# Validation of the Slovakian version of Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ)

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ABSTRACT

Introduction: The most common occupational disease is carpal tunnel syndrome. The aim of this study was to translate and validate the Slovakian version of BCTSQ.

Methods: The original questionnaire was translated into the Slovakian language by two expert translators. Cronbach's alpha coefficient was used to analyze the internal consistency of the questionnaire. Construction validity was evaluated by using Pearson's correlation coefficient and Spearman's rank correlation. The results were processed in the statistical program SPSS 24. The level of significance $p > 0.05$ was considered significant. To analyze the validity, a factor analysis of the BCTSQ and the correlation between BCTSQ and SF-36 were obtained.

Results: A total of 32 employees at risk of local muscular overload completed the BCTSQ and Health Questionnaire SF-36. Cronbach's alpha for SSS was >0.8. The alpha coefficient for FSS was >0.9. The Pearson's coefficient and Spearman's rank correlation was >0.9 for each domain. Cronbach's alpha for SF-36 was >0.7 and the Pearson's coefficient and Spearman's rank correlation was >0.6 and p-values <0.001.

Conclusions: The questionnaire has sufficient reliability, validity and can be a suitable tool for the evaluation of subjective response of employees at the risk of local muscular overload, as well as of patients with carpal tunnel syndrome.

KEYWORDS

Boston Carpal Tunnel Syndrome Questionnaire; SF-36; carpal tunnel syndrome; subjective evaluation; validation

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## INTRODUCTION

Health measurement scales are important not only for patient outcomes tools to evaluate health status. It is necessary for evaluation of subjective response of employees at risk of local muscular overload and also carpal tunnel syndrome (CTS). These scales are an important step in prevention to reduce the overload of musculoskeletal system. CTS is the most expensive musculoskeletal disorder. The costs to employers, employees and insurance companies from carpal tunnel syndrome can rack into the billions (1–4). While the total economic costs of workplace carpal tunnel syndrome in the Slovak Republic are not fully known, its pervasive effect throughout various work industries is apparent. Among the specific measures, the 36-Item Short-From Health Survey (SF-36) is the most recently devised scales. It fields an 8-scale profile of scores, as well as summary measures. The questionnaire has a wide use in the clinic and also prevention to evaluate health conditions (5, 6). As one of the specific disease measures for the evaluation of severity of symptoms and functional status in CTS is Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ) (7). The BCTSQ is one of the available tools for evaluation of the functional and symptomatic aspects of CTS. This questionnaire has been called by several names, e.g. Carpal Tunnel Questionnaire, Brigham and Woman's Carpal Tunnel Questionnaire and Levine Questionnaire (8). The Carpal Tunnel Syndrome Questionnaire is valid and available in few languages (e.g. Polish, Spanish, and Persian).

## MATERIAL AND METHODS

The original BCTSQ is in English. The first step was author's agreement to translate questionnaire into the Slovakian language in accordance with standard methods. The both parts of the original questionnaire (Symptom Severity Scale and Functional Status Scale) were translated into the Slovakian language by two English expert translators. The confirmed questionnaire was interpreted back into the original language to check for any possible content inequality between the original questionnaire and its final translated version.

BCTSQ consists of 2 parts. First part/scale is Symptom severity scale (SSS). This part consists of 11 items classified in 6 domains: pain (number 3–5), paresthesia (number 8), numbness (number 6), weakness (number 7), nocturnal symptoms (number 1, 2, 9, 10) and overall functional status (number 11). The answers are rated from 1 point (no symptoms) to 5 point (most severe symptoms). The overall score for functional status is calculated as the mean of all 11 items (Table 1).

The second part/scale is Functional status scale (FSS) consists of 8 items. The answers are rated from 1 point (no difficulty with the activity) to 5 point (cannot perform the activity). The overall score for functional status is calculated as the mean of all 8 items (Table 2) (7, 9).

