Original Article

DOI: 10.4274/haseki.galenos.2023.9573
Med Bull Haseki 2023;61:326-331

Reliability and Validity of the Turkish Version of the 6-item Carpal Tunnel Syndrome Symptoms Scale

Ender Salbas*, Sezin Solum**

*Balikesir University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Balikesir, Turkey

**Bursa City Hospital, Clinic of Physical Medicine and Rehabilitation, Bursa, Turkey

Abstract

Aim: The use of patient-completed, disease-specific scales is increasing in clinical research and patient follow-up. We aimed to evaluate the reliability and construct validity of the Turkish version of the 6-item Carpal tunnel syndrome (CTS) symptoms scale for CTS.

Methods: The translation and transcultural adaptation of the original scale were performed by an expert committee using the steps recommended in the guiding methods. The internal consistency and test-retest reliability methods were applied to a population of 60 patients. Content validity and face validity were assessed in a pre-patient group. Concurrent validity was examined using the Boston Carpal Tunnel Questionnaire and the Michigan Hand Outcomes Questionnaire.

Results: This study included 60 patients. In the exploratory and confirmatory factor analyses, the Kaiser-Meyer-Olkin value obtained in the study showed that the sample size was sufficient (0.629) for factor analysis, and the result of Bartlett's test was also significant. All factor loadings in this study were found to be quite high. Cronbach's α coefficient was 0.829. The correlation coefficient between the results of these two tests indicates that the Turkish version of the scale is reliable and the test results are stable ($r=0.869$, $p<0.01$).

Conclusion: The Turkish version of CTS-6 was found to be reliable and valid for measuring CTS-associated symptoms. It can be used to effectively evaluate these symptoms.

Keywords: Carpal tunnel syndrome, 6-item Carpal tunnel syndrome symptoms scale, adaptation, validity, reliability, Turkish

Introduction

Carpal tunnel syndrome (CTS) is a common condition that affects the median nerve and usually causes numbness, tingling, pain, and weakness of the hand and fingers. While a definitive diagnosis is made with nerve conduction studies, the patient's history and physical examination findings lead the clinician to the diagnosis of CTS (1). The use of patient-completed, disease-specific scales is increasing in clinical research and patient follow-up.

Various scales have been developed to assess symptoms related to hand problems (2,3). The Boston Carpal Tunnel Questionnaire (BCTQ) and the 6-item CTS Symptoms Scale (CTS-6) have been used to assess symptom severity and for diagnostic screening (4-6). Using factor analysis and item response theory methodology, Atroshi et al. (6) developed a short 6-item version of the symptom severity scale to ease respondent burden while maintaining the psychometric properties of the BCTQ. It has been demonstrated that the CTS-6 has good reliability, validity, and responsiveness (4,7,8). A Spanish validity and reliability study of the CTS-6 was conducted by Rosales et al. (9) in 2016. Schulze et al. (4) conducted a Norwegian translation and cross-cultural adaptation study in 2021. This scale, which is easy to administer and does not tire the subjects, is applicable to the Turkish population and may enable its use in studies and daily practice in patient symptom follow-up. The ease of use may allow us to ask the right questions to the subjects most easily.

This study aimed to evaluate the reliability and construct validity of the Turkish version of the 6-item CTS Symptoms Scale for CTS.

Address for Correspondence: Ender Salbas, Balikesir University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Balikesir, Turkey
Phone: +90 555 669 86 39 E-mail: drendersalbas@gmail.com ORCID: orcid.org/0000-0001-7460-2889
Received: 11.10.2023 **Accepted:** 14.11.2023

Methods

Registration and Permission

Dr. Isam Atroshi, the scale developer and copyright holder, was contacted by email with permission to adapt the scale (Isam.Atroshi@skane.se) by February 2021 (10). The study was approved by the University of Health Sciences Turkey, Bursa Yuksek Ihtisas Training and Research Hospital Clinical Research Ethics Committee (approval no: 2011-KAEK-25 2021/06-04, date: 23.06.2021) and registered on ClinicalTrials.gov (NCT05927896). In accordance with the Declaration of Helsinki, all participants provided written informed consent and volunteered to participate in the study.

