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Prevalence of Carpal Tunnel Syndrome and Its Risk Factors among Information Technology Students in Sialkot

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KEYWORDS

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DECLARATIONS

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ABSTRACT

Background: Carpal tunnel syndrome is a widespread peripheral nerve disorder, particularly common among individuals who engage in repetitive wrist and hand movements. With the rapid increase in the use of digital technology, students in fields requiring extensive computer engagement, such as information technology, are becoming more vulnerable to developing this syndrome at an early age. The constant use of laptops, smartphones, and gaming devices contributes to sustained wrist strain, making carpal tunnel syndrome a growing concern among young adults. **Objective:** To determine the prevalence of carpal tunnel syndrome and identify associated risk factors among information technology students in Sialkot. **Methodology:** This cross-sectional study was conducted between March and September 2025 after receiving formal approval from the research ethical committee of the University of Sialkot, conducted on 375 information technology students aged 19 to 25 years who reported using computers or smartphones for a minimum of four hours daily. Before data collection, written informed consent was obtained from all participants after explaining the study objectives, confidentiality procedures, and the voluntary nature of participation. Students having musculoskeletal disorders, injuries, or trauma were excluded. Symptom Severity Scale and Functional Status Scale scores were measured using the validated Boston Carpal Tunnel Syndrome Questionnaire. Inferential statistics were performed using the chi-square test to examine associations between carpal tunnel syndrome and various risk factors. **Results:** The overall prevalence of carpal tunnel syndrome was found to be 72.3%. Among the affected participants, 48.8% experienced mild symptoms, 19.2% had moderate symptoms, and 4.3% reported severe to very severe symptoms. Statistically significant associations were observed between carpal tunnel syndrome and diabetes mellitus ($p < 0.001$), smoking ($p < 0.001$), hypertension ($p = 0.002$), thyroid disorders ($p < 0.001$), rheumatoid arthritis ($p < 0.001$), and wrist injury ($p = 0.001$). Prolonged gaming (41.3%) and insufficient rest breaks (66.9%) were also linked to reduced functional capacity. **Conclusion:** The findings indicate a notably high prevalence of carpal tunnel syndrome among information technology students. Lifestyle habits, health conditions, and extended device usage were major contributors, whereas age, gender, and body mass index showed minimal impact.

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INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the most common neurological conditions and neuropathic entrapments of the upper extremities. Compression of the median nerve as it passes through the carpal tunnel in the wrist causes carpal tunnel syndrome.¹ The most common reason for personal financial losses, lost productivity, and sick leave among the various forms of compressive neuropathies has been thought to be CTS. This affects at least 3.8% of persons who report having hands that hurt, are unresponsive, and itch on average.² Depending on several variables, CTS can be bilateral or unilateral, affecting only one hand.³ The median nerve and nine flexor tendons are located inside the carpal tunnel, which is anatomically formed by the flexor retinaculum superiorly and the carpal bones inferiorly.⁴

The onset of CTS has been connected to risk factors related to body mass index (BMI). One risk factor that can be altered with lifestyle modifications is obesity. Recent weight gain has been shown to increase the incidence of CTS due to increased fluid collection in the carpal tunnel's tissue gaps.⁵ One of the main risk factors for CTS is diabetes, which is substantially more common in diabetics (14% to 30%) than in the general population (3.8%).⁶ The prevalence of carpal tunnel syndrome symptoms is closely linked to jobs that require four hours of work per day. Continual use of computer devices has been linked to nerve injuries in the upper limbs, especially CTS. The fact that excessive computer use might result in CTS has been a major worry in recent years. This is because of repetitive movements and dynamic muscle atrophy in the upper limb due to compression of the median nerve during the carpal tunnel's passage, which may be caused by vibration exposure, repeated tasks, strict instructions, and non-ergonomic hand positions while performing tasks.⁷

The advancement of technology has been impacted by the evolution of the times. Technology is developing in tandem with the emergence of a more modern period. It is hard to separate people from using digital devices for communication in the modern era. In order to communicate more quickly and effectively, people frequently use devices with internet access to send and receive messages.⁷ A lack of knowledge about ergonomics leads to musculoskeletal diseases. As a result of non-ergonomic laptop designs and user behavior that disregards ergonomics, such as posture, using a

laptop can lead to musculoskeletal disorders. The hand movement for typing is narrow due to the peculiar and non-ergonomic design of the laptop. Among musculoskeletal disorders, computer users frequently report having CTS.⁸ The rationale of the study is that CTS is increasingly observed among young individuals who frequently use computers and smartphones. Information technology (IT) students are especially vulnerable due to prolonged digital device use and repetitive wrist activities, highlighting the need to assess their prevalence and related risk factors in this population.

