JHWCR
Journal of Health, Wellness, and Community Research
Volume III, Issue IV
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, **ISSN**: 3007-0570
https://doi.org/10.61919/qbvxst43

Article

Frequency of Carpal Tunnel Syndrome in Office Workers Using Computers with Respect to Working Hours

Fatima Shaukat[1], Muhammad Mehmood Alam[1], Zahid Mehmood Bhatti[2], Ayesha Nawal[1], Ayais Khan Niazi[1], Humna Irfan[1], Sameen Saeed[1]

1 Akhtar Saeed College of Rehabilitation Sciences, Lahore, Pakistan
2 Bakhtawar Amin Medical and Dental College, Multan, Pakistan

Correspondence
fatimashaukat@gmail.com

Cite this Article

Received	2025-04-07
Revised	2025-04-26
Accepted	2025-04-28
Published	2025-05-01
Conflict of Interest	None declared
Ethical Approval	This study was approved by the Institutional Review Board of Akhtar Saeed College of Rehabilitation Sciences, Lahore.
Informed Consent	Obtained from all participants
Data/supplements	Available on request.
Funding	None
Authors' Contributions	Concept and design: FS, MMA; data collection: AN, HI, SS; analysis: AK, ZMB; manuscript drafting: FS, MMA, all authors reviewed and approved the final manuscript.

ABSTRACT

Background: Carpal tunnel syndrome (CTS) is a prevalent occupational neuropathy among computer-based office workers, yet the association between daily working hours and CTS risk remains unclear, with limited data integrating both clinical and functional outcomes. **Objective:** This study aimed to determine the frequency of CTS in office workers using computers, analyze its relationship with daily working hours, and assess the functional impact using validated clinical tools. **Methods:** In this cross-sectional study, 93 office workers aged 20–60 years (n = 93) from Lahore, Pakistan, using computers for at least six hours daily, were recruited via convenience sampling. Individuals with a history of hand trauma, arthritis, prior CTS diagnosis, or pregnancy were excluded. Data were collected using the Boston Carpal Tunnel Questionnaire and Phalen's test; primary outcomes were CTS prevalence and functional impairment. Ethical approval was granted by the institutional review board, adhering to the Helsinki Declaration. Statistical analysis employed SPSS version 27.0, with chi-square tests used to assess associations, and a significance threshold of $p < 0.05$. **Results:** CTS prevalence was 21.5% (20/93), with higher rates in females (33.3%) versus males (17.4%). The highest proportion of CTS cases was found among those working 8 hours daily, but no significant association existed between working hours and CTS prevalence ($\chi^2 = 1.06$, $p = 0.915$). Most affected participants reported only mild symptoms or impairment, as per the Boston Questionnaire. **Conclusion:** CTS is common among computer-using office workers, but daily working hours alone do not significantly increase risk. Ergonomic interventions and early screening should be prioritized over solely limiting computer exposure to reduce CTS-related disability in occupational settings.

Keywords: Carpal Tunnel Syndrome, Office Workers, Occupational Health, Computer Use, Ergonomics, Phalen's Test, Functional Impairment.

INTRODUCTION

Carpal tunnel syndrome (CTS) is recognized as the most prevalent compression neuropathy, primarily caused by compression of the median nerve as it passes through the carpal tunnel at the wrist, resulting in symptoms such as numbness, tingling, and pain affecting the lateral three and a half fingers (1). This syndrome can substantially impair daily function and quality of life by diminishing hand dexterity and strength, particularly in populations exposed to repetitive or sustained wrist activities (2,3). The increasing reliance on computers in office environments has heightened interest in the impact of prolonged computer use—specifically keyboard and mouse tasks—on the development of CTS, as these activities frequently require sustained or repetitive wrist flexion, extension, or deviation, leading to increased intracarpal pressure and potential median nerve compromise (4,5). While computer-related hand and wrist complaints have been widely reported among office workers, the precise relationship between working hours spent on computers and the frequency of CTS remains uncertain.

