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## RESEARCH PAPER

# Assessment of symptom severity and functional status in patients with carpal tunnel syndrome: Reliability and validity of the Turkish version of the Boston Questionnaire

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### Abstract

**Objectives.** The aim of this study was to develop a Turkish version of the Boston Questionnaire and assess its reliability and validity.

**Methods.** Sixty-seven patients with idiopathic carpal tunnel syndrome were included in the study. The Turkish version of Boston Questionnaire was obtained after translation process, and was then administered to subjects twice within seven days. Reliability was assessed by internal consistency (Cronbach's alpha and item-total correlation), and reproducibility. Validity was examined by correlating the Boston Questionnaire scores to general health status (Short Form-36), pain severity (Visual Analogue Scale) and pinch and grip strength measures.

**Results.** Reliability of the Turkish version was very good, with high internal consistency (Cronbach's alpha 0.82 for symptom severity scale, and 0.88 for functional status scale), and reproducibility (Pearson correlation coefficient 0.60 for symptom severity scale, and 0.77 for functional status scale). The Boston Questionnaire scores were correlated with Visual Analogue Scale, physical functioning, physical role, bodily pain and emotional role subscales of Short Form-36, pinch and grip strength scores to obtain coefficients for external construct validity.

**Conclusion.** Adaptation of the Boston Questionnaire for use in Turkey was successful. Our results seem to support previous finding of the English version, indicating that it is valid and reliable.

**Keywords:** *Carpal tunnel syndrome, Boston Questionnaire, treatment outcome, reliability, validity*

### Introduction

In recent years, standardized instruments in the form of self-administered questionnaires that measure outcomes of concern to patients including symptoms, function, satisfaction with the results of treatment and quality of life are increasingly being used in clinical practice [1–3].

These are generally classified into two categories: Generic and condition-specific. Generic instruments are designed to capture various aspects of health status in any population, irrespective of disease or condition [4]. Disease specific instruments are targeted at a specific disease or condition and thus have the potential to be more responsive and

sensitive than generic instruments [5]. Such questionnaires can evaluate outcomes of treatment from the patient's perspective, and can facilitate comparison between different studies [6].

Clinical evaluation of outcome after treatment of carpal tunnel syndrome (CTS), a frequent cause of disability of the upper extremities, has not been standardized [7,8]. Several tools have been used to assess the outcome of CTS treatment. Although patients assess relief of symptoms and improvement in function, and physicians evaluate the treatment outcome of carpal tunnel syndrome with nerve conduction studies and clinical assessments, observer bias is unavoidable with such methods, which are neither standardized nor reproducible [8].

Self-administered questionnaires may eliminate bias and, though subjective, are standardized, reproducible and sensitive to clinical changes [9]. A self-administered Boston Questionnaire for the assessment of symptom severity and functional status in CTS has been introduced and shown to be reliable and valid [10]. This questionnaire has been translated into different languages and has been found to be valid and reliable [11–13]. In addition, since its introduction, the Boston Questionnaire has been used in a number of studies and the results support its sensitivity to clinical changes [1,8,14]. The Boston Questionnaire has proved to be more responsive to clinical changes after CTS surgery than the commonly performed sensibility and strength measures [8,9,15].

This study aimed to develop a Turkish version of the Boston Questionnaire and evaluate its reliability and validity for this population (see Appendix).

## **Materials and methods**

### *The Boston Questionnaire*

The questionnaire is self-administered and assesses the severity of symptoms and functional status in patients with CTS. The symptom severity scale (SSS) assesses the symptoms with respect to severity, frequency, time and type. The scale consists of 11 questions with multiple-choice responses, scored from 1 point (mildest) to 5 points (most severe). The overall symptom severity score is calculated as the mean of the scores for the eleven individual items. The functional status scale (FSS) assesses the affect of the CTS on daily living. The scale consists of 8 questions with multiple choice responses, scored from 1 point (no difficulty with the activity) to 5 points (can not perform the activity at all). The overall score for functional status was calculated as the mean of all eight. Thus, a higher symptom severity or functional status score indicates worse symptoms or dysfunction [10]).