METHODOLOGY

An observational cross-sectional study was conducted between March and September 2025 after receiving formal approval from the research ethical committee of the University of Sialkot (Ref: USKT/FAHS/RECLetter-00068). The study targeted undergraduate students enrolled in Information Technology programs across various universities in Sialkot. A total of 375 participants were recruited for the research. The sampling method used was non-probability convenience sampling, as it allowed easy access to students who fulfilled the required criteria. The sample size of 375 was calculated using a 95% confidence interval, a 5% margin of error, and an estimated prevalence rate of 70%, ensuring adequate representation of the target population for determining the prevalence of CTS and its associated risk factors among IT students.

Eligible participants included both genders of students aged between 19 - 25 years, falling under the young adulthood category. Only those who reported using computers for a maximum duration of four hours per day and whose average daily smartphone usage exceeded four hours were included. These criteria were selected to focus on individuals with considerable exposure to digital devices, as excessive smartphone use has been associated with increased strain on the wrist and hand. Students were excluded if they had any pre-existing musculoskeletal disorders, injuries, or trauma involving the wrist or hand, as such conditions could confound the findings. Participants who had taken pain-relieving medications within the previous 24 hours and those regularly engaged in wrist or hand strength training exercises were also excluded to ensure an unbiased assessment of symptoms. Before data collection, written informed consent was obtained

from all participants after explaining the study objectives, confidentiality procedures, and the voluntary nature of participation.

The English version of the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) was administered to assess both symptom severity and functional limitations related to CTS. The BCTQ consists of two subscales: the Symptom Severity Scale (SSS), comprising 11 items that evaluate the intensity and frequency of pain, paraesthesia, numbness, weakness, nocturnal symptoms, and difficulty with gripping, and the Functional Status Scale (FSS), consisting of 8 items that measure functional performance in daily activities such as writing, buttoning clothes, holding a book during reading, gripping telephone handles, opening jars, carrying grocery bags, bathing, dressing, and performing various household duties. In addition to the questionnaire responses, demographic data, including age, gender, height, weight, and BMI, were recorded. Information regarding digital device usage patterns, daily screen time, posture, and ergonomic factors was also collected. Furthermore, participants were asked about relevant health-related and lifestyle variables such as smoking, presence of diabetes, hypertension, regular physical activity, and sleep duration to assess possible contributing or confounding factors.

Data were entered and analyzed using SPSS version 27.0. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were applied to summarize demographic data and baseline characteristics of the participants. The prevalence of CTS was calculated based on the BCTQ scoring. Inferential statistics were performed using the chi-square test to examine associations between CTS and various potential risk factors. A p-value of less than 0.05 was considered statistically significant for all statistical tests.

RESULTS

A total of 375 IT students participated in the study, including 179 males (47.7%) and 196 females (52.3%). The mean age was 21.07 ± 1.9 years, and the mean BMI was 22.14 ± 3.21 kg/m². Health-related data indicated that 17.6% of participants had diabetes mellitus, 33.1% hypertension, 21.3% thyroid disorders, and 22.7% rheumatoid arthritis. Lifestyle factors included 23.5% smokers and 12.8% alcohol consumers. Wrist injury was

reported in 33.3% of participants. The demographic and health characteristics presented in Table 1 indicate that although most participants were within a healthy BMI range, notable proportions were underweight or overweight, reflecting varied nutritional profiles within the student population.

