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Association between baseline characteristics of carpal tunnel syndrome and its relation to psychometric properties of the Boston carpal tunnel questionnaire

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ABSTRACT

Objectives: Carpal tunnel syndrome (CTS) generally causes functional disabilities and consequently develops socioeconomic burdens for individuals and our community in the long run. The negative consequences are more recorded in developing nations. Therefore, early addressing the disorder is essential to eliminate the negative impacts on any health-care system.

Methods: This descriptive cross-sectional study was conducted on patients with CTS attending the professorial surgical clinics at Teaching Hospital Jaffna. The demographic and clinical presentation while a self-reported Boston Carpal Tunnel Questionnaire (BCTQ) was used to assess the severity of symptoms and functional status of the wrist and hand.

Results: This study involved 63 respondents whose mean age and body mass index were 55.4 ± 12.4 years and 25.6 ± 3.1, respectively. The larger proportion was female (74.6%) and the majority's civil status was married (90.5%). Menial and skilled jobs were 46.6% and 31.7%, respectively, whereas the remaining were professionals. The right-hand dominance was 93.7%, although 57.1% had the right hand affected. There was a significant association ($r = 0.739$ and $P = 0.0001$) between the clinical tests and the severity of symptoms score.

Conclusion: This study outcomes of CTSs severity and functional status with the BCTQ recommend that this tool and its scales indicate the association between CTSs baseline characteristics and impairments resulting from CTS in the clinical context.

Keywords: Carpal tunnel syndrome, Median neuropathy, Physical examination, Baseline characteristics, Boston carpal tunnel questionnaire

INTRODUCTION

Carpal tunnel syndrome (CTS) is becoming a more significant health problem. It has a negative impact on both individuals and society as it affects a person's health and work productivity, subsequently impacting socioeconomic status. It is a common, well-known medical disorder defined as the median nerve being compressed under the transverse carpal ligament or carpal tunnel at the wrist level. The median nerve comprises 94% sensory and 6% motor fibers at the carpal tunnel level.[1,2] Thus, the symptoms of CTS include sensory impairment as pain,

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numbness, and tingling and burning sensations at the thumb, index, middle, and radial half of the ring finger. At the same time, motor dysfunction ranges from muscle weakness such as decreased grip strength and a loss of coordination. The precise etiology of CTS is unknown.[3] However, there is a link between CTS and predisposing risk factors, including comorbidities, repetitive movements, fracture of the distal radius, pregnancy, obesity, and cold environment, which are considered to be linked with the development of CTS.[4] CTS presents in approximately 3% of the general population. However, a higher incidence was reported among the female population. Females are 4 times more likely to develop CTS in their forties and fifties than males.[5]

It is claimed that high-income countries have generated well-structured information-gathering strategies regarding the incidence rate and prevalence of CTS in their public health sectors.[6] Unfortunately, there is a lack of a national database on CTS prevalence, management, and clinical outcomes in Sri Lanka.[7] However, the negative consequences of CTS have been substantially recorded in developing nations.[8] Therefore, it is essential to support the implementation of management strategies and preventative measures for CTS in the developing country's clinical context. This study aimed to collect conclusive data about the distribution of CTS, therapeutic interventions, clinical outcomes, and risk factors associated with CTS in Sri Lanka. This can support developing strategies to manage CTS cost effectively in clinical settings and implement preventable measures. The Boston Carpal Tunnel Questionnaire (BCTQ) is a self-reported tool that examines both the severity and functional status of CTS eleven and eight questions, respectively. The Symptom Severity Scale (SSS) and Functional Status Scale (FSS) questions are scored on a Likert scale of 1–5, with one as no difficulty and five as difficult. The psychometric properties of outcome measures should be assessed by their face and content validity, construct validity, inter-tester and intra-tester reliability, responsiveness, interpretability, acceptability, and responder burden. This study assessed the reliability and responsiveness of CTS outcome measures.[9]