### *The adaptation process*

The Boston Questionnaire was adapted to the Turkish population using recent guidelines for cross-cultural adaptation [16]. The index was at first translated from English to Turkish by four bilingual authors whose first language was Turkish. These four “forward” translations were reviewed and discussed by the two authors and a synthesis was formed. This version was translated back to English by two English-speaking language specialists. Both were blinded to the concepts being investigated and had no medical background. The translations were compared with the original English text and discrepancies

were resolved by consensus to achieve conceptual equivalence. The final Turkish version of the Boston Questionnaire was then evaluated with regard to reliability and validity.

### *Patients*

The Turkish version of the Boston Questionnaire was tested on 67 consecutive patients (5 men and 62 women) who were admitted to our hospital and diagnosed with idiopathic CTS on the basis of characteristic symptoms, physical examination and electrophysiological studies. Patients were excluded if they had a double crush syndrome (i.e., concomitant cervical radiculopathy, thoracic outlet syndrome, other upper limb nerve entrapment syndromes), other major diseases causing disability and hand pain (i.e., rheumatoid arthritis, hand osteoarthritis), hand surgery within the previous 3 months, language difficulties, inability to complete questionnaire due to cognitive impairment, and if pregnancy was present. After giving their informed consent to participate, all patients were assessed by the same observer (IA), and filled a brief form that described the patient’s demographic and clinical characteristics. Pain severity by Visual Analogue Scale (VAS 0–100 cm), pinch and grip strength by JAMAR hand dynamometer were assessed. Thereafter, all subjects satisfactorily completed the Turkish versions of the Boston Questionnaire and Short Form (SF)-36. The SF-36 is a self-administered questionnaire of general health and well-being consisting of multi-item scales measuring 8 health dimensions (physical functioning, role limitations because of physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations because of emotional problems, mental health). The adaptation studies of SF-36 for use in Turkey were made by Koçyiğit et al. [17].

### *Analyses*

All statistical analyses were performed using the SPSS version 9.05 for Windows computer software package. A level of  $p < 0.05$  was considered statistically significant. Reliability includes two aspects, reproducibility and internal consistency. Reproducibility, (test-retest reliability) refers to the ability of the instrument to give the same result when administered on separate occasions. It was assessed by two times administrations of the scales to the patients within seven days. Correlation of the total scores between two successive administrations was measured with the Pearson correlation coefficient and use as a measure of reproducibility. A correlation coefficient ( $r$ ) of 0 indicates no correlation and a

coefficient of 1.0 indicates perfect agreement between the two scores [18,19].

Internal consistency, or the coherence of the scales, was assessed with the Cronbach alpha and item-total correlation. A Cronbach alpha of 1.0 represents perfect correlation among all items and indicates that the items measure a single construct. Lower value reflect less correlation among items. A Cronbach alpha of 0.8 is considered good and a value of 0.9 is regarded as excellent. Item-total correlation was calculated by Pearson's correlation coefficient [19,20].

Validity is difficult to assess because there is no universally accepted standard for measurement of the symptom severity or the functional status of the hand. External construct validity was assessed by associations with pain severity (VAS), general health status (SF-36) and traditional measures of disability and impairment in CTS, including grip and pinch strength measures. We hypothesized that worse scores for the symptom severity and functional status would correlate with more severe impairment, pain and worse health. Validity was measured with Spearman correlations between instrument scores and the just mentioned objective measures; the Spearman coefficient was used because of the limited sample size and non-normal distributions [20]. In all statistical analyses, a value of correlation coefficient between 0 and 0.25 was regarded as "no or poor" correlation; 0.26–0.50 was regarded as "moderate" correlation; 0.51–0.75 was regarded as "good" correlation and 0.76–1.00 was regarded as "very good" correlation.

## Results

Demographic and disease-related data of the patients are given in Table I. The mean age of the 67 patients

(62 women, 5 men) who completed the Boston Questionnaire was  $49.8 \pm 8.1$  years (range 23–68) and the mean duration of symptoms was  $43.6 \pm 52.9$  months (1–240). All patients completed the questionnaire with no difficulty and said that the Boston Questionnaire was simple and easy to understand.

