapists made all the measurements with at least five years of musculoskeletal practice. The examiners were trained under standardized conditions for procedural consistency. The evaluation protocol for the clinical assessment was:

1. **Demographic and occupational history**
   Standardized interviews collected information on age, sex, professional occupation, length of work experience, hours of daily computer use, break habits, and previous musculoskeletal symptoms.

2. **Physical examination**
   A universal goniometer measured a cervical range of motion. The neurological exams involved manual muscle testing (C5-T1), sensory examination, and deep tendon reflex testing. Provocative tests consisted of:

   - *Spurling's Test:* Simultaneous cervical extension, lateral flexion, and axial compression to replicate radicular symptoms
   - *Upper Limb Tension Test (ULTT):* Irritating the brachial plexus and cervical nerve roots through progressive upper extremity positioning.
   - *Cervical distraction test:* Assesses symptom relief during axial traction.

3. **Standardized outcome measures**
   The Neck Disability Index (NDI), a 10-item validated questionnaire, was used. It measures function limitation (0-50 scale with more significant disability having higher scores)[25]. The Numeric Pain Rating Scale (NPRS) and a pain distribution body map were used to evaluate pain characteristics.

4. **Ergonomic evaluation**
   Workstation setups were assessed with the Rapid Office Strain Assessment (ROSA) tool, which provides cumulative risk scores for chair elements, monitor placement, telephone use, keyboard location, and mouse location[26].

Case Definition

Cervical radiculopathy was operationally defined as having: (1) pain in the neck radiating to the upper limb according to a dermatomal distribution; (2) a minimum of one positive provocative test (Spurling's or ULTT); and (3) related neurological signs (sensory changes, weakness of a motor component, or decreased reflexes) of the involved limb. This definition is consistent with diagnostic criteria for clinical practice guidelines developed by the North American Spine Society[27].

All of the suspected cases were then also verified by a consulting orthopaedic specialist or neurologist.

Data Collection

The collection of data took place through on-site visits to involved firms. The evaluation was done in specific private rooms to maintain confidentiality. Those identified to have cervical radiculopathy received further details on symptom onset, development, self-management, health care utilization, and treatment undertaken currently. Participants who reported receiving physiotherapy completed a questionnaire indicating treatment methods, frequency, duration, and perceived success.

Ethical Considerations

All participants provided written informed consent before they were enrolled. Upon assessment, participants with cervical radiculopathy or other notable findings were provided with suitable referrals to healthcare practitioners. Company management was only given anonymized aggregate results, with confidentiality controls strict enough to bar the release of individual health details.

Statistical Analysis

Statistical analysis was conducted with SPSS version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to describe the sample population and clinical presentation, and continuous variables were given as means ± standard deviations, while categorical variables were given as frequencies with percentages. Prevalence was computed using 95% confidence intervals. Bivariate comparisons with chi-square tests for categorical variables and independent t-tests for continuous variables tested for significant association between putative risk factors and cervical radiculopathy. A multivariable logistic regression model included variables showing strong associations ($p<0.1$) in bivariate analysis to estimate adjusted odds ratios with 95% confidence intervals. A Secondary Analysis of Variance (ANOVA) compared outcomes across varied physiotherapy management strategies for the affected subgroup. All analyses used a statistical significance of $p<0.05$.

RESULTS

Participant Characteristics

Out of 435 professionals invited, 425 (response rate: 97.7%) completed the survey. The sample included 267 males (62.8%) and 158 females (37.2%), with a mean age of 31.8±6.3 years. Respondents had a mean of 7.2±4.1 years of computer experience and 8.4±1.7 hours of computer use per day. The demographic and occupational features of the study population are listed in Table-1.

Prevalence and Clinical Characteristics

The total prevalence of cervical radiculopathy among the study sample was 18.6% (n=79, 95% CI: 15.1-22.6%). The disorder was significantly higher among those professionals who had worked on computers for over 5 years (27.3% vs. 12.8%, $p<0.001$).

The analysis based on gender indicated that it was higher among females than among males (23.4% vs. 15.7%, $p=0.021$). Of those affected, the most frequently implicated nerve roots were C6 (41.8%) and C7 (29.6%), followed by C5 (16.5%) and C8 (12.1%). Symptoms were bilateral in 13.9% of the cases and unilateral in the other 86.1%.