Translation and Cross-cultural Adaptation

In this study, we used a cross-cultural adaptation of the self-report measures manual provided by Beaton et al. (11). A committee of three experts, two with expertise in CTS and one with a background in mechanical engineering, was established to facilitate forward translation and cultural adaptation.

The three members individually translated the original version into Turkish. A committee meeting was then held to discuss the translated terms and phrases in the questionnaire, and a pre-form in Turkish was developed. This preliminary form was then translated back into the original language by a native English speaker with no medical training who was fluent in both English and Turkish. The committee met again to produce a second Turkish form based on the translation, which was then assessed by an evaluation group of seven pre-patients for the clarity of questions, words, and sentences. An adaptation of the form was then produced, resulting in the final Turkish version. The pre-patient group provided face and content validity feedback to one member of the committee, but they were not included in the final analysis.

Study Design and Recruitment

The study was conducted with a cross-sectional observational design. Sixty participants were recruited between 30.04.2021 and 30.10.2021. A total of 60 patients were enrolled in the study, with 10 subjects per item, as per the recommendations outlined by Sousa and Rojjanasrirat (12). Patient recruitment for the study was conducted at the Department of Physical Medicine and Rehabilitation, Kestel State Hospital. Eligible patients were enrolled through a clinical examination conducted by a physical medicine and rehabilitation specialist and a nerve conduction study (NCS). Inclusion criteria for the study included the presence of numbness or tingling in the three radial side fingers, a positive Phalen's or Tinel's test, symptoms lasting more than 3 months, and a consistent NCS with CTS. The exclusion criteria were as follows: no electrophysiological evidence of CTS, history of surgery for CTS, history of cortisone injections for CTS, diabetes or other metabolic diseases, and other inflammatory diseases.

Diagnosis of CTS

To diagnose CTS, we required two or more clinical features that did not belong to other plausible conditions to be observed in the patient and CTS to be detected in the NCS. Clinical features can be listed as follows: presence of numbness, tingling, and paresthesia in the first 3 fingers and/or palm; partial relief of symptoms with shaking of the hand; increase in symptoms at night; and a positive Tinel's or Phalen test. The diagnosis of CTS required minimal CTS findings in a nerve conduction study according to the Padua classification (13).

Instruments

Basic demographics, CTS-6, and two other questionnaires were completed by all patients.

6-item CTS Symptoms Scale

The CTS-6 is a scale designed to measure the severity of CTS symptoms. It consists of six items, five of which are similar to those on the symptom severity subscale of the Boston CTS Scale, while the sixth item is a combination of two items from the same subscale. The CTS-6 has a modified, shortened, and completely different layout from its predecessor and uses a similar scoring system; each response is assigned a numerical value from one (best) to five (worst) and then averaged across all six items, with one missing response allowed (6). To assess the test-retest reliability, the CTS-6 scale was repeated within ~7-10 days.

BCTQ

The BCTQ consists of two subscales: the Symptom Severity Scale and the Functional Status Scale. Each item is scored from one to five, representing increasing difficulty. The average score for each scale was calculated, with higher scores indicating more severe symptoms or functional impairment (14). A Turkish validation study of the BCTQ was also conducted (15).

Michigan Hand Outcomes Questionnaire

Michigan Hand Outcomes Questionnaire (MHQ) is a standardized instrument designed to quantify outcomes in patients with a range of hand conditions. The MHQ consists of six subdomains. Each domain has independent validity and reliability (3). A Turkish validity and reliability study of the MHQ is available (16). The MHQ offers a comprehensive assessment covering a wide array of domains relevant to hand function and well-being. This scale captures the multifaceted impact of hand conditions on a patient's life and provides a holistic understanding of

