Original Article

Factors Related to Quality of Life in Patients with Carpal Tunnel Syndrome: A Cross-Sectional Study

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ABSTRACT

Objectives: To determine the association between the quality of life (QoL) of patients diagnosed with carpal tunnel syndrome (CTS) by electrodiagnostic study (EDX) and CTS severity, as well as to identify other associated factors

Study design: Cross-sectional study

Setting: Department of Rehabilitation Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University

Subjects: A total of 140 CTS participants diagnosed by EDX including patients aged 18 or over, who were able to communicate in Thai, were fully conscious, and were willing to participate in this research.

Methods: Participants were recruited and asked to complete the questionnaire about demographic and clinical characteristics related to CTS, the Boston questionnaire (Thai version), the Thai version of the Hospital Anxiety and Depression Scale (Thai HADS), and the EQ-5D-5L questionnaire. The data from questionnaires and the EDX results were collected and analyzed.

Results: Utility scores of the EQ-5D-5L questionnaire were correlated with Boston functional severity score (FSS) (r = -0.603, $p < 0.001$), Boston symptom severity score (SSS) (r = -0.546, $p < 0.001$), and anxiety (p=0.004). The electrophysiological severity had no association with patients' QoL ($r_s = 0.079$, $p = 0.354$). Health visual analog scale (VAS) scores were correlated with anxiety, Boston functional severity score, and leisure activity. Other factors studied, e.g., age and income, were not associated with the patient's QoL.

Conclusions: CTS patients' QoL is correlated with the subjective symptom severity, functional severity, anxiety, and the inability to participate in leisure activities, but not electrophysiologic severity.

Keywords: carpal tunnel syndrome, quality of life, electrodiagnosis, anxiety

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Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy.[1] The prevalence varies from 3.8-16%[2,3] and is more common among women.[4] However, there has been no report on the prevalence of CTS in the general Thai population, only that of Thais in certain occupations, such as employees at the Royal Irrigation Hospital (62%)[5], and workers of the stone sculpture industry (13%).[6] CTS is caused by the entrapment of the carpal tunnel's median nerve, leading to demyelination and nerve ischemia.[7] Its symptoms include numbness, pain, and/or dysesthesia along the median-innervated hand area. In severe cases, weakness and atrophy of median-innervated muscles can be manifested. These symptoms usually occur in the patient's dominant hand and often get worse at night or while doing activities involving the wrist for an extended period.[3,7] One consequence of CTS is difficulties in performing activities of daily living (ADLs).[8] This may cause patients to quit or switch jobs, resulting in financial problems for them and their families.[9,10] Moreover, CTS has been reported to cause anxiety and depression, which invertedly affect how the patients perceive the severity of their symptoms.[11]

Suspected CTS patients are usually referred for electrodiagnostic studies (EDX) to confirm the diagnosis and to assess the electrophysiological severity. Based on our observations, the higher the severity of CTS, the more burden they feel. In addition, patients with CTS have been reported to have a worse quality of life (QoL) than those without CTS.[12] The study in the United Kingdom (UK) reported that the CTS patients' QoL is inversely associated with its symptom severity.[13] However, the association between electrophysiological severity and QoL has not been established. As the standards for socio-economic status and QoL for the UK and Thai populations are different[14,15], the UK study cannot be applied to future CTS management for the Thai population. The objective of this study is to determine the association between CTS patients' QoL and the severity of CTS. Additionally, we aim to identify other factors that may be associated with QoL. We hypothesized that higher symptom severity scores or more severe CTS according to electrophysiological severity would be correlated with lower utility and health VAS scores.

Methods

Study design

This study is a cross-sectional study. It has been approved by the Siriraj institution review board (No. 569/2564 (IRB1)).