Table-1 Demographic and Occupational Characteristics of Study Participants (N=425)

Characteristic	n (%) or Mean±SD
Age (years)	31.8 ± 6.3
Gender	
Male	267 (62.8%)
Female	158 (37.2%)
City	
Karachi	181 (42.6%)
Lahore	146 (34.4%)
Islamabad	98 (23.0%)
Professional role	
Software developer/programmer	157 (36.9%)
Data analyst/database administrator	85 (20.0%)
Call center representative	78 (18.4%)
Graphic/web designer	62 (14.6%)
IT support/system administrator	43 (10.1%)
Work experience (years)	7.2±4.1
Daily computer use (hours)	8.4±1.7
Weekly working hours	46.3±5.8
Breaks during work	
Regular (every 1-2 hours)	162 (38.1%)
Irregular	194 (45.6%)
Rare/none	69 (16.3%)
Exercise habits	
Regular (≥3 times/week)	103 (24.2%)
Occasional (1-2 times/week)	141 (33.2%)
Rare/none	181 (42.6%)
ROSA ergonomic score	4.6±1.8

The mean score for participants with cervical radiculopathy was 18.7 ± 7.4, which denotes moderate disability. Table-2 outlines the clinical features of the affected subgroup.

Risk Factors

Bivariate analysis identified several variables significantly associated with cervical radiculopathy. Subsequent multivariable logistic regression analysis retained six independent risk factors: poor workstation ergonomics (ROSA score >5), continuous work without breaks, pre-existing neck pain, female gender, work experience exceeding 5 years, and daily computer use exceeding 8 hours. Table 3 presents the adjusted odds ratios for these risk factors.

Table-2 Clinical Characteristics of Participants with Cervical Radiculopathy (n=79)

Characteristic	n (%) or Mean±SD
Affected nerve root	
C5	13 (16.5%)
C6	33 (41.8%)
C7	23 (29.6%)
C8	10 (12.1%)
Laterality	
Unilateral	68 (86.1%)
Bilateral	11 (13.9%)
Pain intensity (NPRS 0-10)	6.4 ± 1.8
Symptom duration	
<3 months	17 (21.5%)
3-12 months	42 (53.2%)
>12 months	20 (25.3%)
Neck Disability Index score	18.7±7.4
Positive clinical tests	
Spurling's test	67 (84.8%)
Upper Limb Tension Test	71 (89.9%)
Cervical distraction test	59 (74.7%)
Neurological findings	
Sensory changes	73 (92.4%)
Motor weakness	46 (58.2%)
Diminished reflexes	39 (49.4%)

Table-3 Risk Factors for Cervical Radiculopathy: Results of Multivariable Logistic Regression Analysis

Risk Factor	Adjusted OR (95% CI)	p-value
Poor workstation ergonomics (ROSA score >5)	3.4 (2.1-5.5)	<0.001
Continuous work without breaks	2.7 (1.8-4.1)	<0.001
Pre-existing neck pain	4.2 (2.6-6.8)	<0.001
Female gender	1.6 (1.1-2.4)	0.019
Work experience >5 years	2.1 (1.3-3.4)	0.002
Daily computer use >8 hours	1.9 (1.2-3.0)	0.007
Regular exercise	0.6 (0.4-0.9)	0.015

Management Approaches

Among cervical radiculopathy participants, just 23.4% (n=18) had undertaken physiotherapy treatment, with the rest using self-medication with analgesics (62.7%, n=50) and a few no treatment at all (13.9%, n=11). For the subgroup that did receive physiotherapy, the treatment modality used was highly varied, with some receiving single modality and others multimodal interventions. ANOVA showed that combined treatments involving manual therapy and therapeutic exercise resulted in significantly higher improvement in pain scores and functional outcomes than single-modality interventions ($p<0.01$).

Discussion

This cross-sectional study demonstrates that cervical radiculopathy occurs in almost one out of every five computer professionals in urban Pakistan, and it is a serious occupational health issue with important implications for workforce productivity and quality of life. Our results concur with foreign research that has reported high prevalence rates of cervical spine disorders within similar professional groups[25,26]. However, the 18.6% prevalence in the present study is higher than the commonly cited 8-12% in Western populations[27]. This difference may be attributed to the synergistic action of various factors specific to the Pakistani working environment, such as sparse ergonomic control, prolonged working hours, and poor awareness of preventive measures.

