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ORIGINAL ARTICLE

Assessment of the Correlation between Clinical and Electrophysiological Results and Risk Factors in Patients with a Preliminary Carpal Tunnel Syndrome Diagnosis

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ABSTRACT

Background: *Carpal tunnel syndrome (CTS) is a frequent upper extremity neuropathy caused by entrapment of the median nerve at the wrist. It causes discomfort, paresthesia, and sensory loss in the median nerve's sensory area, particularly at night. This study examines the correlation between risk factors, symptom severity, functional status, and electromyography (EMG) results in individuals with a preliminary diagnosis of carpal tunnel syndrome (CTS).* ***Methods & Materials:*** *The study included 249 patients referred to the EMG unit at the Department of Neurology, Shaheed Ziaur Rahman Medical College & Hospital, Bogura, Bangladesh (Jan–Dec 2025) with a preliminary CTS diagnosis. An experienced EMG nurse conducted interviews and administered a 14-item questionnaire on demographics, CTS risk factors, and VAS scores, while a blinded Physical Medicine and Rehabilitation professional performed and reported EMG evaluations.* ***Results:*** *The study included 204 (81.9%) female patients and 45 (18.1%) males. The median age was 49 years (range: 20-94). The mean total score on the BCTQ was 5.4±1.5. 53.3% of patients referred to the electrophysiology lab with a preliminary diagnosis of CTS were really diagnosed. Females, persons with a smoking history of more than 21 years, and those with diabetes mellitus were more likely to have electro physiologically confirmed CTS compared to those without.* ***Conclusion:*** *Risk factors, BCTQ scores, and EMG findings were complementary in patients with suspected CTS. Female gender, long-term smoking (≥21 years), and diabetes were significantly associated, highlighting their importance in early identification and management.*

Keywords: *Carpal tunnel syndrome, electromyography, entrapment neuropathy, risk factors.*

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INTRODUCTION

CTS is the most common upper extremity entrapment neuropathy, caused by compression of the median nerve at the wrist. This illness causes symptoms like weakness, numbness, and pain in the hands and fingers [1]. The prevalence ranges between 1-5% [2]. CTS includes multiple risk factors, including female sex, age, obesity, diabetes, hypothyroidism, osteoarthritis, rheumatoid arthritis, trauma, and connective tissue disorders [3, 4]. Repetitive, vigorous, and hand-straining actions, frequent wrist flexion, and continuous use of vibrating equipment are known risk factors. CTS can permanently injure the median nerve, resulting in persistent wrist pain, reduced quality of life and productivity. Early diagnosis and effective therapy of CTS are critical [5]. Diagnosing CTS requires a detailed patient history, physical examination, and positive provocation testing. EMG is the primary diagnostic test for entrapment neuropathies, providing unequivocal confirmation of the diagnosis [6]. This study examines how risk variables affect the intensity of symptoms, functional status, and EMG findings in patients with a preliminary diagnosis of CTS. We aim to identify risk variables related with higher scores on the Boston Carpal Tunnel Questionnaire and their linkage with EMG-confirmed CTS diagnosis. Understanding the link between risk factors and clinical/electrophysiological examinations can help create preventive methods for early diagnosis and management of CTS.

METHODS & MATERIALS

Patients treated at the Department of Neurology, Shaheed Ziaur Rahman Medical College & Hospital in Bogura, Bangladesh, from January 2025 to December 2025, were referred to the EMG unit with a preliminary CTS diagnosis. In total, 249 patients were enrolled. An experienced EMG nurse conducted face-to-face interviews with participants and distributed a questionnaire to collect data. A Physical Medicine and Rehabilitation expert, who was not aware of the questionnaire results, performed and reported on electromyography (EMG) tests. The questionnaire asked 14 initial questions about the patients' age, gender, characteristics, risk factors for CTS, and VAS scores. Next, the Boston Carpal Tunnel Questionnaire (BCTQ) was completed. A p-value of <0.05 indicated statistical significance for comparisons. Data were analyzed using the statistical software SPSS 20.0. The study included 261 patients treated at Shaheed Ziaur Rahman Medical College & Hospital, Bogura, who were 18 years or older, spoke Bengali, and provided informed consent. Patients were excluded if they were under

18, pregnant, had a pacemaker, were referred for EMG for conditions other than CTS, or had a history of CTS surgery.

RESULT

Table I shows Normal nerve conduction values: median nerve—SNAP ≥20 µV, CMAP ≥4.1 mV, distal latency ≤3.8 ms, conduction velocity ≥50 m/s; ulnar nerve—SNAP ≥6 µV, CMAP ≥7.2 mV, distal latency ≤3.3 ms, conduction velocity ≥50 m/s. Values outside these ranges indicate possible nerve dysfunction.

