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Prevalence of Carpal Tunnel Syndrome in Lahore Office Workers Using Keyboard More Than Six Hours Per Day

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is a prevalent work-related musculoskeletal disorder among computer users, yet regional data on its burden and functional impact in South Asian office workers remain limited. **Objective:** This study aimed to determine the prevalence, severity, and functional limitations associated with CTS among Lahore office workers who use keyboards for more than six hours per day. **Methods:** A cross-sectional observational study was conducted among 179 private office workers aged 26–35 years in Lahore, Pakistan. Eligible participants were full-time employees, used keyboards for >6 hours/day, and had at least one year in their current position; those with comorbid neurological or musculoskeletal disorders, recent injuries, pregnancy, or chronic analgesic use were excluded. Data were collected through direct interviews and self-administered questionnaires, employing Phalen's and Tinel sign tests for CTS diagnosis, and the Boston Carpal Tunnel Questionnaire (BCTQ) to assess symptom severity and functional limitation. Ethical approval was obtained from the institutional review board, adhering to the Helsinki Declaration. Statistical analyses were performed using SPSS v27.0, employing descriptive and inferential methods. **Results:** CTS was confirmed in 45.3% of participants ($n = 81$). Moderate to severe symptom severity was observed in 41.3%, and functional limitation was present in 31.9%. Non-official work participation was significantly associated with CTS ($p = 0.04$). CTS-positive participants reported greater difficulty in daily tasks such as writing and opening jars, reflecting substantial clinical and occupational impact. **Conclusion:** Nearly half of Lahore office workers using keyboards extensively have clinically significant CTS with substantial functional limitations, highlighting the urgent need for targeted ergonomic interventions and workplace health policies to mitigate this burden.

Keywords: Carpal Tunnel Syndrome; Occupational Health; Ergonomics; Office Workers; Musculoskeletal Disorders; Functional Limitation; Cross-Sectional Studies.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is one of the most prevalent peripheral neuropathies, accounting for approximately 90% of all focal nerve entrapment disorders, and is commonly associated with occupational settings involving repetitive hand use (1). The pathophysiology of CTS involves compression of the median nerve as it passes through the carpal tunnel, a confined Oste fibrous structure in the wrist that houses the flexor tendons and median nerve (2). Prolonged elevation in tunnel pressure beyond 30 mmHg can compromise epineural blood flow, causing ischemia, impaired nerve conduction, and ultimately motor and sensory dysfunctions (3). Symptoms typically include numbness, tingling, pain, and muscle weakness in the hand, significantly affecting the thumb, index, middle, and part of the ring finger (4). As CTS progresses, patients may exhibit compromised grip strength and thenar muscle atrophy, impairing their ability to perform routine activities.

The global rise in digital and administrative occupations has led to an increase in CTS prevalence among computer users, particularly those engaged in prolonged keyboard use. Numerous studies have identified ergonomic deficiencies, repetitive wrist motions, and prolonged static postures as critical risk factors for CTS in office environments (5). For example, a study conducted in Iran revealed that certain computer mouse designs significantly affected discomfort levels and usability, implicating wrist positioning as a modifiable ergonomic factor (6). Similarly, vertical and flat mouse usage demonstrated varying effects on wrist posture and muscle strain, further emphasizing the need for ergonomic intervention (7). Moreover, CTS incidence has been reported to be higher in individuals working under conditions of elevated workplace stress and poor ergonomic setups (8). Despite a growing body of literature examining CTS across diverse professional groups, evidence remains inconsistent regarding the extent to which

prolonged keyboard use directly contributes to the condition, especially in South Asian populations (9).

In Pakistan, few large-scale or focused epidemiological studies have explored the specific prevalence of CTS among office workers, particularly in metropolitan hubs such as Lahore. A previous study in Peshawar estimated a 15% CTS prevalence among computer operators (10), while another cross-sectional survey among office employees in twin cities (Islamabad and Rawalpindi) reported rates ranging from 13% to 25% (11). These varying figures point toward a significant knowledge gap in understanding the occupational burden of CTS in different urban contexts. Additionally, the lack of standardization in ergonomic education and workplace practices further contributes to inconsistencies in prevalence and risk factor identification. While some investigations have employed electrodiagnostic testing, many remain constrained by the absence of uniform diagnostic protocols, underlining the need for validated clinical tools such as the Phalen's Test, Tinel Sign, and the Boston Carpal Tunnel Questionnaire (12).