### Reliability

Reproducibility, the correlation between the scores on the two successive administrations of the questionnaire, according to the Pearson correlation coefficient, was 0.60 ( $p: 0.0001$ ) for the SSS and 0.77 ( $p: 0.0001$ ) for the FSS, indicating good reproducibility. Internal Consistency, the Cronbach alpha was 0.82 for the SSS (item-total correlation 0.38–0.82  $p: 0.001$ –0.0001) and 0.88 for the FSS (item-total correlation 0.59–0.79  $p: 0.0001$ ), indicating high inter-item correlations within each scale. This implies that the scales function well as unidimensional indices of severity of symptoms and functional status.

### Construct validity

The functional status scale scores had a high correlation with scores of the symptoms severity scale indicating that patients who had severe symptoms had major functional limitations ( $r: 0.73$ ,  $p: 0.00001$ ). The symptom severity scores had moderate correlations with pinch and grip strength ( $r: -0.26$ ,  $p: 0.03$  and  $r: -0.29$ ,  $p: 0.01$ , respectively), good correlation with VAS ( $r: 0.51$ ,  $p: 0.0001$ ) and moderate and good correlations with subscales of SF-36 (physical functioning  $r: -0.55$ ,  $p: 0.0001$ , physical role  $r: -0.54$ ,  $p: 0.0001$ , bodily pain  $r: -0.63$ ,  $p: 0.0001$ , emotional role  $r: -0.40$ ,  $p: 0.001$ ).

The functional status scores had a moderate correlation with grip strength ( $r: -0.36$ ,  $p: 0.003$ ), a fair or poor correlation with pinch strength ( $r: -0.15$ ,  $p: 0.2$ ), moderate correlation with VAS ( $r: 0.38$ ,  $p: 0.001$ ) and moderate-good correlations with subscales of SF-36 (physical functioning  $r: -0.54$ ,  $p: 0.0001$ , physical role  $r: -0.40$ ,  $p: 0.001$ , bodily pain  $r: -0.44$ ,  $p: 0.0001$ , emotional role  $r: -0.29$ ,  $p: 0.01$ ).

All correlations were within our expectations, that worse scores for symptoms severity and functional status were associated with more severe impairment, pain and worse health, and stronger correlations were associated with the physical and pain scales than other SF-36 scales. Correlation coefficients are presented in Table II.

## Discussion

The critical measurement properties of questionnaire scales include ease of administration, reproducibility,

Table I. Demographic and disease-related data for 67 patients with carpal tunnel syndrome.

| Variables            | n (%)     |
|----------------------|-----------|
| <i>Sex</i>           |           |
| Women                | 62 (92.5) |
| Men                  | 5 (7.5)   |
| <i>Occupation</i>    |           |
| Housewife            | 42 (62.7) |
| Working in office    | 20 (29.9) |
| Retired              | 5 (7.5)   |
| <i>Injured hand</i>  |           |
| Right                | 40 (59.7) |
| Left                 | 27 (40.3) |
| <i>Dominant hand</i> |           |
| Right                | 65 (97)   |
| Left                 | 1 (1.5)   |
| Bilateral            | 1 (1.5)   |

Table II. Correlation between the Boston Questionnaire scores and VAS, SF-36, pinch and grip strength scores.

|                      | Symptom Severity Scale                |                 | Fonctional Status Scale               |                 |
|----------------------|---------------------------------------|-----------------|---------------------------------------|-----------------|
|                      | Correlation coefficients ( <i>r</i> ) | <i>p</i> -value | Correlation coefficients ( <i>r</i> ) | <i>p</i> -value |
| VAS                  | 0.51                                  | 0.0001          | 0.38                                  | 0.001           |
| Pinch strength       | -0.26                                 | 0.03            | -0.15                                 | 0.2             |
| Grip strength        | -0.29                                 | 0.01            | -0.36                                 | 0.003           |
| <i>SF-36 scales</i>  |                                       |                 |                                       |                 |
| Physical functioning | -0.55                                 | 0.0001          | -0.54                                 | 0.0001          |
| Physical role        | -0.54                                 | 0.0001          | -0.40                                 | 0.001           |
| Bodily pain          | -0.63                                 | 0.0001          | -0.44                                 | 0.0001          |
| Emotional role       | -0.40                                 | 0.001           | -0.29                                 | 0.01            |
| General health       | -0.12                                 | 0.3             | -0.23                                 | 0.05            |
| Vitality             | -0.17                                 | 0.1             | -0.22                                 | 0.07            |
| Social functioning   | -0.17                                 | 0.1             | -0.14                                 | 0.2             |
| Mental health        | -0.05                                 | 0.6             | -0.02                                 | 0.8             |

internal consistency, validity, and responsiveness to clinical change [21]. The Boston questionnaire is self-administered and can be completed in less than 10 min, imposing negligible burden on patients and investigators [10].