Table – I: Reference values used in our EMG unit

Variable	Median Nerve	Ulnar Nerve
Sensory Nerve Conduction		
SNAP (Sensory Nerve Action Potential) Amplitude (µV)	≥20	≥6.0
Conduction Velocity (m/s)	≥50	≥50
Motor Nerve Conduction		
CMAP (Compound Muscle Action Potential) Amplitude (m/V)	≥4.1	≥7.2
Distal Motor Latency (m/s)	≤3.8	≤3.3
Conduction Velocity (m/s)	≥50	≥50

Table II shows among the study population, a small proportion of participants had occupations involving frequent writing or computer use (14.2%) or work with vibrating tools (8.8%), suggesting that occupational factors were not predominant contributors. Smoking was reported by 32.6% of participants, with the majority of smokers (41.2%) having smoked for 21 years or more, indicating long-term exposure as a potential risk factor. A positive family history of CTS was noted in 35.6% of cases, highlighting a possible genetic predisposition. History of trauma in the affected wrist was relatively uncommon (12.6%), suggesting that traumatic causes were less frequent. Overall, smoking and family history appear to be more prominent risk factors in this cohort compared to occupational or traumatic exposures.

Table – II: Distribution of certain risk factors among patients with a preliminary diagnosis of carpal tunnel syndrome

Variables	n (%)
Occupation involving frequent writing or computer Use	
Yes	37 (14.2)
No	224 (85.8)
Occupation requiring work with vibrating tools	
Yes	23 (8.8)
No	238 (91.2)
Smoking status	
Yes	85 (32.6)
No	176 (67.4)
Duration of smoking among smokers	
1-5 years	12 (14.1)
6-10 years	12 (14.1)
11-20 years	26 (30.6)
21 years or more	35 (41.2)
Family history of CTS (Carpal Tunnel Syndrome)	
Yes	93 (35.6)
No	168 (64.4)
History of trauma in the affected wrist	
Yes	33 (12.6)
No	228 (87.4)

Table III shows Occupational factors (writing/computer use 14.2%, vibrating tools 8.8%) and wrist trauma (12.6%) were uncommon, suggesting minimal contribution to CTS in this cohort. In contrast, long-term smoking (32.6%, with 41.2% ≥21 years) and positive family history (35.6%) were more prominent, indicating that lifestyle and genetic predisposition are likely the major risk factors.

Table – III: Comparison of certain patient characteristics in patients with a preliminary diagnosis of carpal tunnel syndrome based on electromyography results

CTS Diagnosis Based on EMG Results			
Characteristics	**Present n (%)**	**Absent n (%)**	**p**
Age (years) (Median)	51 (24-94)	45 (20-72)	<0.001
Gender			
Male	31 (22.3)	14 (11.5)	0.02
Female	108 (77.7)	108 (88.5)	
Occupation involving frequent writing or computer use			
Yes	20 (14.4)	17 (13.9)	0.91
No	119 (85.6)	105 (86.1)	
Occupation requiring work with vibrating tools			
Yes	14 (10.1)	9 (7.4)	0.44

No	125 (89.9)	113 (92.6)	
Smoking status			
Yes	51 (36.7)	34 (27.9)	0.19
No	88 (63.3)	88 (72.1)	
Duration of smoking among smokers			
1-5 years	9 (9.8)	7 (20.5)	
6-10 years	10 (13.7)	7 (14.7)	0.03
11-20 years	19 (29.4)	12 (32.4)	
21 years or more	30 (47.1)	12 (32.4)	
Family history of CTS (Carpal Tunnel Syndrome)			
Yes	53 (38.1)	40 (32.8)	0.36
No	86 (61.9)	82 (67.2)	
History of trauma in the affected wrist			
Yes	22 (15.8)	11 (9.0)	0.09
No	117 (84.2)	111 (91.0)	

Table IV Correlation analysis revealed that longer pain duration was significantly associated with higher VAS scores and greater symptom severity and functional impairment on the Boston Carpal Tunnel Questionnaire ($p < 0.001$). VAS scores also showed strong positive correlations with both Boston Symptom Severity and Functional Status scores, indicating that higher pain intensity corresponds to worse symptoms and reduced function. BMI demonstrated weak, non-significant correlations with pain and Boston scores, suggesting minimal impact on symptom severity. The Boston Symptom Severity and Functional Status scores were highly interrelated ($r = 0.659–0.908$, $p < 0.001$), and the Boston Total Score closely reflected both subscores, confirming the internal consistency of the questionnaire.