A considerable subset of participants reported chronic health issues such as diabetes, hypertension, thyroid disorders, and rheumatoid arthritis, all of which may influence nerve health, circulation, and inflammation, thereby increasing susceptibility to CTS. Additionally, the presence of lifestyle-related habits such as smoking and alcohol use, along with a substantial proportion reporting previous wrist injury, suggests that students may be exposed to multiple overlapping risk factors, potentially compounding their vulnerability to CTS. Most participants (83.5%) reported using computers or smartphones for more than four hours daily, and 41.3% engaged in gaming for over two hours per day. Repetitive wrist movements were noted in 40.8% of students, and 66.9% admitted to taking few or no rest breaks. The overall prevalence of CTS was 72.3%, with mild symptoms being most frequent (48.8%),

Table 1: Demographics and characteristics of participants

Variables	Categories	Frequency (n)	Percentage (%)
Gender	Male	179	47.7
	Female	196	52.3
BMI	Normal	247	65.9
	Overweight	57	15.2
	Underweight	58	15.5
	Obese	13	3.5
Diabetes Mellitus	Yes	66	17.6
Hypertension	Yes	124	33.1
Thyroid Disorder	Yes	80	21.3
Rheumatoid Arthritis	Yes	85	22.7
Smoking	Yes	88	23.5
Alcohol Use	Yes	48	12.8
Wrist Injury	Yes	125	33.3
Age (years)	Mean $\pm$ SD	21.07 $\pm$ 1.9	

followed by moderate (19.2%) and severe (4.0%) forms. Functional limitations were also recorded, with 36% experiencing mild and 23.2% moderate disability. The device-use patterns shown in Table 2 reveal prolonged daily exposure to digital screens among participants, with a large majority engaged in device use beyond the recommended limit. Engaging in gaming for extended periods and performing repetitive wrist movements were also common behaviours, indicating sustained mechanical strain on the wrist and median nerve. This pattern of continuous digital engagement is further magnified by inadequate rest breaks. The distribution of CTS severity and functional limitation highlights that although most students were affected mildly, a substantial proportion experienced moderate to severe impairment, demonstrating a tangible impact of poor digital-use habits on hand function and daily activities.

Statistical analysis demonstrated significant associations between CTS severity and several health factors, including diabetes mellitus ($p<0.001$), smoking ($p<0.001$), hypertension ($p=0.002$), thyroid disorders ($p<0.001$), rheumatoid arthritis ($p<0.001$), wrist injury ($p=0.001$), and alcohol consumption ($p<0.001$). Among occupational factors, gaming for more than two hours daily ($p<0.001$) and repetitive wrist motion ($p=0.003$) were strongly correlated with increased symptom severity and functional impairment.

Table 3 illustrates that all examined health-related variables exhibited statistically significant associations with both symptom severity and functional limitation. Chronic metabolic and inflammatory conditions, such as diabetes, hypertension, thyroid dysfunction, and rheumatoid arthritis, were strongly linked to worsened CTS symptoms, suggesting that systemic health status plays a substantial role in influencing nerve compression outcomes. The significant associations with smoking and alcohol use further emphasize the negative impact of poor lifestyle habits on nerve health and recovery potential. Wrist injury also showed a strong relationship with symptom severity, reinforcing the role of previous trauma as a predisposing factor for aggravated symptoms and functional decline.

As shown in Table 4, excessive gaming device use and gaming for more than two hours per day demonstrated significant associations with both increased symptom severity and functional

limitations. This finding reflects the impact of prolonged engagement in high-intensity digital activities that require continuous hand and wrist movement. Interestingly, taking fewer rest breaks and having an improper desk setup did not show a statistically significant association in this population, suggesting that the duration and repetitive nature of device use may play a more dominant role in symptom progression compared to ergonomic factors alone among young adults.

DISCUSSION

The present study investigated the occurrence of CTS and its risk factors among IT students in Sialkot, a population with high daily exposure to digital devices, including computers, laptops, smartphones, and gaming consoles. A total of 375 participants were included; 179 (47.7%) were male and 196 (52.3%) were female. Gender was not significantly associated with CTS symptom severity ($p=0.272$) and functional status

Table 2: Device usage patterns, CTS symptom severity, and functional limitation

Variables	Categories	Frequency (n)	Percentage (%)
Daily Device Use	Yes	313	83.5
Gaming >2 Hours Daily	Yes	155	41.3
Repetitive Wrist Motion	Yes	153	40.8
Inadequate Rest Breaks	Yes	251	66.9
Improper Desk Setup	Yes	155	41.3
CTS Symptom Severity	Asymptomatic	104	27.7
	Mild	183	48.8
	Moderate	72	19.2
	Severe	15	4
	Very Severe	1	0.3
Functional Limitation (BCTQ)	No Limitation	129	34.4
	Mild	135	36
	Moderate	87	23.2
	Severe	22	5.9
	Very Severe	2	0.5