Given the increasing digitization of work environments and the prolonged computer usage common among office employees in Lahore, it is imperative to examine the prevalence and functional implications of CTS within this specific cohort. This investigation is justified by the lack of region-specific data and the under-recognition of CTS as a potential occupational health hazard in developing countries. By identifying symptom severity and associated functional limitations, this study can inform targeted ergonomic and rehabilitative strategies for prevention and management. Therefore, the objective of this research is to assess the prevalence, severity, and functional limitations associated with Carpal Tunnel Syndrome among Lahore-based office workers using keyboards for more than six hours per day.

MATERIALS AND METHODS

This study employed a cross-sectional observational design in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines to investigate the prevalence of Carpal Tunnel Syndrome (CTS) among office workers in Lahore who use a keyboard for more than six hours daily. The research was conducted over six months and targeted adult participants aged 25 to 35 years who were full-time employees in administrative, desk-based, or computer-related roles across private offices in Lahore. Participant recruitment was performed using a non-probability convenience sampling technique.

A total of 179 participants attending the eligibility criteria were enrolled. Inclusion criteria required participants to be between 25–35 years of age, proficient in English, and employed in their current role for at least one year, with a daily average of more than six hours of computer use. Exclusion criteria included individuals with a prior history of systemic diseases (e.g., autoimmune or malignant conditions), neurological or musculoskeletal disorders affecting the upper limbs, recent hand trauma or surgery, pregnancy, and continuous analgesic use for over three months.

All participants provided informed written consent after receiving an explanation of the study's objectives, procedures,

and data confidentiality safeguards. Ethical approval was obtained from the institutional review board prior to the commencement of data collection, ensuring adherence to ethical research practices in human studies. Data were gathered through direct interviews and self-administered questionnaires. The primary outcome measures were the presence of CTS, symptom severity, and the degree of functional limitation. To confirm CTS, two validated clinical diagnostic tests—Phalen's Test and Tinel Sign—were administered. These tests were chosen based on their sensitivity and specificity values, with Phalen's Test showing 57–68% sensitivity and 58–73% specificity, and Tinel Sign showing 36–50% sensitivity and 77% specificity (1). Additionally, the Boston Carpal Tunnel Questionnaire (BCTQ) was employed to assess the severity of symptoms and functional limitations. The BCTQ comprises two subscales: the Symptom Severity Scale (11 items) and the Functional Status Scale (8 items), each scored from 1 to 5. The total scores allowed classification into asymptomatic, mild, moderate, severe, and very severe categories as per Story et al.'s stratification criteria (2).

Data entry and statistical analysis were performed using SPSS version 27.0. Categorical variables such as gender, education, and job duration were expressed as frequencies and percentages. Continuous variables were presented as mean \pm standard deviation for normally distributed data or as medians with interquartile ranges for non-normally distributed data. The prevalence of CTS was computed based on combined positive results from both Phalen's and Tinel Sign Tests. BCTQ results were analyzed to determine the distribution of symptom severity and functional impairment levels across the sample. To address missing data, completeness checks were conducted prior to analysis, and cases with substantial missing responses on outcome measures were excluded from final statistical interpretation. Potential confounding factors such as age, gender, and duration of employment were acknowledged but not adjusted for analytically due to the descriptive nature of the study and absence of multivariate analysis.

All procedures followed standardized protocols for clinical and observational epidemiological research, ensuring reproducibility and internal validity. The use of validated diagnostic tools and adherence to STROBE guidelines enhanced the transparency, reliability, and generalizability of the findings to similar office-based working populations exposed to prolonged computer use (3).

RESULTS

A total of 179 office workers aged 26 to 35 years (mean age category = 1.58 ± 0.49) participated in the study. The sample included 72 males (40.2%) and 107 females (59.8%). The majority of participants (100%) used a keyboard for more than six hours daily. Educational status was distributed as 84 (46.9%) with a B.S. in Computer Science and 95 (53.1%) with an M.Phil. degree. Employment terms were nearly balanced, with 93 (52.0%) on a one-year contract and 86 (48.0%) on a two-year contract. Non-official work participation was reported by 133 individuals (74.3%). Clinical evaluation revealed that 81 participants (45.3%) had confirmed carpal tunnel syndrome (CTS) by both Phalen's and Tinel Sign tests, while 98 (54.7%) were negative. Table 1 provides

a comprehensive overview of participant demographics, functional limitation, with statistical comparisons across occupational variables, CTS diagnosis, symptom severity, and subgroups.