Table – IV: Correlation between body mass ındex, visual analog scale scores, pain duration, and boston carpal tunnel questionnaire scores in patients with a preliminary diagnosis of carpal tunnel syndrome

Variables	Pain Duration (months)	VAS Score	BMI	Boston Symptom Severity Score	Boston Functional Status Score	Boston Total Score
Pain Duration (months)						
r*	1	0.254	0.84	0.213	0.264	0.265
p*		0.000	0.177	0.001	0.000	0.000
VAS Score						
r		1	0.173	0.595	0.389	0.529
p			0.005	0.000	0.000	0.000
BMI (Body Mass Index)						
r			1	0.105	0.066	0.093
p				0.091	0.288	0.134
Boston Symptom Severity Score						
r				1	0.659	0.908
p					0.000	0.000
Boston Functional Status Score						
r					1	0.908
p						0.000
Boston Total Score						
r						1
p						

DISCUSSION

The study indicated that CTS was more prevalent in females, older adults, long-term smokers (≥21 years), and diabetic patients. Patients with CTS showed increased pain duration, VAS, BCTQ, and BMI ratings. According to Otelea et al. [6], females are three times as likely than males to experience CTS. Our study indicated that women were substantially more likely to be diagnosed with CTS than males. Women have a narrower carpal tunnel, which accounts for this physical difference. Hidayati et al. [7] found that CTS was most typically diagnosed in the 40-49 age group, while Abumunaser et al. [8] found that CTS was more prevalent in the 45-54 age range. Our study indicated that individuals with CTS had a median age of 51 years, which is consistent with existing literature. Age-related nerve elasticity loss and soft tissue degradation can cause median nerve compression. In Prastowo et al. [9], 86% of patients were housewives, while Al-Jasim et al. [5] found 53% to be housewives. In our investigation, the rate was 55.2%. In our study, housewives accounted for 51.8% of CTS diagnoses across all occupational groups, however this was not statistically significant. This could be attributed to the repetitive nature of daily tasks like housework and childcare. Wrist movements are recognized as risk factors for CTS. Our study, like Şahin et al. [10], indicated that patients with CTS had significantly higher BMI values than those without it. This was due to higher hydrostatic pressure in the carpal tunnel and more stored fat. In research by Al-Jasim et al. [5], 11.7% of patients reported CTS symptoms on the Boston Carpal Tunnel Scale, and DM was shown to be statistically significant. Diabetes prevalence was reported to be 12.5% in the Hail research [10] and 19.4% in the Alduraibi et al. [11] study. In our study, 14.9% of patients were diagnosed with DM, which is consistent with the literature. Diabetes individuals had considerably greater levels of CTS and overall Boston Carpal Tunnel Scale scores. Diabetes's neuropathic consequences, including decreased nerve flexibility and increased tunnel pressure, could explain this. Şahin et al. used the Boston Carpal Tunnel Scale. The CTS group had considerably higher symptom and severity scale scores, but there was no significant relationship between functional status scale scores and electrophysiological diagnosis of CTS [11]. The study found no link between CTS severity and Boston Carpal Tunnel Scale scores in patients.

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Schrijver et al. found a modest connection between the CTS diagnosis on EMG and the Boston symptom and functional scales [12]. Chan et al. showed no connection between pre- and post-operative electrophysiological CTS detection and Boston symptom severity or functional status [13]. Patients with CTS had significantly higher symptom severity, functional status, and total scale scores on the Boston Carpal Tunnel Scale than those without. In patients with unilateral CTS, there is a poor link between CTS severity and the Boston Total score, but a substantial correlation between the Boston Symptom Severity score and CTS severity. In patients with bilateral CTS, there was a weak positive connection between CTS severity in the non-dominant hand and both the Boston Symptom Severity and Total scores. Our study found a greater correlation between Boston Carpal Tunnel Scale scores, electrophysiological CTS diagnosis, and CTS severity, compared to previous research. We feel the study's outcomes are influenced by the patient group and associated risk factors. The study's merits include using validated and reliable assessment instruments, applying EMG to each patient, and implementing blinding.

LIMITATION

This was a single-centered study with a modest sample size. As a result, the study's conclusions may not accurately reflect the situation throughout the country.

CONCLUSION

The study found that CTS was more common in females, long-term smokers (over 21 years), and diabetic patients. Patients with CTS exhibited significantly greater age, wrist pain duration, BCTQ total scores, VAS scores, and BMI values than those without the diagnosis. These findings emphasize the significance of evaluating risk variables in clinical evaluations for early diagnosis and appropriate management of CTS. The correlation between BCTQ scores and EMG results indicates that these assessment methods are useful in clinical practice.

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