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out as a single center at Teaching Hospital Jaffna for 6 months from March 2022. Convenient sampling was applied to recruit a total of 63 participants who were diagnosed as CTS with the nerve conduction study. A data collection tool was used to collect the sample's baseline characteristics, including sociodemographic details such as sex, age, marital status, work, number of children, alcohol-smoking habit, comorbidity, pain location and severity, and a numerical pain scale. Furthermore, an interviewer-administered questionnaire, the BCTQ, was used to assess the SSS and FSS of the CTS while performing the following clinical tests: Tinel sign, Phalen's maneuver, flick sign, square wrist sign, thenar atrophy, and abduction weakness.[7] The interviewers were trained to facilitate data collection and explain any vague information in the questionnaires to overcome any educational or cultural barrier that might have prevented proper understanding. This data collection tool was developed specifically for this study, and a pilot study was carried out outside the study sample to ensure precise clarification of all questions. Descriptive statistics were used to summarize the collected data. Continuous variables were presented as mean ± standard deviation based on their distribution. Categorical variables were reported as frequencies and percentages. One-way analysis of variance was performed to assess the significant relationship between the categorical and continuous variables. Pearson correlation analysis and correlation coefficient were assessed to determine the significant relationship between SSS and FSS. $P < 0.05$ was considered statistically significant.

RESULTS

This study involved 63 respondents. Their age ranged from 24 to 78 years; the mean was 55.4 ± 12.4 years. Among these study participants, the larger proportion was female (74.6%) and the ratio between female and male was 3:1. The majority of participants' civil status was married (90.5%). At 46.6% and 31.7% had menial and skilled jobs, respectively, while the remaining were professionals. The mean body mass index (BMI) was 25.6 ± 3.1, with overweight and obese being almost half the participants at 61.9%, underweight was 1.6%, and the remaining had an ideal (36.5%) BMI. However, both sexes had relatively equal proportional contributions to BMI. The right-hand dominant was 93.7%, whereas 57.1% had the right hand affected only, while a larger proportion (81%) had repetitive wrist movement. Most (77.8%) had comorbidities such as diabetes mellitus, hypertension, dyslipidemia, hypothyroidism, and rheumatoid arthritis. However, many had combined comorbidities. Among these, 38.1% and 22.2% had hypothyroidism and rheumatoid factor, respectively, along with other comorbidities. The frequency of pain severity among patients diagnosed with CTS is demonstrated in Figure 1.

In this study, participants were assessed with several clinical tests, and they were clustered into three groups, whether less than two positive clinical tests, two to four positive tests, and more than four positive tests [Figure 2].

There was a significant relationship with age (0.0001), occupation (0.006), and repetitive movements (0.008) at a 5% level of significance [Table 1]. The Pearson correlation analysis was performed to assess the correlation between the SSS, FSS, and clinical score, revealing a strong positive correlation between clinical tests and SSS and FSS scores

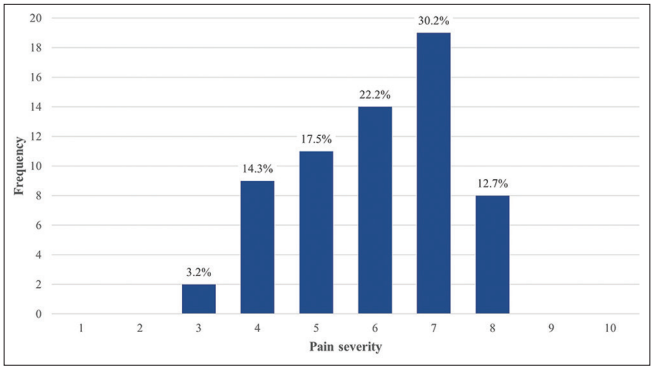

Figure 1: Pain severity of carpal tunnel syndrome according to the numerical pain score.