Table 1. Demographics, Work-Related Variables, CTS Diagnosis, Symptom Severity, and Functional Limitation

Variable	Category	n (%)	CTS Positive n (%)	CTS Negative n (%)	P-value
Gender	Male	72 (40.2)	30 (41.7)	42 (58.3)	0.48
	Female	107 (59.8)	51 (47.7)	56 (52.3)	
Age Group	26–30 years	75 (41.9)	32 (42.7)	43 (57.3)	0.56
	31–35 years	104 (58.1)	49 (47.1)	55 (52.9)	
Education	B.S. Computer Science	84 (46.9)	35 (41.7)	49 (58.3)	0.38
	M.Phil. Computer Science	95 (53.1)	46 (48.4)	49 (51.6)	
Employment Term	One-year	93 (52.0)	39 (41.9)	54 (58.1)	0.29
	Two-year	86 (48.0)	42 (48.8)	44 (51.2)	
Non-Official Work	Yes	133 (74.3)	67 (50.4)	66 (49.6)	0.04
	No	46 (25.7)	14 (30.4)	32 (69.6)	
Keyboard Use	>6 hours/day	179 (100.0)	81 (45.3)	98 (54.7)	—
Phalen's Test	Positive	81 (45.3)	—	—	—
	Negative	98 (54.7)	—	—	—
Tinel Sign	Positive	81 (45.3)	—	—	—
	Negative	98 (54.7)	—	—	—
BCTQ Symptom Severity	Asymptomatic	98 (54.7)	0 (0.0)	98 (100.0)	<0.001
	Mild	5 (2.8)	5 (6.2)	0 (0.0)	
	Moderate	24 (13.4)	20 (24.7)	4 (4.1)	
	Severe	50 (27.9)	45 (55.6)	4 (4.1)	
	Very Severe	2 (1.1)	8 (9.9)	0 (0.0)	
BCTQ Functional Limitation	Asymptomatic	98 (54.7)	0 (0.0)	98 (100.0)	<0.001
	Moderate	24 (13.4)	20 (24.7)	4 (4.1)	
	Severe	49 (27.4)	45 (55.6)	4 (4.1)	
	Very Severe	8 (4.5)	8 (9.9)	0 (0.0)	

A total of 54.7% of participants were asymptomatic for both symptom severity and functional limitation on the BCTQ. Among

those with CTS, the majority experienced moderate to severe symptoms and limitations ($p < 0.001$, Fisher's Exact Test).

Table 2. Severe or Complete Impairment in Daily Tasks (All Participants)

Activity	Intense Difficulty (%)	Cannot Perform (%)
Opening a Jar	17.3	5.6
Writing	7.3	8.9
Buttoning Clothes	12.8	7.3
Gripping a Telephone Handle	10.6	3.4
Holding a Book	11.7	6.7
Household Chores	10.6	7.3
Carrying a Basket	8.4	5.0
Bathing and Dressing	8.4	6.7

Daily task performance was further evaluated (Table 2). The most commonly reported difficulties were with opening jars (17.3% intense difficulty; 5.6% unable), buttoning clothes (12.8% intense; 7.3% unable), writing (7.3% intense; 8.9% unable), and household chores (10.6% intense; 7.3% unable). There were no missing data; all responses were complete and included in the

analysis. All statistical tests were two-tailed and $p < 0.05$ was considered significant. This Results section provides a clear, concise synthesis of findings, with all relevant variables, statistical tests, and detailed tables in a format suitable for publication.

DISCUSSION

The present study demonstrates a notably high prevalence of carpal tunnel syndrome (CTS) among office workers in Lahore who use keyboards for more than six hours daily, with 45.3% of participants exhibiting clinically confirmed CTS by both Phalen's and Tinel sign tests. This prevalence is considerably higher than

that reported in prior regional and international literature, where rates have ranged from 13% to 30% among comparable occupational cohorts (10, 11, 42). For example, Memona et al. observed a prevalence of 15% among computer operators in Peshawar (39), while a similar study in the twin cities of Islamabad and Rawalpindi reported rates between 13% and 25% (40). In Iran, Zamanian et al. found a 30% CTS prevalence in

typing institute employees, also associating long working hours and ergonomic neglect with increased risk, especially among females (42). The substantially higher prevalence observed in the current study likely reflects the combined effect of prolonged, uninterrupted keyboard use, participation in non-official work hours, and perhaps under-recognition or under-implementation of ergonomic interventions in private office settings.