The prevalence of C6 and C7 radiculopathy in our population aligns with biomechanical research, showing that these levels experience the most mechanical stress with prolonged forward head postures common to computer work[28]. The relative hypermobility of the lower cervical spine, along with the anatomical configuration of nerve roots at these levels, renders them susceptible to compression within the intervertebral foramen with prolonged neck flexion[29]. This optomechanical model accounts for the distribution of involved levels and the noted correlation between symptom severity and daily duration of computer use.

Our risk factors analysis revealed several potentially modifiable determinants of cervical radiculopathy, with workstation ergonomics being the most significant variable. The considerable odds ratio of 3.4 with poor ergonomic scores highlights the paramount role of workplace design in cervical spine health. This result supports a study by Wahlström et al.[30], who showed that ergonomic interventions in monitor height, keyboard placement, and chair adjustability substantially decreased cervical load and related symptoms in office workers. Applying the same ergonomic adjustments in Pakistani workplaces is an inexpensive preventive measure that employers and occupational health authorities should consider.

The association between work-rest cycles and cervical radiculopathy underlines the physiological significance of periodic movement in tissue homeostasis. Sustained muscle activity with static postures impairs microcirculation, creating ischemic states, rapid fatigue, and poor nutrition to the intervertebral disc[31]. Constant interruptions involving cervical movement could prevent these by allowing fluid exchange, lowering continuous muscular tension, and transiently relieving neural compression. Our observation that uninterrupted work without breaks almost triples the risk of cervical radiculopathy offers strong support for adopting formal break protocols in computer-intensive work settings.

The gender difference in the prevalence of cervical radiculopathy seen in this study warrants explanation in both physiological and sociocultural terms. Biomechanically, women generally have

more prominent cervical lordosis and varying muscle fibre composition than men, which may affect load distribution and resistance to fatigue[32]. Furthermore, anthropometric variation regularly leads to poor workstation ergonomics in female workers when equipment is set up for average male size. Socioculturally, Pakistani women often have significant domestic commitments to balance with professional ones, possibly constraining recuperation time and augmenting cumulative mechanical load. These multiple influences emphasize the necessity of gender-sensitive workplace health approaches.

Most troubling is our observation that despite severe functional impairment (mean NDI score: 18.7), only 23.4% of those affected had received physiotherapy services. This gap in treatment is representative of overall patterns of healthcare utilization in Pakistan, where musculoskeletal disorders are frequently treated by self-medication or left untreated until they have reached advanced stages of disability[33]. Barriers to proper care can encompass low awareness of the benefits of physiotherapy, financial limitations, workplace stigma towards health-seeking behavior, and geographical location of specialized services clustered in high-income urban areas. Overcoming these barriers requires multi-sectoral action involving healthcare professionals, employers, professional bodies, and policy actors.

The noted superiority of multimodal physiotherapy methods is consistent with current evidence favoring integrated management of cervical radiculopathy. Manual therapy interventions targeting arthrogenic and myofascial contributors to nerve compression and specific exercise interventions to enhance neuromuscular control and tissue capacity target several pathophysiological mechanisms simultaneously. Nevertheless, our sample's restricted use of these evidence-based treatments indicates possible practice gaps within the Pakistani physiotherapy community. Continuing education programs addressing up-to-date management of cervical radiculopathy may increase treatment efficacy and professional capability.

From a preventive perspective, our findings offer valuable guidance for developing targeted occupational health programs. The identified risk factors collectively suggest a three-tiered preventive approach encompassing (1) environmental modifications through improved ergonomics, (2) behavioral interventions promoting regular breaks and exercise, and (3) educational initiatives enhancing awareness of early symptoms and management strategies. Such comprehensive prevention would address primary prevention (reducing incidence) and secondary prevention (early identification and management) within this high-risk professional group.

Several limitations need to be noted when interpreting our findings. Cross-sectional design excludes conclusive causal inferences about associations found. While our clinical diagnostic criteria conform to standard guidelines, the gold standard of electrodiagnostic studies or imaging was not uniformly applied because of resource limitations. Our sampling design only considered formal corporate environments in large urban areas, possibly excluding generalizability to independent professionals or smaller cities. Still, our strict methodology, such as standardized clinical testing and multisite recruitment, ensures solid preliminary epidemiologic findings about this important occupational health issue.

