

Validation of the Polish version of the Hand Function Scoring system

Maciej Belka^{1,A–F}, Mateusz Koziej^{2,A–F}, Jan Banach^{3,A–F}, Marta Dagmara Banach^{4,A–F}, Marek Trybus^{5,A–F}

¹ University Hospital in Cracow, Poland

² Department of Anatomy, Jagiellonian University Medical College, Cracow, Poland

³ Faculty of Health Sciences, Jagiellonian University Medical College, Cracow, Poland

⁴ Department of Neurology, Jagiellonian University Medical College, Cracow, Poland

⁵ 2nd Department of General Surgery, Jagiellonian University Medical College, Cracow, Poland

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;

D – writing the article; E – critical revision of the article; F – final approval of the article

Advances in Clinical and Experimental Medicine, ISSN 1899–5276 (print), ISSN 2451–2680 (online)

Adv Clin Exp Med. 2025;34(3):379–384

Address for correspondence

Marta Dagmara Banach

E-mail: martabanach@yahoo.com

Funding sources

None declared

Conflict of interest

None declared

Received on November 2, 2023

Reviewed on January 4, 2024

Accepted on March 12, 2024

Published online on April 17, 2024

Abstract

Background. The Hand Function Scoring (HFS) system was created to assess the results of rehabilitation treatment after hand injuries. A perceived hand function improvement in patients who underwent carpal tunnel syndrome surgery prompted us to use the Watts HFS questionnaire in our study.

Objectives. The study aimed to: 1) translate and validate the new questionnaire into Polish; 2) analyze the usefulness of the scale in the pre- and post-operative assessment of patients with carpal tunnel syndrome; and 3) compare the results with other questionnaires recognized as the gold standard in carpal tunnel treatment evaluation.

Materials and methods. Patients with electromyographically confirmed carpal tunnel syndrome ($n = 317$) were enrolled in the study. Participants completed the HFS, Boston Carpal Tunnel Questionnaire (BCTQ), Michigan Hand Outcomes Questionnaire (MHQ), and the Quality-of-Life Scale (QoLS) on their first visit to our clinic. Two weeks later, 84 patients completed the same questionnaires again, and 6–12 months after the operation, we received 90 additional responses.

Results. The analysis showed that the HFS questionnaire met the validation criteria and had a strong correlation with the BCTQ questionnaire for the Symptoms Severity Scale (SSS) ($\text{Rho} = 0.70$, $p < 0.001$) and the Functional Status Scale (FSS) ($\text{Rho} = 0.89$, $p < 0.001$).

Conclusions. The HFS questionnaire was successfully employed in the subjective assessment of carpal tunnel symptom syndrome severity and the analysis of treatment results, and would complement the clinical assessment of patients during treatment. The questionnaire could also be used in future scientific research.

Key words: quality of life, carpal tunnel syndrome, Hand Function Scoring (HFS) system, Boston Carpal Tunnel Questionnaire (BCTQ), Michigan Hand Outcomes Questionnaire (MHQ)

Cite as

Belka M, Koziej M, Banach J, Banach MD, Trybus M. Validation of the Polish version of the Hand Function Scoring system.

Adv Clin Exp Med. 2025;34(3):379–384.

doi:10.17219/acem/185977

DOI

10.17219/acem/185977

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Background

Carpal tunnel syndrome is a disease that significantly reduces the quality of life (QoL),^{1,2} mostly due to pain, numbness and muscle weakness that consequently lead to difficulties with everyday activities.¹

One of the critical elements of diagnostics is a thorough pre-operative assessment of the patient.² The literature often confirms that, apart from the objective results of tests such as electromyography or ultrasound, understanding patient's subjective opinions on their health is equally important.^{3,4} These opinions might be influenced by many factors that cannot be easily measured and quantified, such as current mental state, motivation and involvement in the treatment process, or socio-economic status.^{3,5} Questionnaires, especially those tailored or adapted to a single disease, are the most useful methods of assessing the disease severity subjectively experienced by patients and allow for the assessment of treatment progress via different methods.