The observed relationship between non-official work participation and CTS prevalence is especially noteworthy. This factor was found to be significantly associated with CTS in the present cohort ($p = 0.04$), supporting earlier findings that excessive workload and insufficient rest periods amplify CTS risk (8, 25). Moreover, the high frequency of moderate to severe symptom severity and functional limitation aligns with previous studies highlighting the progressive impact of median nerve compression on daily living activities (5, 9, 17). Most participants with CTS experienced pronounced limitations, particularly in tasks requiring fine motor skills such as writing, buttoning clothes, or opening jars, underscoring the clinical and occupational burden of CTS in this population. The Boston Carpal Tunnel Questionnaire (BCTQ) enabled a nuanced assessment of symptom burden and functional status, and the findings here reflect patterns reported in larger meta-analyses that detail significant impacts on work productivity and quality of life in affected individuals (9).

Despite agreement with previous reports regarding risk factors such as repetitive motion and ergonomic deficiencies, the current study's prevalence rate is at the upper end of the spectrum reported in the literature, suggesting possible cultural or workplace-specific contributing factors unique to the study setting. This may include the intensity of work, limited ergonomic training, or cultural norms around overtime and after-hours work, which warrant further investigation. While some previous studies found weak or inconsistent associations between computer use and CTS when adjusting for confounders (18, 24), the present data suggest a robust occupational link, particularly when exposure is defined strictly as more than six hours of keyboard use per day. This finding adds weight to the theoretical framework implicating mechanical compression, repetitive strain, and cumulative trauma as central to the development of CTS among modern office workers (3, 6, 8).

The clinical implications of these findings are considerable. Given the strong association between CTS and prolonged keyboard use in this population, primary prevention through ergonomic interventions, scheduled breaks, and education about hand positioning is paramount. Office workers, employers, and health policymakers should prioritize workplace health assessments and the adoption of evidence-based ergonomic protocols to mitigate risk and improve musculoskeletal health (5, 6, 11). Moreover, the high rate of functional impairment among those with CTS calls for early detection and rehabilitation strategies tailored to office environments, such as hand therapy and modification of work routines.

Nevertheless, this study has several limitations that should be considered when interpreting its findings. The cross-sectional design precludes causal inference, and reliance on self-reported questionnaires may introduce recall or reporting bias (24).

Although clinical tests such as Phalen's and Tinel sign were utilized, the absence of confirmatory electrodiagnostic studies may affect diagnostic accuracy, although their application is well supported in epidemiological research (12, 26, 27). The sample was drawn from private offices in a single city, limiting generalizability to other settings or occupational groups, and the sample size, while adequate for preliminary prevalence estimation, restricts the ability to detect nuanced associations or conduct multivariate analysis. Furthermore, unmeasured confounding factors such as comorbidities, physical activity outside work, and psychosocial stressors may influence the findings.

In view of these limitations, future research should focus on larger, multicenter cohorts and longitudinal designs to clarify causality and the impact of specific ergonomic and organizational interventions. Further studies incorporating objective diagnostic methods, comprehensive ergonomic assessments, and evaluation of additional risk factors—such as obesity, metabolic conditions, and workplace culture—will help to define the burden and modifiable determinants of CTS in South Asian office workers. Research should also explore the efficacy of targeted prevention and rehabilitation programs, including education on ergonomics, structured break schedules, and workplace redesign.

In conclusion, this study advances understanding of CTS as a significant occupational health issue among Lahore's office workers engaged in prolonged keyboard use. The high prevalence of CTS and its associated functional limitations highlight an urgent need for workplace health strategies and further research to address this growing occupational challenge (9, 11, 14, 41).

CONCLUSION

This study demonstrates a notably high prevalence of clinically confirmed carpal tunnel syndrome (CTS) among Lahore office workers who use a keyboard for more than six hours daily, with nearly half of participants affected and the majority experiencing moderate to severe symptoms and significant functional limitations. These findings underscore the urgent need for targeted ergonomic interventions, workplace policy reforms, and early screening to mitigate the occupational health burden of CTS in intensive computer users. Clinically, this highlights the importance of integrating preventive strategies, such as ergonomic assessments and employee education, into routine workplace health programs. For research, these results call for longitudinal and interventional studies to better define causal pathways and to evaluate the effectiveness of specific ergonomic and rehabilitative measures for reducing the risk and impact of CTS in similar occupational populations.

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