

Validity of IMPACT-S for Assessing Activities and Participation in patients with Carpal Tunnel Syndrome

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Abstract—

Objective of the study:

The study aims to establish whether IMPACT-S is an apt measure for assessing activities and participation in Carpal Tunnel Syndrome patients.

Significance of the study:

Carpal Tunnel Syndrome is one of the commonest entrapment neuropathies leading to marked activity and participation limitations. IMPACT-S is based on the ICF framework for assessing the functional involvement of the subject in terms of activities and participation. The current study focuses on establishing its validity of measuring activities and participation in patients with Carpal Tunnel Syndrome which will help clinicians and researchers use IMPACT-S for CTS patients.

Hypothesis:

Null Hypothesis: There is no validity of IMPACT-S for functional evaluation of Carpal Tunnel Syndrome patients.

Alternate Hypothesis: IMPACT-S is a valid tool for functional evaluation in Carpal Tunnel Syndrome patients.

Operational Definitions:

Validity: The psychometric property of a tool to measure what it is intended to (Singh et al, 2014).

ICF: WHO recommends the International Classification of Functioning (ICF) as a comprehensive measure for assessing and rehabilitating patients (2007).

IMPACT-S: ICF Measure of Participation and Activities – Screener (IMPACT-S) is a self- measure tool for assessing functioning and disability in patients (Post et.al, 2008).

BCTQ: The Boston Carpal Tunnel Questionnaire is a standardised a scale for assessment of CTS severity and functional ability (Fischer et.al 2014).

Keywords: IMPACT-S tool, Carpal Tunnel Syndrome patients, ICF framework, CTS patients.

I. INTRODUCTION

The upper extremity terminates at the hand which serves as a linkage between the body and the surroundings and any restrictions in its functioning results in ADL (Activities of Daily Living) limitations²¹. Nerve damage occurring at stenotic anatomical structures is known as Entrapment neuropathy. Entrapments neuropathies are a common diagnosis in a clinical setting¹³ and are often a cause for stress having physical, psychological and financial ramifications for the patients⁶. Carpal tunnel Syndrome frequently known as CTS is one of the most commonly encountered neuropathy of the upper-limb resulting in pain and disability of the hand. CTS usually results from compression of the carpal tunnel underneath the flexor retinaculum impinging the median nerve between the carpal bones and the flexor retinaculum, i.e. Carpal tunnel⁶. CTS is frequently associated with a specific set of signs and symptoms like numbness of the hand, burning pain in the palm and the

thumb, index and middle fingers, along with reduced grip strength¹⁵. The pain and disability experienced by the patients oftentimes is continuous with swelling, loss of motor control and weak grip due to thenar muscle atrophy in chronic disease stage²⁶. Patients with CTS were found to have an association with age, female gender and high BMI⁶.

CTS represent a large burden on occupational health with both social as well as economic ramifications¹⁹. A literature analysis through bibliometric investigation of articles on carpal tunnel syndrome (CTS) was carried out for a period of 35 years and shows CTS cases are increasing day by day, as more people are working on flat surfaced boards like keyboards of computers or musical instruments¹⁸. Other reasons for CTS include diabetes, thyroid dysfunction and autoimmune disease etc¹². Profoundly more literature is attributed to female patients than their male counterparts¹⁸.

Boston questionnaire or commonly called the Carpal Tunnel (formerly Levine) questionnaire serves as a common tool during CTS patient evaluation that can be used to indicate patient disability and the functional performance⁹. The scale was formulated initially by Levine et al., in 1993 as a self-administered, self-report questionnaire, with validity for disease specific outcome score for CTS and has two subscales for symptoms and functions⁹. Thus the scale has been found to be helpful for effectively and objectively assessing the symptom severity and functional status of subjects with CTS⁹. The scale was reported to have good reproducibility, internal consistency and responsiveness to clinical change⁹.

The World Health Organization (WHO) proposed the adoption a system that allows the description and comparison of health in various populations in the year 2001. There were two systems; the International Classification of Disease and the International Classification of Functioning, Disability and Health (ICF). The former is an etiologic based disease classification system while the latter (ICF) is based on disability and functioning²³. With the approval by WHO in 2001, the ICDH was revised and the International Classification of Functioning Disability and Health (ICF) was established¹⁶. Stier-Jarmer, 2009 described the role of ICF as a useful tool for assessment of severity and prognosis of musculoskeletal conditions; and as indicators for health, economy²⁴, along with education, insurance, labour health, disability policy and others²⁵ and as disease outcome measures²⁴.