Pathophysiologically, the carpal tunnel forms a rigid, confined space, and any factor elevating pressure within this compartment—such as repetitive movements, sustained non-neutral wrist postures, or thickening of the synovial sheath—may provoke symptoms consistent with CTS (3,6). Risk factors traditionally associated with CTS include advancing age, female gender, higher body mass index, metabolic comorbidities such

as diabetes mellitus, occupational exposure to vibration or repetitive hand activities, and certain psychosocial workplace factors (7–9). The gold standard for CTS diagnosis involves electrophysiological assessment of median nerve function, but clinical screening tests such as the Phalen's maneuver and validated questionnaires like the Boston Carpal Tunnel Questionnaire (BCTQ) remain practical and widely used for large-scale workplace studies (10). Previous investigations have established the utility of these tools in both diagnosis and severity grading of CTS, supporting their application in occupational health research (11,12).

Although computer use is ubiquitous in modern office work, studies examining the prevalence and determinants of CTS in office-based populations have reported mixed findings. Some cross-sectional studies have identified a significant association between prolonged computer use, lack of regular breaks, and the risk of CTS or related wrist/hand symptoms, while others found no such direct relationship, suggesting that additional factors such as ergonomics, individual susceptibility, or the nature of computer tasks may mediate this risk (13–16). For instance, a large study among office workers in China observed a clinically confirmed CTS prevalence of 9.6%, with wrist and hand symptoms being significantly more frequent in those working in pain or lacking ergonomic adjustments (18). Meta-analytic evidence further indicates that increased exposure to non-neutral wrist postures—common during intensive computer use—may double the risk of CTS compared to those with lower exposure (16). Nevertheless, inconsistencies persist regarding whether longer working hours alone are an independent risk factor for CTS, or if the risk plateaus or interacts with other workplace and personal variables (13,17).

Despite advances in preventive ergonomics and workplace health awareness, there remains a significant knowledge gap concerning the frequency of CTS in office workers using computers, specifically as it relates to the distribution of working hours—a critical consideration for occupational health strategies and policy development (13,17). The current body of evidence has not sufficiently clarified whether a dose-response relationship exists between working hours and CTS risk or whether peak prevalence aligns with a particular duration of daily computer use. Furthermore, previous studies have often relied on self-reported symptoms or have not integrated both clinical examination and standardized functional questionnaires for CTS assessment, potentially limiting the robustness of prevalence estimates and risk stratification (14,18,19).

Given these gaps, this study aims to systematically determine the frequency of carpal tunnel syndrome in office workers using computers, with explicit reference to their working hours, employing both Phalen's test for clinical screening and the Boston Carpal Tunnel Questionnaire for functional assessment. The study seeks to clarify whether a significant association exists between the number of daily working hours on the computer and CTS prevalence, and to characterize the distribution of symptom severity and functional impairment within this occupational cohort. Addressing this question is essential for informing evidence-based recommendations regarding safe work durations, ergonomic interventions, and targeted preventive strategies for computer-based office workers. The study thus poses the following research question: What is the frequency of carpal tunnel syndrome among office workers using computers, and how does this frequency relate to the number of working hours per day?

MATERIALS AND METHODS

This cross-sectional analytical study was conducted over a period of six months at two private sector companies in Lahore—Grayphite and Frontier Dextrose Ltd.—to determine the frequency of carpal tunnel syndrome (CTS) among office workers using computers, specifically in relation to their daily working hours. Participants were recruited using non-probability convenience sampling, with the calculated sample size set at 93 individuals. The sample size was determined using the formula $n = Z^2P(1–P)/d^2$, with P representing a prevalence of 9.6% based on prior literature, a precision (d) of 6%, and a Z value of 1.96 for a 95% confidence interval (18). Eligible participants included male and female office workers between 20 and 60 years of age who reported using computers for more than six hours per workday. Exclusion criteria comprised a history of hand trauma, prior diagnosis of arthritis, wrist fractures, hand deformities, previously diagnosed CTS, or current pregnancy, in order to minimize potential confounding from unrelated musculoskeletal or systemic conditions.