The HFS questionnaire created by Watts et al. to assess the results of rehabilitation after hand injury consists of 25 questions rated on a scale of 1 to 4 points. The result of the questionnaire is the sum of all points obtained, with 100 points signifying the worst possible impairment of hand function.⁴ The questionnaire was used to assess hand function after fractures of the distal end of the radius⁶ and showed a positive correlation with injury severity and the time needed to return to work.^{4,6,7} Another study found that it correlated with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire ($R = 0.903$, $p < 0.05$),⁶ which has been consistently used to assess carpal tunnel syndrome.^{8,9} However, HFS alone has never been used to evaluate such patients. To this end, we aimed to simultaneously assess patients using the Michigan Hand Outcomes Questionnaire (MHQ), previously used in upper limb diseases, and the Boston Carpal Tunnel Questionnaire (BCTQ), adapted to assess carpal tunnel syndrome symptoms. In our opinion, introducing a new questionnaire for more extensively evaluating the ability to cope with everyday activities would complement the clinical evaluation of patients and help understand patient-perceived disease severity.

Objectives

The study aimed to: 1) translate into Polish and validate the HFS questionnaire; 2) assess its usefulness in the evaluation of surgical treatment progress in patients suffering from carpal tunnel syndrome; and 3) compare and analyze the obtained results with other questionnaires recognized as the gold standard in this disease.

Materials and methods

Study design, setting and eligibility criteria

The questionnaire was initially translated into Polish according to the scheme proposed by Beaton et al.,¹⁰ with 340 patients treated in the Trauma and Orthopaedics Clinical Department of the University Hospital in Cracow (Poland) between April 2019 and May 2021 qualified for the study. During the first visit to the clinic, patients were informed in detail about the study plan, completed a short personal questionnaire about gender, age, weight, height, and place of residence, and provided signed informed consent to participate. When patients reported bilateral symptoms of carpal tunnel syndrome, the more affected limb was examined, and when the symptoms were similarly severe, the dominant limb was examined. Afterward, patients completed the HFS, BCTQ, MHQ, and Quality-of-Life Scale (QoLS) questionnaires. Two weeks later, patients completed the HFS questionnaire again before the surgery, with the next check-up taking place 6–12 months later. The median differences between measurements, along with their quartiles and minimum and maximum range, are presented in Fig. 1.

Study inclusion criteria were: 1) age between 18 and 75 years; 2) a diagnosis of carpal tunnel syndrome confirmed with electrophysiological examination; 3) fluent Polish language; 4) a recommendation for carpal tunnel syndrome surgical treatment; 5) no other pre-existing neurological, psychiatric or musculoskeletal disorders affecting the upper limbs; and 6) no expected changes in carpal tunnel syndrome severity within 2 weeks. Exclusion criteria included: 1) ongoing rehabilitation and 2) recent wrist injury. Based on this criteria, 23 patients were excluded from the study, with 317 taking part. Implementing such inclusion and exclusion criteria facilitated the selection of a more homogenous patient cohort, with this approach aiming to enhance the internal validity of the study by ensuring a more uniform and representative group of individuals with the specified condition.

The Bioethics Committee of the Jagiellonian University approved the study (approval No. 1072.6120.32.2018), which was conducted in line with the 1964 Helsinki Declaration and its subsequent amendments.¹¹

Hand Function Scoring system

The HFS questionnaire contains 25 questions about difficulties in performing daily activities, some of which coincide with those included in the BCTQ questionnaire. The results ranged from 25 to 100 points, with higher scores indicating worse hand function.⁴