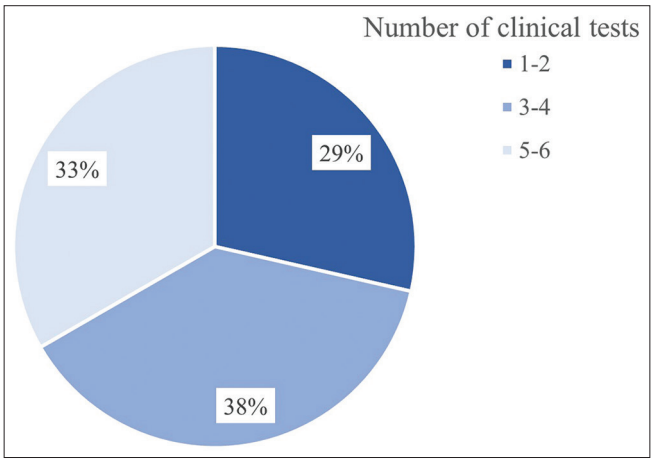

Figure 2: Number of clinical positive tests among the reported carpel tunnel syndrome.

among the diagnosed CTS. The correlation coefficient between clinical tests and SSS and FSS scores are 0.739 and 0.639, respectively ($P < 0.01$). The *P*-value for this correlation is 0.000, which indicates that this correlation is statistically significant at the 0.01 level [Table 2].

DISCUSSION

A research study indicated that CTS is linked with aging, sex variation, increasing BMI, diabetic mellitus, and pregnancy.[10] According to the development of CTS with aging, McCabe *et al.* reported that incidence increased with age, even it became severe after 59 years.[11] Another study revealed that 45–54 years in males and 55–64 years in females were the highest prevalence of CTS patients. Furthermore, the authors found a bimodal distribution of CTS incidents with age, the highest at age 50–54 years, followed by another peak at age 75–84 years. In comparison, males' bimodal distribution with the first peak in their period of fifties and a second peak in their seventies and found that a greater number of CTS cases occurred between 60 and 80 years, whereas the first peak

Table 1 : Baseline characteristics and BCTQ among CTS reported cases.

Baseline characteristic	Cases (63)	*P*-value
Age, years		
Mean±SD	55.35±12.4	0.0001*
Sex		
Females (%)	47 (74.6)	0.594
Males (%)	16 (25.4)	
Dominant hand		
Right (%)	59 (93.7)	0.372
Left (%)	4 (6.3)	
Occupation		
Professional (%)	14 (22.2)	
Skilled (%)	20 (31.7)	0.006
Unskilled (%)	29 (46.0)	
Body mass index		
Underweight	1 (1.6)	
Ideal	23 (36.5)	0.376
Overweight	39 (61.9)	
Marital status		
Single (%)	6 (9.5)	0.537
Married (%)	57 (90.5)	
Repetitive movement		
Yes (%)	51 (81.0)	0.008
No (%)	12 (19.0)	

*ANOVA *t*-test remaining *P*-value derived from Pearson Chi-square. SD: Standard deviation, BCTQ: Boston Carpal Tunnel Questionnaire, CTS: Carpal tunnel syndrome

was in their fifties and the second peak in their seventies.[12] Alhusain *et al.* study mentioned that the number of CTS peaked among females than males 2:1.[13] Our study found that the larger proportion was females (74.6%) and the ratio between females and males was 3:1. The right-hand dominant was at 93.7%, whereas 57.1% was affected with only the right hand, while a larger proportion (81%) had a repetitive wrist movement. In this study, most participants (77.8%) had comorbidities such as diabetes mellitus, hypertension, dyslipidemia, hypothyroidism, and rheumatoid arthritis. However, many had combined the comorbidities among this; 38.1% and 22.2% had hypothyroidism and rheumatoid factor, respectively, along with other comorbidities.