Participants

Patients diagnosed with CTS by EDX at the Department of Rehabilitation Medicine, Faculty of Medicine Siriraj Hospital were recruited according to the following criteria: being at least 18 years of age, able to understand and communicate in the Thai language, fully conscious and willing to participate in this research and able to provide written informed consent. Patients with a history of prior injections or surgery of the wrist, a history of wrist fracture, and a known history of other neurological disorders with symptoms involving the wrist and hand, e.g., polyneuropathy, proximal median or ulnar neuropathy, plexopathy, mononeuritis multiplex, cervical radiculopathy, and females who were pregnant or within 12 months postpartum, were excluded from this study. Sample size calculation was based on a study by Ulbrichtová R. et al.[16] using Spearman rank correlation ($\alpha = 0.05$, power = 0.8) and was equal to 140 participants. Demographic data (sex, age, BMI, comorbidity (e.g., hypertension, diabetes mellitus, dyslipidemia, spondylosis, rheumatologic diseases), dominant hands, health insurance plan, educational level, occupation, characteristics of work and leisure, income) and clinical data (duration and side of symptoms, consequences of symptoms toward work/leisure) were collected using questionnaires.

Outcome measurements

Three following questionnaires were used in this study.

• QoL data was collected using EQ-5D-5L questionnaires. The first part of the questionnaire was the EQ-5D descriptive system, with scores ranging from 1 to 5 of five health dimensions, which were then converted into utility scores using the "Thai 5L Calculator" program containing the score conversion formula based on a study by Pattanaphesaj J. of population-based preference scores of the Thai version EQ-5D-5L.[17] The other part was the health visual analog scale (VAS), in which patients rated their health on a scale of 0 to 100, with 100 being the best health they can imagine and 0 being the worst health they can imagine. The current EQ-5D-5L questionnaire was developed to provide greater discriminatory power and increased reliability for index score (kappa coefficient = 0.44-0.77) compared to the older EQ-5D-3L questionnaire and has shown reasonable convergent validity.[17]

• The subjective severity (symptom severity score) and the functional status score of CTS were obtained using the Thai version of the Boston questionnaire. This questionnaire consists of two sections: the 11-item symptom severity score (SSS) and the 8-item functional status score (FSS). Each item is scored on a range of 1 to 5. The higher the score, the more severe the patient feels. The Thai version of the

Boston questionnaire provides reliable measurement with a Cronbach's alpha coefficient of 0.89 and 0.91 for SSS and FSS, respectively.[18]

• Anxiety and depression were measured using the Thai version of the Hospital Anxiety and Depression Scale (Thai HADS). It is divided into two subscales: an anxiety subscale and a depression subscale. Each subscale has seven items with scores ranging from 0 to 3. Summing up the scores in each subscale, a total score of at least 11 indicates that the patient may present abnormality in each psychiatric condition. The sensitivities of the anxiety and depression subscales are 100% and 85.71%, respectively, and the specificities are 86.0% and 91.3%, respectively. Thai HADS also shows good reliability (kappa coefficient = 0.67 for anxiety, and = 0.73 for depression) and validity (Cronbach's alpha coefficient = 0.8551 for anxiety, and = 0.8259 for depression) for both subscales.[19]

According to EDX, the CTS severity grading scheme developed by Stevens JC[20] was used to stratify electrophysiological severity into three groups: (1) mild CTS, prolonged distal sensory latency with or without sensory nerve action potential (SNAP) amplitude reduction; (2) moderate CTS, abnormal median sensory latency as noted for mild CTS, and prolonged median motor distal latency; and (3) severe CTS, prolonged median sensory and motor distal latency with SNAP either absent or at low amplitude or absent motor response.

Statistical methods

All the data was analyzed using the IBM SPSS statistics program version 28. The data is presented as mean and standard deviation (SD) for quantitative data and number with percentage for qualitative data. The correlation analysis was done using the Pearson correlation coefficient for jointly normally distributed data and the Spearman rank correlation coefficient for nonnormally distributed continuous data. We also compare the differences between two independent groups of quantitative data using an independent t-test and the differences among more than two groups using analysis of variance (ANOVA). Further multiple stepwise linear regression was done to iteratively examine the statistical significance of each independent variable and to eliminate confounding variables. The *p*-value < 0.05 indicates statistical significance.

Results

The 140 CTS patients recruited into this study met all the eligibility criteria. Tables 1, 2 and 3 show participants' characteristics and QoL.