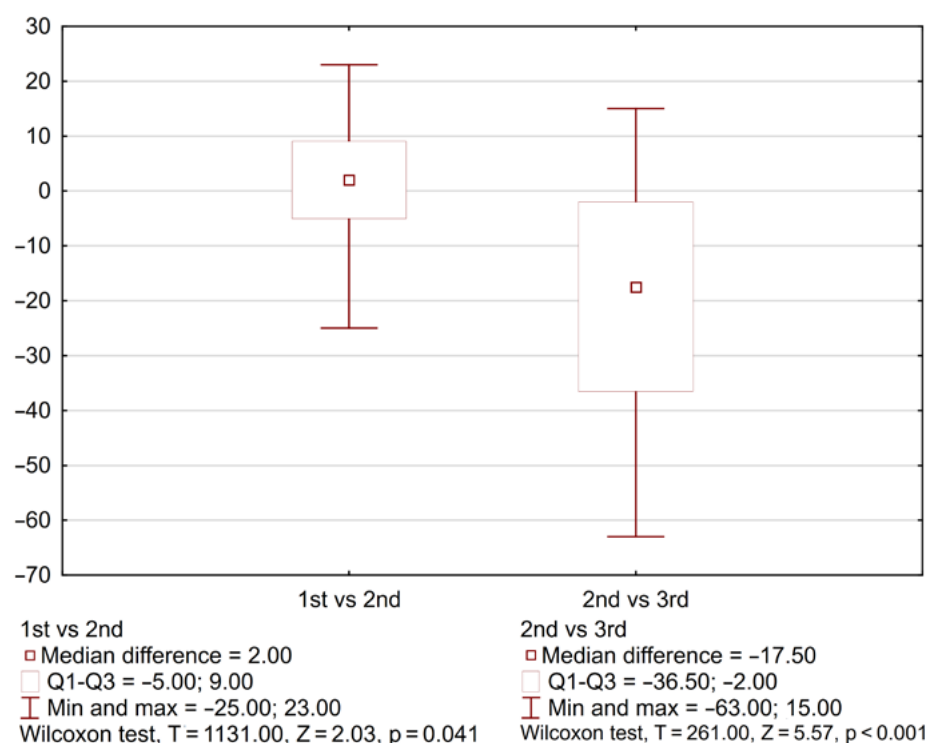


Fig. 1. Median differences in the Hand Function Scoring (HFS) system results between the 1st and 2nd measurements and the 2nd and 3rd measurements

Boston Carpal Tunnel Questionnaire

The BCTQ consists of several questions divided into 2 parts, one assessing carpal tunnel syndrome symptom severity and the other evaluating its impact on daily functioning. The final result is the mean score obtained from individual questions, with a lower score indicating a better subjective assessment of limb functioning.¹² The study used the Polish version of the questionnaire.²

Michigan Hand Outcomes Questionnaire

The MHQ is the only one that allows for simultaneous assessment of both upper limbs in terms of general functioning, problems with performing daily activities, pain intensity, and a subjective assessment of the aesthetics and general satisfaction with hand functioning. The questionnaire was designed to assess many upper limb diseases,¹³ with its usefulness in evaluating patients with carpal tunnel syndrome confirmed in multiple studies.^{14–16} The higher the final score, the better the limb function, except for pain assessment, where a lower score indicates less pain. The Polish version of the questionnaire was used in this study.¹⁵

Quality of Life Scale

The questionnaire proposed by Spitzer et al. in 1986 assessed QoL. The tool is a simple questionnaire consisting of 5 questions assessing the level of activity, daily life, health, support, and appearance.^{15,17} The Polish version of the questionnaire was used in this study.¹⁸

Statistical analyses

All calculations employed Statistica v. 13.3 software (StatSoft Inc., Tulsa, USA), with data analyzed for normal distribution and presented using the mean and standard deviation ($\pm$ SD) if normally distributed and quartiles (Q1–Q3) if the data failed the normality test. For correlations between variables, Pearson's correlation was used when both quantitative variables were normally distributed, with Spearman's rank order correlation used when this condition was not met. Correlations between pre- and post-surgery results were evaluated.