their experiences. In addition, it has undergone rigorous validation, demonstrating robust psychometric properties including reliability, validity, and sensitivity. Its specificity for hand and upper extremity conditions makes it a valuable tool for targeted assessments, making it widely recognized and trusted in both clinical practice and research settings.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 26.0 Statistics Package Program and AMOS 24 software (17). The categorical data are given as numbers and percentages, and the mean, standard deviation, and minimum and maximum values of the age variable are given. The normal distribution of numerical variables was determined by calculating skewness and kurtosis values. According to the rules of normal distribution, reference values were used so that skewness values were within ±1.5 (18) and kurtosis values were within ±3 (19). In this context, it was observed that the data of the test and re-test CTS-6, BCTQ Symptom and Function Severity Subscales, MHQ, and its sub-factors were normally distributed. The correlation analysis of the test-retest reliability of the CTS-6 and the concurrent validity of the CTS-6 with the BCTQ and MHQ scales were examined by Pearson correlation analysis. The correlation coefficient between 0.00 and 0.30 was considered a low-level relationship, between 0.30 and 0.70 as a medium-level relationship, and between 0.70 and 1.00 as a high-level relationship (20). In the data analysis, exploratory factor analysis (EFA) with the SPSS package program was used to reveal the factor structures of the scales, and confirmatory factor analysis (CFA) with AMOS 24 was used to confirm the factors. For reliability analyses, Cronbach's alpha, internal consistency coefficient, and item-total correlation were calculated. In the entire study, significance levels were realized by considering 0.05 and 0.01 values.

Results

Sixty patients with CTS were included in this study. The demographic and clinical characteristics of the patients are presented in Table 1. All participants completed both of the scales. For the retest, all participants were asked to complete the CTS-6 again 7-10 days later.

Construct Validity

Exploratory and Confirmatory Factor Analysis (EFA-CFA)

The six items of the CTS-6 were subjected to EFA. The principal axis analysis method and the varimax rotation technique were applied for the factor loadings. Factors with eigenvalues (Eiqen value) greater than one were considered, and a maximum of one factor structure was desired. The factor loadings were set at 0.50. The Kaiser-Meyer-Olkin (KMO) value was 0.629, and the result of Bartlett's test was $p<0.001$. The KMO value obtained in this study shows that the sample size was sufficient for factor analysis, and the result of Bartlett's test was also significant. There was a high correlation between the items and the data that fit a multiple-normal distribution. According to the results, the data were suitable for factor analysis. Factor analysis revealed that the scale could have a single-factor structure, and the CTS-6 factor loadings ranged between 0.655 and 0.790 (Table 2). The expected factor loading for each item was 0.03 and above. All factor loadings in this study were found to be quite high.

Reliability

The reliability of the CTS-6 scale was evaluated through analysis, yielding a Cronbach's α coefficient of 0.829. The expected α coefficient of a good scale is expected to be above 0.70 (21). Accordingly, the reliability of the CTS scale used in this study was sufficient. Confirmatory factor analysis was conducted to evaluate the validity of the single-factor structure that emerged from the EFA of the CTS-6, which showed an acceptable level of fit.

Test-retest Reliability

There was a high, positive, and significant correlation between the test and retest results of CTS-6 ($r=0.869$, $p<0.01$). The correlation coefficient between the results

Table 1. Socio-demographic characteristics of patients

		n (%)
Gender	Female	43 (71.7)
	Male	17 (28.3)
Comorbidity	None	46 (71.9)
	Hypertension	11 (17.2)
	Diabetes mellitus	4 (6.3)
	Hypothyroidism	1 (1.6)
	COPD	2 (3.1)
Level of education	Illiterate	1 (1.7)
	Primary education	26 (43.3)
	High School	26 (43.3)
	University	7 (11.7)
Marital status	Single	10 (16.7)
	Married	48 (80.0)
	Other	2 (3.3)
Occupation	Housewife	34 (56.7)
	Worker	8 (13.3)
	Officer	14 (23.3)
	Farmer	4 (6.7)
Age	Mean ± SD Med. (Min.-Max.)	46.58±8.42 45.5 (34-73)

COPD: Chronic obstructive pulmonary disease, Min.-Max.: Minimum-maximum, SD: Standard deviation, n: Number of patients

obtained from these two tests means that the scale is reliable and stable. High reliability is also an indication that the measurement results are free from random errors that may arise from the application (21).