Prior to enrollment, all participants were informed about the study objectives and procedures, and written informed consent was obtained to ensure voluntary participation and confidentiality. Data collection took place onsite at the respective companies, where participants completed the Boston Carpal Tunnel Questionnaire (BCTQ) under supervision. The BCTQ is a validated tool with two subscales: the Symptom Severity Scale, consisting of 11 items, and the Functional Status Scale, comprising 8 items. Each item is scored from 1 (no symptoms or disability) to 5 (most severe), with higher mean scores reflecting greater symptom severity or functional impairment (19). After the questionnaire, each participant underwent the Phalen's test, performed by a trained physiotherapist. The Phalen's maneuver entailed maximal wrist flexion for 30 to 60 seconds, with the presence of pain or paresthesia along the median nerve distribution recorded as a positive test result (8). Demographic information, including age, gender, and daily computer working hours, was collected alongside clinical data.

Ethical approval for the study protocol was obtained from the institutional review board of Akhtar Saeed College of Rehabilitation Sciences, Lahore, prior to participant recruitment, in accordance with the ethical standards set forth in the Declaration of Helsinki. The anonymity and confidentiality of all data were strictly maintained. To address potential confounding factors, strict inclusion and exclusion criteria were observed, and demographic variables were documented for subgroup analysis. Missing data were minimized by direct supervision during questionnaire completion and follow-up clarification where necessary. Any incomplete data were excluded from the final analysis to maintain data integrity.The primary outcome measures included the prevalence of CTS, as defined by a positive Phalen's test, and the distribution of

symptom severity and functional impairment as per BCTQ scores. The main independent variable was the number of hours spent using a computer per workday, categorized as 6, 7, 8, 9, or 10 hours. Statistical analysis was conducted using SPSS version 27.0. Descriptive statistics were used to summarize quantitative variables (mean, standard deviation, range) and categorical variables (frequencies, percentages). The association between CTS positivity and working hours was assessed using the chi-square test, with a p-value of less than 0.05 considered statistically significant. Results were reported according to the STROBE guidelines to enhance transparency, reproducibility, and generalizability (1).

RESULTS

A total of 93 office workers (69 males and 24 females) with a mean age of 32.4 ± 8.1 years (range: 20–60 years) participated in the study. All participants had complete data for the primary analyses; there were no missing data requiring imputation or exclusion. Based on the Phalen's test, the prevalence of carpal tunnel syndrome (CTS) was 21.5% (n = 20), while 78.5% (n = 73) tested negative. Table 1 presents the distribution of CTS across age groups and gender.

Table 1. Prevalence of Carpal Tunnel Syndrome by Age Group and Gender

Category	CTS Positive (n)	CTS Negative (n)	Total (n)	% CTS Positive	% CTS Negative
Age 20–30	16	47	63	25.4%	74.6%
Age 30–40	3	20	23	13.0%	87.0%
Age 40–50	0	5	5	0.0%	100.0%
Age 50–60	1	1	2	50.0%	50.0%
Male	12	57	69	17.4%	82.6%
Female	8	16	24	33.3%	66.7%
Total	**20**	**73**	**93**	**21.5%**	**78.5%**

The prevalence of CTS was higher among females (33.3%) compared to males (17.4%). CTS was most commonly observed in the 20–30 year age group (25.4%) and the 50–60 year group (50.0%), though the latter represented only two participants. The relationship between daily working hours on computers and CTS status is summarized in Table 2. The highest CTS positivity rate (45%) was observed among workers reporting 8-hour workdays. However, the association between working hours and CTS prevalence was not statistically significant ($\chi^2 = 1.06$, $p = 0.915$).