The electrophysiological severity of CTS was found to have no association with the health VAS score ($r_s = -0.007$, $p = 0.933$) or utility score ($r_s = 0.079$, $p = 0.354$) of EQ-5D-5L. On the contrary, the subjective measures of CTS severity obtained from the Thai version of the Boston questionnaire

showed a significant inverse correlation with the utility score (r = -0.546, p < 0.001) and health VAS score (r = -0.222, p = 0.008) of EQ-5D-5L (Table 4).

Functional severity scores obtained from the Thai version of the Boston questionnaire were also found to be significantly inversely correlated with the utility scores (r = -0.603, p < 0.001) and health VAS scores (r = -0.276, p = 0.001) of EQ-5D-5L. In terms of QoL, lower health VAS scores were significantly correlated with the absence of leisure activities (p = 0.011), presence of anxiety (p = 0.001), presence of depression (p = 0.012), and having at least one comorbidity (p = 0.015). Lower utility scores of QoL were significantly correlated with being affected by CTS (p = 0.002) and anxiety (p = 0.004).

Table 1. Demographic data of participants

Characteristics	
Age (years)[1]	58.9 (10.5)
BMI (kg/m²)[1]	25.3 (4.4)
Sex: Female[2]	118 (84.3)
With comorbidity[2]	102 (72.9)
Have routine work[2]	122 (87.1)
Have leisure[2]	120 (85.7)
Participants' income (baht/month)[2]	
≤50,000	129 (92.1)
>50,000	11 (7.9)

[1]Mean (SD), [2]number (%)
BMI, body mass index

Table 2. Clinical characteristics of participants

Characteristics	
Right handed[1]	122 (87.1)
Side of symptoms[1]	
Right	34 (24.3)
Left	29 (20.7)
Both	77 (55.0)
Worse side (patients with symptoms presented on both hands)[1]	
Right	47 (61.0)
Left	30 (39.0)
Duration of symptoms[1]	
≤6 months	68 (48.6)
>6 months	72 (51.4)
Dominant hand affected[1]	116 (82.9)
Being affected by CTS[1]	92 (65.7)
EDX grading[1]	
Mild degree	34 (24.3)
Moderate degree	43 (30.7)
Severe degree	63 (45.0)
Boston Symptom Severity Score[2]	25.5 (6.5)
Boston Functional Severity Score[2]	13.0 (4.3)
Thai HADS[1]	
Anxiety (score ≥11)	8 (5.7)
Depression (score ≥11)	5 (3.6)

[1]Number (%), [2]Mean (SD)
HADS, Hospital Anxiety and Depression Scale; EDX, electrodiagnosis; CTS, carpal tunnel syndrome

Table 3. Quality of life of participants based on EQ-5D-5L

EQ-5D-5L	Mean (SD)
Utility score	0.850 (0.149)
Mild degree	0.867 (0.105)
Moderate degree	0.845 (0.152)
Severe degree	0.845 (0.167)
Health VAS	75.4 (15.0)
Mild degree	75.3 (12.0)
Moderate degree	74.1 (16.0)
Severe degree	76.3 (16.0)

VAS, visual analog scale

Multiple stepwise linear regression analyses were done. Table 5 shows that factors contributing to lower utility scores were Boston FSS, Boston SSS, and anxiety. In addition, factors related to lower health VAS scores were Boston FSS, anxiety, and having leisure activities.

Further analysis revealed that subjective severity (Boston questionnaire) was not associated with electrophysiologic severity (p = 0.059). Other factors (sex, age, BMI, level of education, health care scheme, characteristics of routine work, income of patients, debts and savings, dominant hands, dominant hand involvement, and duration of CTS) were not associated with the patient's QoL.

Discussion

The patients' QoL was inversely correlated with self-reported symptom severity of CTS. Patients with higher utility scores had better QoL, while those with higher Boston SSS had more severe CTS. The utility score reflects the health states of patients where they reported whether they had problems in each specific dimension while health VAS score reflects how the patients perceive their current health. This implies that patients may report to have problems in their lives leading to a lower utility score and, as a result, a diminished QoL. They might, however, perceive their health more positively than its actual condition. This could explain the correlation obtained by regression analysis between Boston SSS and the utility scores but not with the health VAS scores.