Face and Content Validity

For face and content validity, the pre-patient group was interviewed about their views on the questionnaire, and the results of these face-to-face interviews were evaluated by two expert committee members. The experts concluded that the questionnaire covered the most relevant aspects of patients with CTS and that all items should be included in the Turkish version and had good face validity. According to the committee, all items in the Turkish version were consistent with the construct; therefore, the content validity was considered excellent (100%).

Concurrent Validity

There was a positive, significant, and moderate correlation between the CTS-6 and BCTQ scores (SSS and FSS: r=0.517, p<0.01; r=0.316, p<0.01, respectively). A high MHQ score reflects better outcomes and fewer disease complaints, whereas a high CTS-6 score reflects increased symptoms. Therefore, a negative correlation is expected. There was a moderate, negative, and significant correlation between CTS-6 and MHQ patient satisfaction, activities of daily living subscales, and overall scores (r=-0.483, p<0.01) (Table 3).

Discussion

This study demonstrated that the Turkish version of the CTS-6 (Table 4) is a valid and reliable instrument for patients with CTS and that the scale can be applied to the Turkish population.

Self-completion scales have been widely used for the treatment of various diseases. The main purpose of the scales is to ask the subject about the conditions of the relevant situation without boring or tiring the subject. CTS-6, which consists of six easy-to-understand questions, is a successful scale in this respect (6). Translating a scale into another language is not always easy because of differences in the socio-cultural components of that language. Therefore, there is no consensus on validity and reliability studies. For example, there is no consensus on

Table 2. CTS-6 item factor loadings, reliability and item-total correlation analysis results

Question	Items	Factor loadings	Item-total correlation	Cronbach alpha
Q1	Pain at night	0.750	0.617	0.829
Q2	Pain during daytime	0.688	0.539	
Q3	Numbness or tingling at night	0.742	0.611	
Q4	Numbness or tingling during daytime	0.655	0.506	
Q5	Pain	0.790	0.672	
Q6	Numbness or tingling	0.779	0.669	

Table 3. Levels of association between CTS-6 and reference scales

Scales and subscales	Coefficient	CTS-6	BSS	FSS	MHQ-A	ADL	JP	P	AE
BCTQ symptom severity scale (BSS)	r	0.517**	1.000						
	p	0.000							
BCTQ - function severity scale (FSS)	r	0.316*	0.789**	1.000					
	p	0.014	0.000						
The Michigan hand outcomes questionnaire (MHQ-A) Overall	r	-0.483**	-0.605**	-0.493**	1.000				
	p	0.000	0.000	0.000					
Activities of daily living (ADL)	r	-0.415**	-0.605**	-0.591**	0.815**	1.000			
	p	0.001	0.000	0.000	0.000				
Job performance (JP)	r	-0.235	-0.426**	-0.337**	0.245	0.360**	1.000		
	p	0.071	0.001	0.008	0.059	0.005			
Pain (P)	r	-0.190	-0.155	-0.271*	0.139	0.229	0.262*	1.000	
	p	0.147	0.236	0.037	0.290	0.078	0.043		
Aesthetic appearance (AE)	r	-0.022	0.163	0.033	0.155	0.185	-0.298*	-0.086	1.000
	p	0.870	0.212	0.802	0.237	0.156	0.021	0.515	
Patient satisfaction (PS)	r	-0.416**	-0.435**	-0.275*	0.622**	0.625**	0.276*	-0.075	0.278*
	p	0.001	0.001	0.033	0.000	0.000	0.033	0.569	0.031

Table 4. Turkish Version of the CTS-6					
6 Maddelik KTS Semptom Ölçeği					
Aşağıdaki soruları cevaplarken son 2 haftalık süreyi göz önünde bulundurunuz. Her bir bulgu veya yakınmanın 24 saat içindeki sıklığını size en çok uyan cevaba göre işaretleyiniz.					
Elinizde hissettiğiniz aşağıdaki belirti ve bulgular ne kadar şiddetliydi?					
	Yok	Hafif	Orta	Şiddetli	Çok şiddetli
Gece ağrısı					
Gün içerisindeki ağrı					
Gece uyuşma veya karıncalanma					
Gün içerisindeki uyuşma ve karıncalanma					
Elinizde gördüğünüz aşağıdaki belirtiler, geceleri ne sıklıkta uyanmanıza neden oldu?					
	Hiç	1 kez	2-3 kez	4-5 kez	5'ten fazla
Ağrı					
Uyuşma veya karıncalanma					

how many different translations of the scale there should be, how many people the committee should consist of, how the committee members should relate to the scale in question, who should do the back-translation, and whether back-translation is really necessary. Fortunately, there are suggestions and guidelines in the literature that address these issues in detail (11,12).