Analysis of differences between men and women was undertaken to assess if the results revealed factors that might influence the study outcomes. Student's t-test for independent variables was employed if quantitative variables were normally distributed and there was homogeneity of variance (evaluated using the t-test for variance), while the Mann–Whitney U test was applied when a normal distribution was not met. Differences between pre- and post-operative results were also analyzed using the Student's t-test for normally distributed dependent variables and the Wilcoxon test for non-normal data. A p-value below 0.05 was considered statistically significant.

Tests evaluating repeatability of measurements, internal consistency and analysis of measurement errors were used for reliability analysis. The repeatability of the measurements was assessed using the interclass correlation coefficient (ICC), a model of absolute agreement of two-way mixed effects. The value of this coefficient varies between 0 and 1, with the expected value for this type of work being

above 0.7. The 2nd method for assessing repeatability was Bland–Altman plots, in which the vertical axis shows the difference between the two HFS results and the horizontal axis the average value of the 2 pre-operative measurements, with a 2-week break in between. The graph shows the 95% confidence interval (95% CI) for mean measurements defined as $\pm 1.96 \times \text{SD}$.¹⁹

The analysis of internal consistency employed Cronbach's alpha parameters to evaluate whether individual questions correlated with each other. To assess measurement errors, the standard error of measurement (SEM) coefficient was calculated according to the formula $\text{SEM} = \text{SD} \times \sqrt{1 - \text{ICC}}$, which indicates perfect questionnaire reliability when equal to 0. In addition, the minimum detectable change with a 95% CI was calculated according to the formula $\text{MDC95} = 1.96 \times \text{SEM} \times \sqrt{2}$, which tells us what the minimum change in the questionnaire answers is to be considered correct and exclude measurement error.

Determining the validation criterion involved investigating correlations between the HFS questionnaire and the current gold standard for carpal tunnel syndrome patient assessment (the BCTQ questionnaire)¹² to calculate the correlation coefficient.¹⁰ In addition, the analysis of marginal effects used the 15% criterion, meaning that the proportion of patients who achieved the maximum and minimum number of possible points should not exceed 15% of the study group.²⁰

Cohen's standard mean response factor

$$\text{SRM} = (\text{Me}_{\text{preoperative}} - \text{Me}_{\text{postoperative}}) / \text{SD}_{\text{of the mean difference}}$$

was used to analyze responsiveness to produce values above 0.8 (large), 0.5 (medium) and 0.3 (small).²¹

Study size

The sample size of 50 participants was determined with the intention of adequately powering the study to detect significant HFS changes, the primary outcome measure of interest. The sample size was calculated based on an Cronbach's alpha level of 0.05, an absolute error rate of 5% and a presumed SD of 20 for the HFS scores. These parameters were chosen to ensure that the study would have sufficient statistical power to detect meaningful differences or correlations in HFS scores before and after the intervention, allowing for robust and reliable conclusions.

Results

No significant differences were found between the original and translated copies in the translation process. In the initial questionnaire comprehension analysis conducted on 10 patients, no problems with understanding questions were reported. The final Polish version of the questionnaire was created (Supplementary Material 1). Ultimately, 317 patients were enrolled in the study,

with 84 answering the questionnaire again before surgical treatment and 90 responding 6–12 months after. All individuals who responded to the 2nd pre-operative questionnaire also provided responses post-operatively. However, due to missing data and an inability to calculate the questionnaire outcome, several individuals were excluded from the analysis of the 2nd pre-operative response.

Most patients were women (73.19%), the mean duration of symptoms was 22.77 ± 25.31 months, and carpal tunnel syndrome was more common on the right side (53.00%). The mean age was 59.05 years ($\text{SD} = \pm 14.24$) for both men and women, while men were heavier (90.0 kg (Q1–Q3 = 80.0–98.0) compared to 70.0 kg (Q1–Q3 = 62.0–80.0 kg)) and taller (175.0 cm (Q1–Q3 = 170.0–179.0) compared to 163.0 cm (Q1–Q3 = 158.0–168.0 cm)) than women. The overall body mass index (BMI) was 27.69 kg/m^2 , with men having a higher median BMI (29.01 kg/m^2 , Q1–Q3 = 27.74 – 32.65 kg/m^2) than women (26.36 kg/m^2 , Q1–Q3 = 23.23 – 29.64 kg/m^2).