Reproducibility reflects whether the same result is obtained on repeated administrations, assuming no clinical change [10,20]. The reproducibility of the Turkish version was good, with Pearson's correlation coefficients of 0.60 (SSS) and 0.77 (FSS), and comparable with the Swedish, Spanish and Portuguese versions (0.64–0.71, 0.87–0.85, 0.60–0.55 respectively) [11–13]. But it was less than the reproducibility of English original version (0.91 for SSS and 0.93 for FSS) [10]. This difference may be due to administration of the Turkish version twice within seven days compared to administration of the English version on two successive days.

Internal consistency indicates the extent that a scale of questions measure a single concept – in the current study, severity of symptoms or functional status of the hand. Higher internal consistency is generally associated with lower error variance or greater precision [10,22]. The internal consistencies of the SSS and the FSS (Cronbach alpha 0.82 and 0.88 respectively) were very good. Similar results for internal consistency have been reported for the Swedish, Spanish, Portuguese and original version of the Boston Questionnaire (0.80–0.87, 0.90–0.91, 0.83–0.90 and 0.89–0.88) [10–13].

Validity refers to whether the scale measures what it is purported to measure. There is no universally accepted standards for the measurement of symptom severity or functional status [10,22]. The validity of the original version of the Boston Questionnaire were assessed with pinch and grip strength measures, two point discrimination, pressure sensitivity on Semmes-Weinstein monofilament testing and sensory conduction velocity of the median nerve.

Levine et al. presented that the Boston Questionnaire had moderate and good correlations with pinch ( $r$ : 0.47 for SSS and  $r$ : 0.60 for FSS) and grip strength scores ( $r$ : 0.38 for SSS and  $r$ : 0.50 for FSS) but it did not correlate with objective measures of sensory function of the median nerve [10]. Correia de Campos et al. also determined that the Portuguese version of Boston Questionnaire significantly were correlated with pinch and grip strength measurements [13]. In our study, both scales of Boston Questionnaire scores had a moderate correlations with grip strength scores ( $r$ : -0.29 for SSS,  $r$ : -0.36 for FSS), and had moderate and poor correlation with pinch strength scores ( $r$ : -0.26 for SSS,  $r$ : -0.15 for FSS). Although these correlations were lower than those of the English and Portuguese versions, they were statistically significant ( $p > 0.05$ ) except correlation between FSS and pinch strength. Misunderstanding or poor cooperation of some patients about the use of dynamometer might have affected the results. Atroshi et al. established that the Swedish version of Boston Questionnaire were correlated with all SF-36 scales [11]. We also, determined that both SSS and FSS had moderate and good correlations with physical functioning, physical role, bodily pain and emotional role subscales of SF-36. That is; worse symptoms or dysfunctions correlated with worse state of health. In additional, we observed that SSS and FSS had good correlation with VAS.

A major pitfall about the scale observed during the study was the indifference of dominant and non-dominant sides. Tasks like writing, buttoning of clothes, opening of jars are done primarily with the dominant hand and may not be affected with non-dominant hand CTS. Besides the fact that in bilateral CTS patients' scores might be affected from the symptom and function of the other side must not be underestimated.

In conclusion, our results display that the Turkish version of the Boston Questionnaire is a reliable and valid region specific outcome measure and this questionnaire can provide a standardized measure of symptom severity and functional status in Turkish patients with the CTS.

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## Appendix

### Boston sorgulama formu

#### Semptom Şiddeti Skalası

Aşağıdaki sorularda, son iki hafta süresince tipik 24 saatlik bir dönemdeki semptomlarınızı gösteren bir cevabi daire içine alınız.