Table 3: Association between health-related factors with symptom severity and functional limitation

Health-related Factors	Symptom Severity (p-value)	Functional Limitation (p-value)	Significance
Diabetes Mellitus	< 0.001	< 0.001	Significant
Hypertension	0.002	0.015	Significant
Thyroid Disorder	< 0.001	0.004	Significant
Rheumatoid Arthritis	< 0.001	< 0.013	Significant
Smoking	< 0.001	< 0.001	Significant
Alcohol Use	< 0.001	0.002	Significant
Wrist Injury	0.001	0.002	Significant

($p=0.439$). In contrast to the findings reported by Khired et al. (2024), where women's median SSS and FSS scores were much higher than men.⁹ The majority of participants, 309 (82.4%), were young adults aged 19–22 years, with fewer in the 23–25 years group, 66 (17.6%). Age was not significantly associated with CTS symptom severity ($p=0.335$) and functional status ($p=0.159$). By contrast, previous studies have consistently reported that CTS is more prevalent among computer users in the older age groups.¹⁰ Similarly, another study was carried out. Hashimoto et al. (2020) reported a higher prevalence in older Japanese adults aged between 50 to 89 years, with 7.2% of women and 1.8% of men affected.¹¹

Regarding BMI, 58 (15.5%) participants had underweight, 247 (65.9%) participants had a normal BMI, 57 (15.2%) were overweight, and 13 (3.5%) were obese in the current study. No significant differences were observed in SSS ($p=0.31$) or FSS ($p=0.33$) scores across BMI groups. It is consistent with a study conducted by Alduraibi et al. (2023), indicating no significance, but symptoms were roughly more prevalent in overweight and obese individuals than in those who were not overweight.¹² Almost 313 (83.5%) participants used computers, smartphones, tablets, and gaming consoles, and 62 (16.5%) participants did not use them, which had a significant association with the severity ($p=0.006$) and functional status ($p<0.001$) of CTS. The finding differs from a study conducted by Ithnin and Rajendrana (2022) found that statistical testing revealed a weak connection, meaning there is little to no relationship between the likelihood of having

Table 4: Association between device use with CTS severity and functional limitation

Occupational Factor	Symptom Severity (p-value)	Functional Limitation (p-value)	Significance
Gaming Device Use	< 0.001	< 0.001	Significant
Gaming >2 Hours Daily	< 0.001	< 0.001	Significant
Few Rest Breaks	0.184	0.354	Not Significant
Improper Desk Setup	0.173	0.817	Not Significant

CTS and the frequency of smartphone use.¹³ About 155 students (41.3%) reported gaming for more than two hours a day, and 220 (58.7%) students reported no gaming for more than two hours a day, which had a strong correlation with SSS ($p<0.001$) and FSS ($p<0.001$). On the other hand, 153 (40.8%) participants reported performing repetitive motion, and 222 (59.2%) participants did not, which was not significantly associated with SSS ($p=0.204$) but significantly associated with FSS ($p=0.003$). The finding is consistent with a study conducted by Zethira and Hendrati (2024) that showed there is a substantial association between repetitive motions, playing frequency, and playing duration and carpal tunnel syndrome in gamers who are students.¹³ In the current study, 196 students (52.3%) reported regularly exercising, and 179 (47.7%) did not. There was no significant correlation with SSS ($p=0.865$), but there was a significant association with FSS ($p=0.025$) scores.

A previous study conducted by Demissie et al. (2023) reported that the majority of participants (96.7%) were working in an awkward posture, and 92.2% did not regularly exercise.¹⁴ About 155 people (41.3%) were reported to be using an incorrect desk or workstation configuration, and 220 (58.7%) did not. But there was no statistical significance with SSS ($p=0.173$) and FSS ($p=0.817$). According to the other study, workers with inadequate desk arrangements and those without ergonomic chairs had CTS prevalence of 23.6% and 21.1%, respectively, which were significantly higher than those of workers with more ergonomic setups.⁸ 251 (66.9%) of the students took rest breaks, and 124 (33.1%) did not. No significant association was observed in SSS ($p=0.184$) or FSS ($p=0.354$) scores. This is in contrast with the findings of Feng et al. (2021), who

reported that working without breaks and using computers intensely were linked to a higher prevalence of hand and wrist symptoms.¹⁵ In the present study, 66 (17.6%) participants reported with diabetes mellitus, and 309 (82.4%) did not. There was a highly significant correlation with SSS ($p < 0.001$) and FSS ($p < 0.001$). Abuharb and colleagues (2024) reported that when diabetes characteristics were looked at, higher severity scores of CTS were significantly linked to eye issues and discomfort or numbness in the legs or feet, in line with earlier studies that highlight how diabetes problems affect the development and severity of CTS.¹⁶