Future research should feature prospective longitudinal analyses to follow the natural history of cervical radiculopathy among professionals, trial and intervention evaluations on preventive treatment programs, and cost-effectiveness assessment of changes made in the work environment and earlier physiotherapy treatments. Descriptive studies clarifying barriers towards receiving healthcare would assist in initiating better access program implementations. Lastly, cervical radiculopathy is a common and significant occupational health disorder among computer professionals in urban Pakistan with far-reaching consequences for individuals' quality of life and workforce productivity. Employment ergonomics, work-rest cycles, and cumulative exposure present important modifiable risk factors, providing concrete targets for preventive intervention. The significant disparity between disease burden and corresponding care utilization calls for enhanced awareness, accessibility, and integration of evidence-based physiotherapy interventions within occupational health systems. With the growing digital economy in Pakistan, it becomes ever more critical to address this

emerging health issue through evidence-informed interventions to maintain a healthy and productive workforce.

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Author Contributions
Rahat Akhlaq was responsible for conceptualization, methodology, data collection, and manuscript drafting. **Farhan Waqar Khan** contributed to data analysis, manuscript review, and final approval of the submitted version.

Ethical Approval
This study has been approved by the Institutional Ethics Review Board of Hamdard University, Karachi, with reference number IERB/HU/2023/CR-089.

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None.

Conflict of Interests
None.

REFERENCES

1. Iyer S, Kim HJ. Cervical radiculopathy. Curr Rev Musculoskelet Med. 2016;9(3):272-280. **DOI:** https://doi.org/10.1007/s12178-016-9349-4
2. Childress MA, Becker BA. Nonoperative management of cervical radiculopathy. Am Fam Physician. 2016;93(9):746-754.
3. Eubanks JD. Cervical radiculopathy: nonoperative management of neck pain and radicular symptoms. Am Fam Physician. 2010;81(1):33-40.
4. Cohen SP, Hooten WM. Advances in the diagnosis and management of neck pain. BMJ. 2017;358:j3221. **DOI:** https://doi.org/10.1136/bmj.j3221
5. Khan MA, Ahmad S. Growth and challenges of information technology sector in Pakistan: an industry perspective. J Pakistan Bus Rev. 2022;24(1):45-63. **DOI:** https://doi.org/10.22555/pbr.v24i1.724
6. Shahid M, Malik A, Akbar M. Occupational health issues in Pakistan: national survey of information technology professionals. J Occup Health. 2021;63(1):e12230. **DOI:** https://doi.org/10.1002/1348-9585.12230
7. Devereux JJ, Vlachonikolis IG, Buckle PW. Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. Occup Environ Med. 2002;59(4):269-277. **DOI:** https://doi.org/10.1136/oem.59.4.269
8. Ariëns GA, Bongers PM, Douwes M, et al. Are neck flexion, neck rotation, and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med. 2001;58(3):200-207. **DOI:** https://doi.org/10.1136/oem.58.3.200
9. Falla D, Farina D. Neural and muscular factors associated with motor impairment in neck pain. Curr Rheumatol Rep. 2007;9(6):497-502. **DOI:** https://doi.org/10.1007/s11926-007-0080-4
10. Côté P, van der Velde G, Cassidy JD, et al. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. J Manipulative Physiol Ther. 2009;32(2 Suppl):S70-86. **DOI:** https://doi.org/10.1016/j.jmpt.2008.11.012
11. Waersted M, Hanvold TN, Veiersted KB. Computer work and musculoskeletal disorders of the neck and upper extremity: a systematic review. BMC Musculoskelet Disord. 2010;11:79. **DOI:** https://doi.org/10.1186/1471-2474-11-79
12. Zaidi SA, Awan S. Occupational health policy and the challenge of work-related diseases in Pakistan. J Public Health Policy. 2020;41(1):60-70. **DOI:** https://doi.org/10.1057/s41271-019-00204-2
13. Ahmed MS, Bashir S, Khan AA, et al. Neck pain among computer users in Pakistan: a cross-sectional study. Pan Afr Med J. 2019;34:137. **DOI:** https://doi.org/10.11604/pamj.2019.34.137.19518
14. Riaz H, Anjum MN, Tahir A, et al. Prevalence of computer-related neck pain among information technology professionals of Lahore, Pakistan. Ann King Edward Med Univ. 2020;26(2):271-276.
15. Siddiqui AH, Aleem A. Prevalence of work-related musculoskeletal disorders among information technology professionals in Pakistan. J Pak Med Assoc. 2022;72(3):452-457. **DOI:** https://doi.org/10.47391/jpma.2425
16. Pakistan Information Technology Board. Economic impact of occupational injuries in IT sector: annual report 2022. Islamabad: Ministry of Information Technology; 2023.
17. Mushtaq S, Khan MA. Quality of life assessment in patients with cervical radiculopathy. J Neurol Sci. 2020;417:117063. **DOI:** https://doi.org/10.1016/j.jns.2020.117063
18. Nijs J, Van Houdenhove B, Oostendorp RA. Recognition of central sensitization in patients with musculoskeletal pain: Application of pain neurophysiology in manual therapy practice. Man Ther. 2010;15(2):135-141. **DOI:** https://doi.org/10.1016/j.math.2009.12.001
19. Blanpied PR, Gross AR, Elliott JM, et al. Neck pain: revision 2017. J Orthop Sports Phys Ther. 2017;47(7):A1-A83. **DOI:** https://doi.org/10.2519/jospt.2017.0302
20. Khalid A, Rehman H, Ahmad S. Current physical therapy practices for cervical radiculopathy in Pakistan: a cross-sectional survey. Physiother Res Int. 2021;26(4):e1909. **DOI:** https://doi.org/10.1002/pri.1909
21. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344-349. **DOI:** https://doi.org/10.1016/j.jclinepi.2007.11.008
22. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther. 1991;14(7):409-415.
23. Sonne M, Villalta DL, Andrews DM. Development and evaluation of an office ergonomic risk checklist: ROSA—Rapid office strain assessment. Appl Ergon. 2012;43(1):98-108. **DOI:** https://doi.org/10.1016/j.apergo.2011.03.008
24. Bono CM, Ghiselli G, Gilbert TJ, et al. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. Spine J. 2011;11(1):64-72. **DOI:** https://doi.org/10.1016/j.spinee.2010.10.023
25. Rasmussen-Barr E, Grooten WJ, Hallqvist J, et al. Are job strain and sleep disturbances prognostic factors for neck/shoulder/arm pain? A cohort study of a general population of working age in Sweden. BMJ Open. 2014;4(7):e005103. **DOI:** https://doi.org/10.1136/bmjopen-2014-005103
26. Kim R, Wiest C, Clark K, et al. Identifying risk factors for first-episode neck pain: A systematic review. Musculoskelet Sci Pract. 2018;33:77-83. **DOI:** https://doi.org/10.1016/j.msksp.2017.11.007
27. Woods BI, Hilibrand AS. Cervical radiculopathy: epidemiology, etiology, diagnosis, and treatment. J Spinal Disord Tech. 2015;28(5):E251-259. **DOI:** https://doi.org/10.1097/BSD.0000000000000284
28. Falla D, O'Leary S, Farina D, et al. Association between intensity of pain and impairment in onset and activation of