This study found that most participants' civil status was married (90.5%). There was a significant correlation with married females being at more risk of developing CTS in their fifth decade. A study in Saudi Arabia showed that CTS is perceived as recurrent occupational related. This caused not only a financial issue but also caused employers to significantly suffer an indirect financial burden due to loss of productivity and time spent hiring new employees.[14] Several studies reported that workplace physical exposure developed a high risk of CTS due to hand force, repetition, posture, and vibration collected at the risk level.[13] This study reported that 46.6% and

Table 2: Relationship between clinical tests and Symptom Severity Scale and Functional Status Scale.

Clinical score *Symptom severity scale cross tabulation					
Clinical Test	**Symptom Severity Scale**			**Total**	**Pearson Chi-square *P*-value**
	Mild	**Moderate**	**Severe**		
1–2	17	1	0	18	0.0001
3–4	4	13	7	24	
5–6	0	9	12	21	
Total	21	23	19	63	
Clinical score *Functional status scale cross tabulation					
Clinical test	**Functional status scale**			**Total**	**Pearson Chi-square *P*-value**
	Mild	**Moderate**	**Severe**		
1–2	10	8	0	18	0.0001
3–4	3	16	5	24	
5–6	2	6	13	21	
Total	15	30	18	63	

31.7% were menial and skilled jobs, respectively, whereas the remaining were professionals, although it found a relationship between occupational factors and CTS occurrence. The mean BMI was 25.6 ± 3.1, with overweight being almost half the participants at 52.3%, whereas obese was 9.6%, underweight reported at 5.3%, and remaining were ideal. However, both sexes had relatively equal contributions.[15] The findings of our study supported the hypothesis that a person with a higher BMI has a higher risk of developing CTS. However, the pathophysiology between the BMI and CTS is unclear.[16]

The authors Kozak *et al*. claimed that CTS had a significant correlation to exposure to repetitive wrist movements, with a poor correlation with heavy-weight lifting activities of the hand.[17] However, a study contended that workers exposed to vibrating tools seem to be at potential risk of developing CTS.[18] This study also found a considerable association between repetitive wrist movements and CTS. The diagnosis of CTS requires adequate medical history taking, comprehensive physical examination, and investigation to reach a precise differential diagnosis of CTS.[19] The patient should be questioned on the frequency of these symptoms, whether they happen at night or during the day, or whether certain positions or repeated movements provoke them. Physical assessment of the patient's hand is a fundamental approach to diagnosing CTS since specific discoveries may indicate the availability of other factors. In our study, clinical tests of Phalen's test (95.2%) and Tinel signs (87.2%) had a more frequent positive with patients diagnosed with CTS, whereas a recent systematic review reported that the Phalen's test and Tinel's sign were the most assessed provocative maneuvers to have a differential diagnosis of CTS.[20] In our study, the Pearson correlation analysis was performed to assess the correlation between the SSS, FSS, and clinical score, which revealed a strong positive correlation between clinical tests, SSS and FSS scores among the diagnosed CTS. The correlation coefficient between clinical tests and SSS and FSS scores is 0.739 and 0.639, respectively ($P < 0.01$). The *P*-value for this correlation is 0.000, which indicates that this correlation is statistically significant at the 0.01 level.

The limitations of the study

This study was conducted in one clinical setting with a relatively recruited small sample size. Therefore, the study ought to be carried out in multiple clinical contexts, including a larger number, as it would bring better strength to the study findings in future.

CONCLUSION

The BCTQ is a self-reported tool to measure the outcome of CTS severity and functional status in patients. The findings of this study recommend that the BCTQ and its score indicate the association between CTS baseline characteristics and impairments resulting from CTS. This should be considered along with diagnostic accuracy tools to arrive at a differential diagnosis of the disease and design the interventions for having cost-effective and efficient prognostic outcomes among CTS in the clinical context.

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AUTHORS' CONTRIBUTIONS

TS and SG: Study concept. ST: Data collection and analysis. TS and SG: Manuscript writing. All authors have critically

reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

This study was approved by the Ethics Review Committee of Teaching Hospital Jaffna on 30/12/2021. The ethical clearance number is S01/12/2021.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

DECLARATION OF PATIENT CONSENT

The authors' certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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