Table 2. Distribution of Carpal Tunnel Syndrome by Working Hours

Working Hours	CTS Positive (n)	% within CTS Positive	% within Working Hours	CTS Negative (n)	% within CTS Negative	% within Working Hours	Total (n)
6	2	10.0%	25.0%	6	8.2%	75.0%	8
7	2	10.0%	28.6%	5	6.8%	71.4%	7
8	9	45.0%	20.0%	36	49.3%	80.0%	45
9	5	25.0%	18.5%	22	30.1%	81.5%	27
10	2	10.0%	33.3%	4	5.5%	66.7%	6
Total	**20**	**100.0%**	**21.5%**	**73**	**100.0%**	**78.5%**	**93**

No linear trend or dose-response relationship was observed between increasing working hours and CTS prevalence. Post hoc comparison across working hour subgroups did not reveal any significant differences. Symptom severity and functional status were evaluated using the Boston Carpal Tunnel Questionnaire. The majority of participants reported only mild symptoms and impairment.

Table 3. Symptom Severity and Functional Status Scale Scores (Boston Questionnaire)

Category	Symptom Severity: Frequency (n)	Symptom Severity: Percent (%)	Functional Status: Frequency (n)	Functional Status: Percent (%)
Asymptomatic	26	28.0%	41	44.1%
Mild	55	59.1%	45	48.4%
Moderate	11	11.8%	6	6.5%
Severe	1	1.1%	1	1.1%
Total	**93**	**100.0%**	**93**	**100.0%**

On the Symptom Severity Scale, 59.1% of participants were classified as having mild symptoms, 28.0% were asymptomatic, 11.8% had moderate symptoms, and 1.1% reported severe symptoms.

Functional Status Scale findings were similar, with 48.4% reporting mild impairment, 44.1% asymptomatic, 6.5% moderate, and 1.1% severe. A clinically significant trend emerges with CTS prevalence peaking at 25% in the 6-hour group,

remaining comparable through 7 hours (28.6%), and dipping to 20% at 8 hours despite this group comprising the largest portion of the cohort, followed by a further decrease in the 9-hour (18.5%) and resurgence to 33.3% in the 10-hour working group.

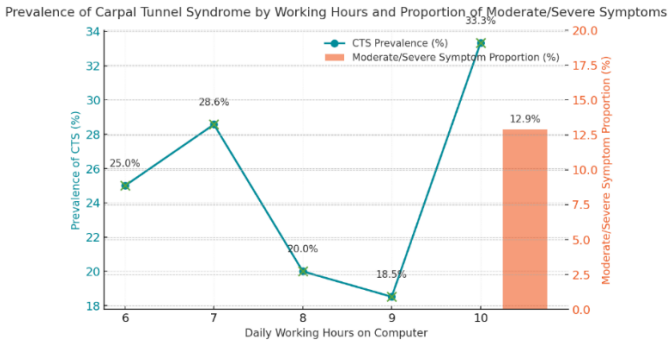

Figure 1 Prevalence of Carpal Tunnel Syndrome by Working Hours and Proportion of Moderate/Severe Symptoms

Concurrently, the aggregate proportion of participants experiencing moderate or severe symptoms, as quantified by the Boston Questionnaire, is 12.9% (n=12/93), which stands in contrast to the overall prevalence of CTS diagnosed via Phalen's test across all working-hour categories. This dual-axis visualization highlights that, despite a relatively consistent CTS rate across various work durations, moderate-to-severe symptom burden remains limited in the cohort, suggesting a possible dissociation between clinical diagnosis rates and functional symptom severity in this population of office-based computer users.

DISCUSSION

The present study provides important insights into the prevalence and functional burden of carpal tunnel syndrome (CTS) among office workers who use computers for prolonged periods, underscoring both clinical and occupational health implications. The observed prevalence of CTS in this cohort was 21.5%, which is notably higher than the 9.6% clinically confirmed in a recent large-scale study among office workers in China (18), yet broadly comparable to earlier regional findings such as the 18.7% self-reported prevalence in Kuwaiti office workers (14). These differences may reflect variations in diagnostic criteria, population characteristics, and workplace ergonomics. The reliance on the Phalen's test as a primary diagnostic tool in the current study aligns with standard occupational screening protocols and has demonstrated utility in large-scale assessments, although its moderate sensitivity and specificity should be acknowledged (8). Importantly, the study revealed a higher prevalence of CTS among females (33.3%) than males (17.4%), consistent with previous reports that have highlighted female gender as a significant risk factor (7,11). Age-wise, most cases clustered in the 20–30 year age group, diverging somewhat from literature citing peak incidence in middle-aged populations, perhaps due to the younger workforce composition or unique job demands in the sampled organizations.