Reproducibility represents data reflecting whether the same result is obtained on repeated test administrations at different times when the subject's clinical findings are the same (22). The reproducibility of the Turkish version of the CTS-6 is excellent, with a correlation coefficient of 0.869, similar to the Spanish and Norwegian versions (0.85 and 0.86, respectively) (4,9). However, it was lower than that of the original English version (0.95) (10).

Internal consistency indicates the extent to which the questions on a scale measure a single concept (22). According to the results of the KMO and Bartlett's tests, the data were suitable for factor analysis. Factor analysis revealed that the scale could have a single-factor structure, and all CTS-6 factor loadings in this study were quite high. High internal consistency reduces error variance or increases precision (22). The internal consistency of CTS-6 (Cronbach's alpha=0.82) was excellent. Similar results for internal consistency have been reported for the Spanish, Norwegian, and original versions of CTS-6 (0.81-0.82-0.86, respectively) (4,9,10).

Validity refers to whether the scale measures what it claims to measure (11,12). For the Spanish version, Rosales et al. (9) used QuickDASH. We used MHQ and BCTQ for concurrent validity and found that CTS-6 was moderately correlated with MHQ and BCTQ. Content and face validity were examined in a pre-patient group through face-to-face interviews with committee members. This study revealed that the Turkish version of the CTS-6 demonstrated face and content validity.

Draghici et al. (23) reported that the CTS-6 questionnaire can be used in the diagnosis of moderate CTS using multiple logistic regression. The 6-item CTS symptom scale is being used with increasing frequency (24). On the other hand, Doi et al. (25) argued for the need for the remaining additional items of the SSS and questions of the Functional Scale 9 and 15.

Study Limitations

A limitation of this study was that it did not include post-treatment measures. To clarify that a symptoms scale can also indicate symptoms related to recovery, it is useful to perform pre- and post-treatment measurements. Despite its limitations, the Turkish version of the scale has high factor loadings, internal consistency, and concurrent validity.

Conclusion

This study showed that the Turkish version of the CTS-6 has adequate parameters, including internal consistency, test-retest reliability, and concurrent validity. The Turkish version of CTS-6 is reliable and valid for assessing CTS-related symptoms.

Acknowledgements

We extend our sincere gratitude to Abdullah Cobanoglu and Ali Yavuz Karahan for their invaluable assistance.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Turkey, Bursa Yuksek Ihtisas Training and Research Hospital Clinical Research Ethics Committee (approval no: 2011-KAEK-25 2021/06-04, date: 23.06.2021).