The patients's QoL was not correlated with the electrophysiologic severity measured by EDX which is consistent with previous studies.[13,21] In other words, the electrophysiologic severity does not reflect the symptoms and perspectives of patients toward the syndrome. This finding may be due to the fact that the decreased hand function in CTS patients can be compensated for by other normal muscles innervated by other nerves. The severity of self-reported symptoms is beneficial for evaluating the patient's QoL. It is essential to provide standard treatment according to EDX severity. However, healthcare providers should also provide treatments that aim to relieve patients' symptoms and concerns despite the low degree of severity.

Anxiety contributed to a lower QoL compared to patients with no anxiety. According to previous studies[13,22], treating

Table 4. Association between quality of life and demographic data, and clinical characteristics

	EQ-5D: Utility score	*p-value	EQ-5D: Health VAS	*p-value
Boston Symptom Severity Score[#]	r=-0.546	<0.001*	r=-0.222	0.008*
Boston Functional Severity Score[#]	r=-0.603	<0.001*	r=-0.276	0.001*
EDX grading[$]	r_s=-0.079	0.354	r_s=-0.007	0.933
Age[#]	r=-0.088	0.303	r=-0.077	0.366
BMI[#]	r=0.046	0.588	r=-0.003	0.697
Side of symptoms[@]		0.394		0.505
Right	0.848 (0.120)		77.9 (15.1)	
Left	0.883 (0.107)		75.2 (14.1)	
Both	0.839 (0.172)		74.3 (15.3)	
Duration of symptoms[@]		0.906		0.763
< 3 months	0.856 (0.147)		74.2 (17.5)	
3-6 months	0.838 (0.142)		74.2 (14.8)	
6-12 months	0.868 (0.107)		78.2 (12.2)	
>12 months	0.848 (0.169)		75.9 (14.4)	
Dominant hand[†]		0.691		0.537
Right	0.848 (0.151)		75.7 (14.5)	
Left	0.863 (0.133)		73.3 (18.6)	
Dominant hand affected[†]		0.220		0.989
Yes	0.843 (0.154)		75.4 (15.1)	
No	0.884 (0.118)		75.4 (14.9)	
Consequences of symptoms to work/leisure[†]		0.002*		0.345
Affected	0.826 (0.162)		74.5 (15.4)	
Not affected	0.898 (0.107)		77.0 (14.2)	
Thai HADS Anxiety[†]		0.004*		0.001*
No anxiety (score <11)	0.859 (0.143)		76.4 (14.5)	
Anxiety (score ≥11)	0.705 (0.178)		58.2 (13.6)	
Thai HADS Depression[†]		0.085		0.012*
No depression (score <11)	0.854 (0.145)		76.0 (14.8)	
Depression (score ≥11)	0.738 (0.216)		59.0 (21.3)	
Sex[†]		0.342		0.935
Male	0.878 (0.127)		75.1 (15.1)	
Female	0.845 (0.153)		75.4 (15.0)	
Comorbidity[†]		0.127		0.015*
Yes	0.839 (0.155)		73.5 (15.0)	
No	0.882 (0.126)		80.4 (13.9)	
Have routine work[†]		0.408		0.072
Yes	0.854 (0.147)		76.3 (15.1)	
No	0.823 (0.164)		69.4 (13.4)	
Have leisure/hobbies[†]		0.989		0.011*
Yes	0.850 (0.147)		76.7 (14.5)	
No	0.851 (0.165)		67.5 (15.7)	

[#]Pearson correlation coefficient (r), [$]Spearman rank correlation coefficient (r_s), [†]independent t-test, [@]analysis of variance (ANOVA), *$p < 0.05$ indicates statistical significance

VAS, visual analog scale; BMI, body mass index; HADS, Hospital Anxiety and Depression Scale; EDX, electrodiagnosis

anxiety results in a better life quality for patients. Holistic care, including the psychosocial approach, should not be disregarded since recognition of anxiety and the ability to handle these conditions can help patients to achieve a higher QoL.

According to our results, leisure activities contributed to a higher QoL in CTS patients. The enhancement of patients' overall mental health and well-being through leisure activities is clear and supported by evidence.[23] Leisure activities allow patients to relax or escape from a stressful life. Some activities may help build social relationships and psychological support by engaging in group activities leading to a better

QoL. Nevertheless, some activities require hand skills, and patients who engage in such activities for an extended period could possibly aggravate CTS. Our study did not collect data on specific types of activities that patients were involved in; we suggest that these data should be collected in future research.