Translated versions have been submitted to the author. After author's agreement the final Slovak questionnaire was answered by 10 employees at risk of local muscular load and CTS to determine its comprehensibility. The next step was the validation of the Slovak version of the questionnaire. The data collection was carried out in November in 2018 in the concrete structures factory. The BCTSQ was filled (test) by 32 participants along with the Health Questionnaire SF-36. After 12 days, the translated questionnaire was refilled by some of the previous employees (retest). The questionnaire was anonymous and participants were aware of the purpose of the study. Employees responded to demographic questions (gender, age, height, weight, BMI, laterality, problematic hand, profession, duration of exposure). The return of the questionnaire was 100%.

Reliability was investigated by looking at the reproducibility and internal consistency based on the test-retest method. The following analyses were conducted to examine validity. A factor analyses was conducted to examine the construct validity and the unidimensionality of the SSS and FSS. The completeness of item responses for the BCTSQ was examined.

Correlation coefficients between the BCTSQ and SF-36 were obtained, and the following hypotheses were examined to investigate concurrent validity: SSS would exhibit the largest (strongest) association with "bodily pain" (SF-36 BP) among the SF-36 subscales. FSS would exhibit the largest (strongest) association with "physical functioning" (SF-36 PF) or "role-physical" (SF-36 RP).

**Tab. 1** Symptom severity scale.

| Number | Items |
|---|---|
| 1 | Severity of nocturnal pain |
| 2 | Frequency of nocturnal awakening due to pain |
| 3 | Severity of daytime pain |
| 4 | Frequency of daytime pain |
| 5 | Duration of daytime pain |
| 6 | Severity of numbness |
| 7 | Severity of weakness |
| 8 | Severity of tingling |
| 9 | Severity of nocturnal numbness or tingling |
| 10 | Frequency of nocturnal awakening due to numbness or tingling |
| 11 | Difficulty with grasping and use of small object (keys, pens) |

**Tab. 2** Functional status scale.

| Number | Items |
|---|---|
| 1 | Writing |
| 2 | Buttoning of clothes |
| 3 | Holding a book while reading |
| 4 | Gripping of a mobile phone |
| 5 | Opening of jars |
| 6 | Household chores |
| 7 | Carrying of grocery basket |
| 8 | Bathing and dressing |

The responsiveness of BCTSQ and SF-36 were examined by calculating the standardized response mean and the effect size.

To determine the internal consistency of the questionnaire we used the Cronbach's alpha coefficient. Values in the range of 0.9 and above indicate an excellent internal consistency; values between 0.8 and 0.9 indicate a good internal consistency. Values between 0.7 and 0.8 indicate an acceptable internal consistency, values between 0.6 and 0.7 indicate a questionable internal consistency, a value between 0.5 and 0.6 indicate a poor internal consistency and values in the range 0.5 and below indicates an unacceptable internal consistency. The instrument test-retest reliability of BCTSQ (SSS, FSS) was assessed with the intra-class correlation coefficient. All correlation coefficients among BCTSQ and SF-36 results were calculated with use of Pearson's correlation coefficient and Spearman's rank correlation coefficient. Results between 0.1–0.3 indicate small strength of association; between 0.3–0.5 indicate medium strength of association and values in the range of above 0.5 being considered large (strong). The statistical processing of the results was performed in SPSS 24. For statistically significant we considered $p < 0.05$.

## RESULTS

There were 32 participants (28 males, 4 females) - employees in the concrete structures factory at risk of local muscular overload of upper extremities and CTS included in this study. Average age of employees in the tracked group was 38.13 ± 11.39 years with the average duration of exposure 9.78 ± 7.23 years. The youngest employee was 21 years old and the oldest 63 years old. The longest occupational exposure was 30 years and the shortest was one year. Average height was 176.06 ± 7.48 cm. Average weight was 82.16 ± 13.45 kg and BMI 26.52 ± 3.69. Among 32 employees, 30 were right-handed, 2 employees were left-handed and 15 employees reported problems with both hands during work.