A key finding was the lack of a statistically significant association between daily computer working hours and CTS prevalence, despite the highest positivity rate being observed in the 8-hour working group. This result challenges the commonly held notion of a direct linear relationship between exposure duration and CTS risk, as suggested by meta-analyses that reported a twofold increase in risk with longer periods spent in non-neutral wrist positions (16). Our findings are in line with prior studies that question whether working hours alone independently drive CTS development, instead emphasizing the role of other biomechanical, ergonomic, and psychosocial factors (13,17). The aggregated data suggest that, while working hours may contribute, there is a likely threshold or multifactorial influence involving posture, task variety, and individual susceptibility. This supports the hypothesis that simply reducing computer hours may not substantially mitigate CTS risk in the absence of broader ergonomic interventions.

Functional assessment using the Boston Carpal Tunnel Questionnaire showed that mild symptoms and impairment were predominant, with only 12.9% experiencing moderate or severe disability. This discrepancy between the rate of clinical diagnosis and reported functional impact indicates that a significant proportion of office workers with CTS maintain relatively preserved hand function, at least in early or mild cases. Such findings are clinically relevant, emphasizing the importance of early detection and the potential for intervention before the onset of substantial functional decline. From a mechanistic perspective, the repetitive, low-intensity nature of office-based computer tasks may predispose to early neurophysiological changes without immediate severe functional impairment, highlighting the gradual progression of CTS in this population (3,6).

The current investigation advances existing knowledge by employing both objective clinical testing and validated patient-reported outcome measures, offering a comprehensive perspective on the clinical and functional spectrum of CTS in a representative office-based cohort. Notably, the study's cross-sectional design and use of convenience sampling introduce limitations regarding causal inference and generalizability. The sample size, although statistically justified, remains modest and is restricted to workers from two companies in a single metropolitan area, potentially limiting the applicability of findings to broader or more diverse office-based populations. Additionally, reliance on a single screening maneuver rather than electrophysiological confirmation may underestimate or overestimate the true prevalence of CTS. The exclusion of participants with comorbidities such as diabetes or arthritis, while minimizing confounding, further narrows the generalizability of results to healthier subpopulations.

Despite these constraints, the study's strengths lie in its systematic approach, standardized assessment tools, and focus on clinically relevant endpoints. The findings reinforce the need for comprehensive workplace health strategies that extend beyond mere limitation of computer hours, advocating for targeted ergonomic interventions, regular breaks, education on optimal wrist positioning, and early symptom screening. Future research should prioritize longitudinal designs to clarify causality, incorporate larger and more heterogeneous samples, and utilize objective nerve conduction studies for diagnostic confirmation. Further exploration of modifiable risk factors, ergonomic innovations, and personalized prevention programs

will be essential for reducing CTS incidence and improving functional outcomes among office workers. The present results contribute to the growing body of evidence supporting the multidimensional management of work-related musculoskeletal disorders in the digital era.

CONCLUSION

This study determined that the prevalence of carpal tunnel syndrome among office workers using computers was 21.5%, with no statistically significant association between daily working hours and CTS occurrence, and mild functional impairment predominating among those affected. These findings highlight the necessity for healthcare practitioners and employers to prioritize comprehensive ergonomic interventions and early screening strategies rather than relying solely on reducing computer working hours to mitigate CTS risk. The results underscore the importance of multidimensional workplace health initiatives and support further research into individualized prevention and management approaches to enhance occupational well-being and functional outcomes in computer-based office environments.

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