Informed Consent: All participants provided written informed consent and volunteered to participate in the study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: E.S., S.S., Design: E.S., S.S., Data Collection or Processing: E.S., S.S., Analysis or Interpretation: E.S., S.S., Literature Search: E.S., S.S., Writing: E.S., S.S.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Sevy JO, Varacallo M. Carpal Tunnel Syndrome. StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Matthew Varacallo declares no relevant financial relationships with ineligible companies. 2023.
2. Hoang-Kim A, Pegreffi F, Moroni A, Ladd A. Measuring wrist and hand function: common scales and checklists. Injury 2011;42:253-8.
3. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. J Hand Surg Am 1998;23:575-87.
4. Schulze DG, Nilsen KB, Killingmo RM, Zwart JA, Grotle M. Clinical utility of the 6-item CTS, Boston-CTS, and Hand-diagram for carpal tunnel syndrome. Front Neurol 2021;12:683807.
5. Levine DW, Simmons BP, Koris MJ, et al. A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. J Bone Joint Surg Am 1993;75:1585-92.
6. Atroshi I, Lyren PE, Ornstein E, Gummesson C. The six-item CTS symptoms scale and palmar pain scale in carpal tunnel syndrome. J Hand Surg Am 2011;36:788-94.
7. Mollestam K, Rosales RS, Lyren PE, Atroshi I. Measuring symptoms severity in carpal tunnel syndrome: score agreement and responsiveness of the Atroshi-Lyren 6-item symptoms scale and the Boston symptom severity scale. Qual Life Res 2022;31:1553-60.
8. Lyren PE, Atroshi I. Using item response theory improved responsiveness of patient-reported outcomes measures in carpal tunnel syndrome. J Clin Epidemiol 2012;65:325-34.
9. Rosales RS, Martin-Hidalgo Y, Reboso-Morales L, Atroshi I. Reliability and construct validity of the Spanish version of the 6-item CTS symptoms scale for outcomes assessment in carpal tunnel syndrome. BMC Musculoskelet Disord 2016;17:115.
10. Atroshi I, Lyren PE, Gummesson C. The 6-item CTS symptoms scale: a brief outcomes measure for carpal tunnel syndrome. Qual Life Res 2009;18:347-58.
11. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976) 2000;25:3186-91.
12. Sousa VD, Rojjanasrirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. J Eval Clin Pract 2011;17:268-74.
13. Padua L, LoMonaco M, Gregori B, Valente EM, Padua R, Tonali P. Neurophysiological classification and sensitivity in 500 carpal tunnel syndrome hands. Acta Neurol Scand 1997;96:211-7.
14. Multanen J, Ylinen J, Karjalainen T, Ikonen J, Hakkinen A, Repo JP. Structural validity of the Boston Carpal Tunnel Questionnaire and its short version, the 6-Item CTS symptoms scale: a Rasch analysis one year after surgery. BMC Musculoskelet Disord 2020;21:609.
15. Sezgin M, Incel NA, Serhan S, Camdeviren H, As I, Erdogan C. Assessment of symptom severity and functional status in patients with carpal tunnel syndrome: reliability and functionality of the Turkish version of the Boston Questionnaire. Disabil Rehabil 2006;28:1281-5.
16. Oksuz C, Akel BS, Oskay D, Leblebicioglu G, Hayran KM. Cross-cultural adaptation, validation, and reliability process of the Michigan Hand Outcomes Questionnaire in a Turkish population. J Hand Surg Am 2011;36:486-92.
17. Arbuckle JL. Amos (Version 26.0). Chicago: IBM SPSS; 2019.
18. Tabachnick BG, Fidell LS. Using multivariate statistics. Harlow, Essex: Pearson Education; 2014.
19. Kallner A. Formulas. In book: Laboratory Statistics. 2018:1-140.
20. Büyüköztürk Ş. Sosyal bilimler için veri analizi el kitabı: istatistik, araştırma deseni, SPSS uygulamaları ve yorum: Pegem Akademi; 2023.
21. Ashley RA, Team SCR. Clinical trials of a matrix metalloproteinase inhibitor in human periodontal disease. Ann N Y Acad Sci 1999;878:335-46.
22. Nunnally JC, Bernstein IH. Psychometric theory. 3. ed., internat. stud. ed., [Nachdr.] ed. New Delhi: Tata McGraw-Hill Ed.; 2010.
23. Draghici NC, Leucuta DC, Ciobanu DM, Stan AD, Lupescu TD, Muresanu DF. Clinical utility of Boston-CTS and Six-Item CTS Questionnaires in carpal tunnel syndrome associated with diabetic polyneuropathy. Diagnostics (Basel) 2022;13:4.
24. Krogh TP, Isaksen C, Rojo-Manaute JM, et al. Implementation of ultrasound-guided carpal tunnel release. Dan Med J 2023;70:A11220689.
25. Doi K, Mane SA, Hattori Y, Sakamoto S, Sonezaki S, Saeki Y. Rasch analysis of the carpal tunnel syndrome instrument. J Hand Ther 2023;S0894-1130:00107-2.