The mean pre-operative HFS value was 44.0 (Q1–Q3 = 25.0–59.0), the 2nd was 49.0 (Q1–Q3 = 35.0–61.0) and the 3rd was 25.0 (Q1–Q3 = 25.0–26.0), while ICC = 0.909, Cronbach's alpha = 0.95, SEM = 5.54, and MDC95 = 15.31. The difference between pre- and post-operative measurements for paired samples was statistically significant ($p = 0.001$). The median with quartiles of the BCTQ, MHQ and QoLS questionnaires are presented in Table 1. We did not observe ceiling or floor effects in our study.

The Bland–Altman analysis indicated that the agreement limit for HFS was between -20.81 (95% CI = -24.41 – -17.22) and 16.69 (95% CI = 13.10 – 20.29). The results of this analysis showed that there was high agreement between 2 measurements in a short interval, confirming good repeatability of the results.

The Polish version of the HSF correlated strongly with the symptom severity section of the BCTQ ($\text{Rho} = 0.70$,

Table 1. Median scores with 1st quartile (Q1)–3rd quartile (Q3) for the 1st measurement in each questionnaire

Questionnaire	Median	Q1–Q3
MHQ OHF	50.00	25.00–75.00
MHQ ADL	68.21	30.71–100.00
MHQ Work	75.00	25.00–100.00
MHQ Pain	70.00	70.00–80.00
MHQ Aesthetic	100.00	81.25–100.00
MHQ Satisfaction	41.67	25.00–75.00
MHQ total	63.38	46.49–79.23
BCTQ SSS	3.00	2.09–4.00
BCTQ FSS	2.38	1.00–3.38
QoLS1	10.00	8.00–10.00

HFS – Hand Function Score; MHQ – Michigan Hand Outcome Questionnaire; OHF – Overall Hand Function; ADL – Activities of Daily Living; BCTQ – Boston Carpal Tunnel Questionnaire; SSS – Symptoms Severity Scale; FSS – Functional Severity Scale; QoLS – Quality of Life Scale.

Table 2. Spearman's correlations between the Hand Function Scoring (HFS) system questionnaire results and those used for comparison in the study

Questionnaires	HFS correlation	
	Rho	p-value
MHQ OHF	−0.77	<0.001
MHQ ADL	−0.92	<0.001
MHQ Work	−0.76	<0.001
MHQ Pain	0.53	<0.001
MHQ Aesthetic	−0.38	0.001
MHQ Satisfaction	−0.77	<0.001
MHQ total	−0.85	<0.001
QoLS	−0.50	<0.001
BCTQ SSS	0.70	<0.001
BCTQ FSS	0.89	<0.001

MHQ – Michigan Hand Outcome Questionnaire; OHF – Overall Hand Function; ADL – Activities of Daily Living; BCTQ – Boston Carpal Tunnel Questionnaire; SSS – Symptoms Severity Scale; FSS – Functional Severity Scale; QoLS – Quality of Life Scale.

$p < 0.001$) and the BCTQ section evaluating upper limb function ($Rho = 0.89$, $p < 0.001$), meeting the validation condition. Moreover, the HSF questionnaire correlated strongly with the MHQ results ($Rho = -0.85$, $p < 0.001$), with the result being negative due to the inverse calculation used. As expected, HFS correlated the most with the part evaluating hand function in everyday activities ($Rho = -0.92$, $p < 0.001$). In addition, the HFS score moderately correlated with the QoL ($Rho = -0.50$, $p < 0.001$). Table 2 presents all HFS questionnaire correlation results.