*Gece el veya elbileği ağrınızın derecesi nedir?*

- 1-Gece el veya elbileğimde ağrı olmuyor
- 2-Hafif ağrı
- 3-Orta derecede ağrı
- 4-Şiddetli ağrı
- 5-Çok şiddetli ağrı

*Son iki hafta içinde el veya elbileği ağrısı nedeniyle bir gecede ortalama kaç defa uyandınız?*

- 1-Hiç
- 2-Bir defa
- 3-İki-üç defa
- 4-Dört-beş defa
- 5-Beş defadan fazla

*Gündüz el veya elbileğinizde ağrınız oluyor mu?*

- 1-Gündüz hiç ağrım olmuyor
- 2-Gün içinde hafif ağrım oluyor
- 3-Gün içinde orta derecede ağrım oluyor
- 4-Gün içinde şiddetli ağrım oluyor
- 5-Gün içinde çok şiddetli ağrım oluyor

*Gündüz kaç defa el veya elbileğinizde ağrınız oluyor?*

- 1-Hiç
- 2-Günde bir-iki defa
- 3-Günde üç-beş defa
- 4-Günde beş defadan fazla
- 5-Devamli ağrım oluyor

*Gündüz bir ağrı dönemi ortalama ne kadar sürüyor?*

- 1-Gündüz hiç ağrı olmuyor
- 2-10 dakikadan az
- 3-10-60 dakika arası

4-60 dakikadan daha uzun  
5-Gündüz devamlı ağrı oluyor

*Elinizde hissizlik (duyu kaybı) var mı?*

1-Hayır  
2-Hafif hissizlik var  
3-Orta derecede hissizlik var  
4-Ciddi derecede hissizlik var  
5-Çok ciddi derecede hissizlik var

*El veya elbilenizde güçsüzlük var mı?*

1-Güçsüzlük yok  
2-Hafif güçsüzlük var  
3-Orta derecede güçsüzlük var  
4-Ciddi güçsüzlük var  
5-Çok ciddi derecede güçsüzlük var

*Elinizde karıncalanma hissi oluyor mu?*

1-Olmuyor  
2-Hafif karıncalanma oluyor  
3-Orta derecede karıncalanma oluyor  
4-Ciddi derecede karıncalanma oluyor  
5-Çok ciddi derecede karıncalanma oluyor

*Elinizdeki his kaybı ve karıncalanma gece ne kadar şiddetli oluyor?*

1-Gece karıncalanma ve his kaybı olmuyor  
2-Hafif  
3-Orta  
4-Şiddetli  
5-Çok şiddetli

*Son iki hafta içinde ortalama bir gecede kaç kez elinizde his kaybı veya karıncalanma ile uyandınız?*

1-Hiç  
2-Bir defa  
3-İki-üç defa

4-Dört-beş defa  
5-Beş defadan fazla

*Anahtar veya kalem gibi küçük cisimleri tutmak ve kavramakta zorluk çekiyor musunuz?*

1-Hayır  
2-Hafif zorlanıyorum  
3-Orta derecede zorlanıyorum  
4-Şiddetli zorlanıyorum  
5-Çok şiddetli zorlanıyorum

#### *Fonksiyonel Durum Skalası*

Son iki hafta içinde sıradan bir günde, el ve elbilenizi aşağıdaki aktiviteleri yapmakta ne kadar zorluk çekmenize sebep oldu? Aktiviteyi yapabilirliğinizi en iyi tanımlayan rakamı yuvarlak içine alınız.

|                                |   |   |   |   |   |
|--------------------------------|---|---|---|---|---|
| Yazı yazmak                    | 1 | 2 | 3 | 4 | 5 |
| Giysilerin düğmesini iliklemek | 1 | 2 | 3 | 4 | 5 |
| Okurken kitabı tutmak          | 1 | 2 | 3 | 4 | 5 |
| Telefon ahizesini tutmak       | 1 | 2 | 3 | 4 | 5 |
| Kavonoz açmak                  | 1 | 2 | 3 | 4 | 5 |
| Alışveriş torbalarını taşımak  | 1 | 2 | 3 | 4 | 5 |
| Günlük ev işleri               | 1 | 2 | 3 | 4 | 5 |
| Banyo yapmak ve giyinmek       | 1 | 2 | 3 | 4 | 5 |

1-Zorlanmadan

2-Hafif zorlanarak

3-Orta derecede zorlanarak

4-Şiddetli zorlanarak

5-El veya elbilenizi şikayetlerim nedeniyle hiç yapamıyorum.