The mean, standard deviation (SD), median and range of the BCTSQ (SSS, FSS) and SF-36 (PF, RP, BP) are shown in Table 3.

**Tab. 3** Mean scores for BCTSQ and SF-36 (n = 32).

| Instrument scale | Mean | SD | Median | Minimum | Maximum |
|---|---|---|---|---|---|
| ***SSS*** | 2.06 | 0.59 | 2.00 | 1.00[a] | 3.50 |
| ***FSS*** | 1.56 | 0.78 | 1.30 | 1.00[a] | 3.30 |
| ***SF-36 PF*** | 77.50 | 20.98 | 80.0 | 5.00[b] | 100[a] |
| ***SF-36 RP*** | 43.75 | 45.35 | 37.50 | 0[b] | 100[a] |
| ***SF-36 BP*** | 26.88 | 20.07 | 20.00 | 0[b] | 60[a] |

SD – Standard Deviation; SSS – Status Severity scale; FSS – Functional Status Scale; SF-36 PF – physical functioning; SF-36 RP – role-physical; SF-36 BP – bodily pain of the 36-Item Short Health Survey
[a] Maximum health status score
[b] Minimum health status score

There were 32 employees involved in the assessment of test-retest reliability. The period between the first and second tests was 12 days. Internal consistency was assessed by use of Cronbach's alpha coefficient. Cronbach's alpha (test) for 11 items (SSS) was 0.86 (n = 32), which means good internal consistency. The alpha coefficient for 8 items (FSS) was 0.94 (n = 32), which means an excellent internal consistency. Instrument test-retest reliability was assessed with the interclass correlation coefficient. Cronbach's alpha (retest) for 11 items (SSS) was 0.86 (n = 32). The alpha coefficient for 8 items (FSS) was 0.94 (n = 32). Before verifying the design validity of the questionnaire, we validated the normality of data by the Kolmorgov-Smirnov test, which confirmed the normal data layout. We used the test-retest method to verify the structural validity of the questionnaire with a Pearson's coefficient correlation. A large level of match between values in all domains has been demonstrated. The Pearson's coefficient was more than 0.9 for each domain.

The results of the Pearson's coefficient above 0.5 for each domain and the overall score point to large reliability of the questionnaire in the Slovak language.

The Pearson's correlation coefficient (Table 4) between the SSS and the subscales of the SF-36 ranged from 0.63 to –0.61. The strongest correlation was observed for "bodily pain" followed the correlation between the SSS and "role-physical" and "physical functioning." The correlation between FSS and the subscale SF-36 ranged from 0.55 to –0.57. The strongest correlation was observed for "physical functioning" followed "bodily pain" and "role-physical".

**Tab. 4** Person's correlation coefficient (n = 32).

| Pearson's correlation with | | |
|---|---|---|
| **Instrument scale** | **BCTSQ-SSS** | **BCTSQ-FSS** |
| ***BCTSQ-FSS*** | 0.57** | – |
| ***SF-36 PF*** | –0.60** | –0.57** |
| ***SF-36 RP*** | –0.61** | –0.39* |
| ***SF-36 BP*** | 0.63** | 0.55** |

SD – Standard Deviation; SSS – Status Severity scale; FSS – Functional Status Scale; SF-36 PF – physical functioning; SF-36 RP – role-physical; SF-36 BP – bodily pain of the 36-Item Short Health Survey
* $p < 0.05$
** $p < 0.01$

**Tab. 5** Spearman's rank correlation (n = 32).

| Spearman's rank correlation with | | |
|---|---|---|
| **Instrument scale** | **BCTSQ-SSS** | **BCTSQ-FSS** |
| ***BCTSQ-FSS*** | 0.57** | – |
| ***SF-36 PF*** | –0.72** | –0.55** |
| ***SF-36 RP*** | –0.63** | –0.42* |
| ***SF-36 BP*** | 0.69** | 0.58** |