About 88 students (23.5%) reported smoking, while 287 (76.5%) did not, and a strong correlation between SSS and FSS ratings ($p < 0.001$). This result is consistent with a study where cigarette smokers had a 4.2 times increased risk of CTS compared to non-smokers.¹⁴ This is consistent with an Indian study, which reported that smokers were 1.6 times more likely than non-smokers to develop CTS. 48 students (12.8%) reported drinking alcohol, and 327 (87.2%) did not. There was a significant association with SSS ($p < 0.001$) and FSS ($p = 0.002$). This result contrasts with the findings that, although the alcohol consumption element has not yet been fully investigated, it may contribute to the development of CTS symptoms.¹⁷

In the present study, 125 students (33.3%) reported wrist injuries, and 250 (66.7%) did not, which was significantly associated with SSS ($p = 0.001$) and FSS ($p = 0.002$). Similar to a previous study, it was found that a significant rise in carpal tunnel pressure due to wrist deformity from fracture displacement, hematoma formation, and generalized edema can lead to the development of CTS symptoms within a few days after the injury.¹⁸ 85 students (22.7%) had rheumatoid arthritis, and 290 (77.3%) did not, which was significantly associated with SSS ($p < 0.001$) and FSS ($p = 0.013$). This supports the findings of a study that reported rheumatoid arthritis was the most prevalent ailment, accounting for 8.9% of cases.¹²

In the current study, 124 students (33.1%) reported with hypertension, and 251 (66.9%) did not; this was a significant association with SSS ($p = 0.002$) and FSS ($p = 0.015$). Therefore, hypertension raises the risk of getting CTS.¹⁹ Almost 80 students (21.3%) reported thyroid problems, and 295 (78.7%) did not, had a significant association with SSS ($p < 0.001$) and FSS

($p = 0.004$), which means that thyroid disease is a risk factor for CTS.¹⁷ In the present study, 183 (48.8%) of participants experienced mild symptoms. About 104 (27.7%) of the participants were asymptomatic, while 72 (19.2%) of the participants reported moderate symptoms. 15 (4.0%) had severe symptoms, and only 1 (0.3%) experienced very severe symptoms. In FSS, 135 (36.0%) of participants had mild functional impact, 129 (34.4%) were asymptomatic, and 87 (23.2%) with moderate limitation. Only a small proportion, 22 (5.9%) of participants reported severe limitations, and only 2 (0.5%) reported very severe limitations. Overall, Mild symptoms and mild functional impact were the most prevalent, while asymptomatic and moderate cases showed relatively lower prevalence. This is consistent with a study carried out by Asif et al. (2024) that the majority of CTS participants had mild symptoms and functional limitations.²⁰

The limitations of this study were that only the young population between the ages of 19 and 25 was included in the study. The findings application to older populations showed that CTS was more prevalent and limited by this small age range. The study was conducted only among IT students or in a particular city, so the results might not be representative of other areas or fields. All risk factors were self-reported; there may have been bias in remembering or reporting. Recommendations are to increase the generalizability of the findings; future research should involve people from a range of age groups, academic fields, and professional backgrounds. Encourage people to have healthy lives by avoiding sedentary behavior, alcohol consumption, and smoking. To validate correlations and direct preventative measures, carry out additional clinical and longitudinal research.

CONCLUSION

In the current study, the prevalence of carpal tunnel syndrome was 72.3%. Mild symptoms and mild functional impact were the most prevalent, while asymptomatic, moderate, severe, and very severe cases showed relatively lower prevalence. Diabetes, hypertension, thyroid disorders, rheumatoid arthritis, smoking, alcohol use, wrist injuries, prolonged gaming, and device use were found to be associated factors of carpal tunnel syndrome. Demographic characteristics like age, gender, and body mass index were less important in this study.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.

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