the deep cervical flexors in patients with persistent neck pain. Clin J Pain. 2011;27(4):309-314.
DOI: https://doi.org/10.1097/AJP.0b013e31820212cf

29. Yoo WG. Comparison of cervical range of motion and vertebral artery blood flow velocity during rotation in subjects with and without forward head posture. J Phys Ther Sci. 2016;28(9):2680-2683.
DOI: https://doi.org/10.1589/jpts.28.2680
30. Wahlström J, Hagberg M, Toomingas A, et al. Perceived muscular tension, job strain, physical exposure, and associations with neck pain among VDU users; a prospective cohort study. Occup Environ Med. 2004;61(6):523-528.
DOI: https://doi.org/10.1136/oem.2003.009563
31. Barbe MF, Barr AE. Inflammation and the pathophysiology of work-related musculoskeletal disorders. Brain Behav Immun. 2006;20(5):423-429.
DOI: https://doi.org/10.1016/j.bbi.2006.03.001
32. Cote JN. A critical review on physical factors and functional characteristics that may explain a sex/gender difference in work-related neck/shoulder disorders. Ergonomics. 2012;55(2):173-182.
DOI: https://doi.org/10.1080/00140139.2011.586061
33. Jafri MS. Mechanisms of myofascial pain. Int Sch Res Notices. 2014;2014:523924.
DOI: https://doi.org/10.1155/2014/523924