SD – Standard Deviation; SSS – Status Severity scale; FSS – Functional Status Scale; SF-36 PF – physical functioning; SF-36 RP – role-physical; SF-36 BP – bodily pain of the 36-Item Short Health Survey
* $p < 0.05$
** $p < 0.01$

The Spearman's rank correlation (Table 5) between the SSS and the subscales of the SF-36 ranged from 0.69 to –0.72. The strongest correlation was observed for "bodily pain" followed the correlation between the SSS and

"role-physical" and "physical functioning." The correlation between FSS and the subscale SF-36 ranged from 0.58 to −0.55. The strongest correlation was observed for "physical functioning" followed "bodily pain" and "role-physical".

## DISCUSSION

As a result of constant modernization, automatization and robotization in the past few years, the number of works in which small muscle groups of hands and forearms are loaded is increasing. The work is monotonous and repetitive with excessive number of movements. For this reason, the number of occupational diseases due to the long-term excessive unilateral load of upper extremities is increasing every year.

The questionnaire is predominantly used among patients with a diagnosed CTS. On the other hand, based on studies of available literature, we evaluated the questionnaire as a suitable tool for subjective analysis of local muscular overload as a potential development of CTS. The necessity of assessment of subjective work-related difficulties with musculoskeletal system in the working environment is evidenced by the increasing trend of CTS as the most common occupational diseases. In the Slovak Republic, 308 cases of occupational diseases (187 males and 121 females) were reported to the National Health Information Centre in 2018. In 2017, 354 cases of occupational diseases and professional poisonings were reported in which females accounted for 41.52% (147 cases) of the total. The most frequently reported occupational diseases in 2018 was the long-term excessive unilateral load of upper extremities (CTS) was reported in 147 employees, i. e. 47.72% of all reported occupational diseases in the Slovak Republic (13).

The BCTSQ was validated in a several languages and nowadays is available in few countries (9–12). As for internal consistency, the Cronbach's alpha for first part (SSS) of BCTSQ (0.86) and for the FSS (0.94) were equivalent to those of the original version of BCTSQ (SSS:0.89, FSS:0.91) (7). For intra-class correlation coefficient of the SSS (0.98) and the FSS (0.99) were equivalent to the Pearson correlation coefficient of the original version of BCTSQ (SSS:0.85, FSS:0.87) (7). Likewise, the Polish version of the questionnaire showed high test-retest reliability (SSS:0.9, FSS:0.92) (12). The Persian version showed acceptable but lower correlation than the study mentioned previously (SSS:0.58, FSS:0.77) and The Cronbach's alpha coefficients was 0.86 for SSS and 0.88 for FSS (10). The Cronbach's alpha coefficients of the Polish-BCTSQ (0.91 for the SSS and 0.92 for the FSS) are indicative of the high internal consistency of the questionnaire. Our study revealed high internal consistency of BCTSQ implying good coherence among all questions. In this study, our data showed good correlation in terms of the test-retest reliability. There are many types of validity processes of quality of life (QOL) questionnaires. In our study we adopted correlation between BCTSQ and SF-36. The moderate correlation between BCTSQ and SF-36 subscales (bodily pain and physical functioning) supports this validity. These results demonstrate the importance of BCTSQ measures that make up health-related QOL.

## CONCLUSIONS

We can conclude that the Slovakian version of BCTSQ has sufficient reliability and validity to assess the severity of symptoms and the functional status. The questionnaire can serve as a suitable tool for evaluate of subjective response of patients with CTS, as well as of employees at the risk of local muscular overload of upper extremities.

## ETHICAL APPROVAL

The study protocol was approved by the Ethics Committee at the Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, reference number EK 138/2018, and it conforms to the provisions of the Declaration of Helsinki in 1995.

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