The standard Cohen's d value for HFS was 0.69. Figure 1 shows the median differences between the 1st and 2nd pre-operative measurements and those recorded post-operatively, both of which were statistically significant (pre-surgery ($T = 1131.00$, $Z = 2.03$, $p = 0.041$) and post-surgery ($T = 261.00$, $Z = 5.57$, $p < 0.001$)).

Discussion

In this study, we translated the HFS questionnaire into Polish and validated it using a group of carpal tunnel syndrome patients. The questionnaire's high correlation with the BCTQ symptom severity scale (SSS) ($Rho = 0.89$) suggests it can be effectively used for the clinical assessment of treatment results in such patients. Furthermore, Cronbach's alpha coefficient of 0.95, a measure of the compliance of answers given by patients to individual questions, demonstrates the high quality of the tool. Analysis of the original work by Watts et al. revealed the HFS to be of higher quality,⁴ though Cronbach's alpha coefficient for the Polish version of the BCTQ and MHQ were at a similar level, with 0.906 for the BCTQ SSS, 0.924 for the BCTQ FSS,² and individual MHQ subscales ranging from 0.79

to 0.96.¹⁵ Therefore, the HFS questionnaire can be used to assess carpal tunnel syndrome patients.

Our institution mainly uses the BCTQ to assess patients with carpal tunnel syndrome. However, in our opinion, introducing a new questionnaire to more extensively assess coping with everyday activities would support the clinical evaluation of treatment effects. In addition, HFS allows for a more comprehensive comparison of treatment results between different research centers. As such, HFS could be employed in further scientific works.

The available evidence demonstrates that the HFS can assess patients with wrist fractures, and the results correlated with the time off work, with worse hand function causing more time off.^{5,6} The HFS authors then used the results to assess post-injury hand function improvement after rehabilitation.⁴ These findings indicate that the HFS would be a useful tool for assessing carpal tunnel syndrome treatment effectiveness.

Our analysis showed that the HFS questionnaire correlated with the QoLS ($Rho = -0.50$, $p < 0.001$). There are only a few studies reporting the impact of carpal tunnel syndrome on QoL using questionnaires evaluated in the current study, with 1 such study showing a correlation between the BCTQ and the QoLS ($r = 0.50$, $p < 0.05$). This finding is similar to ours, though the correlation with the 36-item short-form survey (SF-36) was as high as 0.70.⁸ In turn, the MHQ correlation with SF-36 was much lower, and in individual subscales of the SF-36, it ranged between $r = 0.254$ and $r = 0.520$.¹⁵

The strength of the current study lies within its prospective nature and the simultaneous analysis of comparisons between questionnaires used. In addition, the usefulness of the newly validated questionnaire in the assessment of patients with carpal tunnel syndrome was demonstrated.

Study limitations

Study limitations include its single-center nature, the inability to eliminate patient selection bias, and the fact that participating patients did not fully or completely reflect the entire population of those suffering from carpal tunnel syndrome. Further research with more participants is needed to obtain a broader scope for using the questionnaires in patients with carpal tunnel syndrome.

Conclusions

The current work translated the HFS questionnaire into Polish and validated it. The results strongly correlate with the BCTQ questionnaire, meaning it can be used to assess patients with carpal tunnel syndrome throughout the treatment process, allowing for a more extensive and subjective assessment of hand functioning during everyday activities. Furthermore, the HFS can compare therapy results between treatment centers and in future scientific research.

Supplementary data

The Supplementary materials are available at <https://doi.org/10.5281/zenodo.10723897>. The package includes the following files:

Supplementary Material 1. Polish version of the validated HFS system.

Supplementary Material 2. Results of the Shapiro–Wilk tests for the variables used in the research.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

ORCID iDs

Maciej Belka  <https://orcid.org/0000-0001-5058-5914>
Mateusz Koziej  <https://orcid.org/0000-0002-2635-0776>
Marta Dagmara Banach  <https://orcid.org/0000-0002-4656-3656>
Marek Trybus  <https://orcid.org/0000-0003-2750-8608>

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