The mean QoL from EQ-5D-5L in this study is relatively high, implying that CTS does not impact much of patients' overall QoL as CTS only involves hands and the symptoms are not correlated with the electrophysiologic severity as mentioned above. However, exploring the details of each

Table 5. Multiple stepwise linear regression analyses

Variable	Model		Unstandardized coefficients[#]	[*]*p*-value
Utility score for QoL	1	(Constant)	1.132 (0.003)	<0.001[*]
		Boston FSS	-0.021 (0.002)	<0.001[*]
	2	(Constant)	1.234 (0.041)	<0.001[*]
		Boston FSS	-0.015 (0.003)	<0.001[*]
		Boston SSS	-0.007 (0.002)	<0.001[*]
	3	(Constant)	1.226 (0.040)	<0.001[*]
		Boston FSS	-0.015 (0.003)	<0.001[*]
		Boston SSS	-0.007 (0.002)	<0.001[*]
		Anxiety (score ≥11)	-0.109 (0.041)	0.008[*]
VAS for health	1	(Constant)	76.4 (1.3)	<0.001[*]
		Anxiety (score ≥11)	-18.3 (5.3)	0.001[*]
	2	(Constant)	88.4 (3.9)	<0.001[*]
		Anxiety (score ≥11)	-17.1 (5.1)	0.001[*]
		Boston FSS	-0.9 (0.3)	0.001[*]
	3	(Constant)	81.9 (4.6)	<0.001[*]
		Anxiety (score ≥11)	-14.9 (5.1)	0.004[*]
		Boston FSS	-1.0 (0.3)	<0.001[*]
		Leisure	8.7 (3.4)	0.011[*]

[#]Estimated coefficient (SD), [*]*p* < 0.05 indicates statistical significance
VAS, visual analog scale; FSS, functional severity score; SSS, symptom severity score

dimension reveals that patients reported higher scores (more problems) in pain/discomfort, anxiety/depression, and usual activities dimensions than in mobility and self-care dimensions. Despite the lower impact on QoL, patients still perceive a worsened QoL in specific dimensions, and holistic care in these dimensions remains essential.

This study evaluated the QoL using the EQ-5D-5L questionnaire, which requires patients to report their subjective feelings. The Boston questionnaire has similar properties, which might explain the close correlation between the results from these two questionnaires but not the correlation between the QoL and EDX. Additionally, the number of patients with anxiety and/or depression was small (7%) yet a significant correlation with the QoL was found, indicating that answers to the EQ-5D-5L questionnaire were probably influenced by the psychological condition of patients. Objective measures, e.g., hand grip strength, should be included as measures of hand function or severity stratification in future studies.

Although some dimensions in the EQ-5D-5L questionnaire, including pain/discomfort and usual activities dimensions, resemble those in the Boston questionnaire, the mobility dimension of the EQ-5D-5L questionnaire does not reflect the physical impairment caused by CTS. Nevertheless, up to now, there are no CTS-specific measures of life quality. The EQ-5D-5L questionnaire is also concise, simple, and less time-consuming, suitable for patients of advanced ages. Based on all the properties discussed above, the EQ-5D-5L questionnaire has shown itself to be a proper measure in this study.

A strength of this study is the comprehensive data collection, which includes a considerable number of factors that could potentially contribute to the patient's QoL. This strength allows us to analyze the correlation among those factors and

confidently report the results of analyses. A limitation of this study is that some of the questionnaires used are not disease-specific and subjective, i.e., based on the patients' feelings, which means that other unexpected factors may affect their feelings on the day they complete the questionnaire. In addition, the patients recruited in this study mainly lived in Bangkok and surrounding areas, so they may not accurately reflect CTS patients in other areas of Thailand. We recommended recruiting patients from regional hospitals in similar studies in the future to more accurately represent the entire population.

Conclusions

CTS patients' QoL is correlated with the subjective symptom severity, functional severity, anxiety, and the inability to participate in leisure activities, but not the electrophysiologic severity obtained by EDX.

Disclosure

The authors declare no conflicts of interest.

Acknowledgment

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