IMPACT-S is the ICF Measure of Participation and Activities- Screener. The scale was developed according to the ICF (International Classification of Functioning, Disability and Health)¹⁷. ICF describes the interaction between disease/ conditions and the contextual factors as Dynamic in nature. ICF can be used to evaluate the functioning and disability of an individual³². IMPACT-S is an ICF based self-administered measure for assessing functioning and disability¹⁷. IMPACT-S has wide applications and can be used for assessment of healthcare needs as well as outcome measurement for healthcare¹⁷. IMPACT-S has shown to have good reliability and validity for measuring the constraints in activity and participation of daily life as per the ICF framework¹⁷. IMPACT-S scoring between 29% and 83% indicates 'no limitation/ restriction', between 13% to 45% indicates 'some limitation/ restriction' and between 3% to 34% indicates 'serious limitation/ restriction'¹⁷.

Validity of a criterion describes the extent to which a tool measures what it is supposed to. Validity can be of three types: Content, Criterion –related and Construct Validity. Content validity is the degree to which the tool is adequate for the respective usage. Criterion-related validity indicates the prediction probability of an outcome or a condition. Construct validity indicates the level to which the predicted correlations match the theoretical hypothesis³.

The IMPACT-S scale is based on ICF format and can be helpful to use new outcome measures for CTS patients. The validity of IMPACT-S has not been estimated for CTS patients. The current study is aimed at to evaluating the validity of IMPACT-S as a valid tool for patients with CTS by comparing with standardized BCTQ scale specifically among patients with diagnosed Carpal Tunnel Syndrome to assess CTS patients. This study will be in agreement with the suggestion given by Post et.al, 2008 recommending that validity be established for IMPACT-S for other clinical conditions.

II. LITERATURE REVIEW

- **Melissa Airem Cazares-Manríquez, Claudia Camargo Wilson, Ricardo Vardasca, Jorge Luis García-Alcaraz, Jesús Everardo Olgún-Tiznado, Juan Andrés López-Barreras and Blanca Rosa García-Rivera (2020)** conducted a literature review for better understanding the association between risk factors and CTS. These risk factors can age, gender, BMI, hand dominance, abdomen size and vitals to better understand the risk factors most commonly associated with CTS. Of the 72 articles studied, it was concluded that CTS has high associations with age, female sex and high BMI.
- **S.Ram (2019)** conducted a retrospective study to assess the recent developments in the literature based on those published on CTS during 1983 to 2017. It was concluded that middle aged population is more prone to the CTS and the

female gender has higher incidence than Males. The study suggested that CTS appears to be an occupational disease, a large population around the globe working on computer or keyboards have been reported to have CTS.

- **Jochen Fischer, Neville W. Thompson, John W. K. Harrison (2014)** in their study checked the validity of a scale for the disease severity rating and ability of Carpal Tunnel Syndrome patients. Out of the 38 patients that underwent surgery, only 26 patients reported any positive recovery after 3 months of the surgery. The study concluded that the scale has good reproducibility, consistency and clinical responsiveness. The scale can be used as a standardised tool for outcome measurement for CTS.
- **Marcel WMPost, Luc P. de Witte, Enid Reichrath, Manon M. Verdonschot, Gert Jan Wijnhuizen, and Rom JM Perenboom (2008)** conducted a research work to understand the psychometric properties of the scale IMPACT-S in road accident survivors. The study centred on the consented 275 participants, of which 197 participants stayed till the end. The dropout rate was 28.4%. The results of the study are indicative of IMPACT-S having good psychometric properties for functional assessment of patients according to the ICF framework.
- **Yves Roquelaure, Catherine Ha, Natacha Fouquet, Alexis Descatha, Annette Leclerc, Marcel Goldberg and Ellen Imbernon (2009)** conducted a study to assess the work-related population-attributable fraction of CTS in industries and occupations with high risk for CTS in overall populace. The study included 1644 CTS patients over a 3 year period. The results of the research work indicate that 5-50% of CTS cases are preventable with specific strategies in these areas.
- **Sampada Swapneel Karne and Nilima Sudhakar Bhalerao(2016)** conducted a cross-sectional study of CTS in patients with primary hypothyroidism. A total of 36 participants were included. Results show that greater values of BMI correspond to more risk of CTS in subjects with hypothyroidism.
- **Shirin Mohammadi, Mohammad Mohsen Roostayi, Sedigheh Sadat Naimi, Alireza Akbarzadeh Baghban(2019)** conducted a randomized clinical trial aimed at evaluation of cupping on the outcomes of patients with Carpal tunnel Syndrome. The variables used were: ‘Symptom Severity Scale, Functional Status Scale, Distal Sensory and Motor Latency’. They concluded that cupping therapy can be used as a complementary therapy in treatment of CTS.
- **Dimitios Kostopoulos (2004)** conducted a review detailing the treatment of CTS of non- surgical approaches with emphasis in neural mobilization. Entrapment of median nerve frequently causes disability especially amongst working populations. It was concluded that neurodynamic testing and neuro-mobilization of median nerve as assessment and treatment of choice approach to rehabilitating patients with CTS.
- **Ivan Urits, Kyle Gress, Karina Charipova, Vwaire Orhurhu, Alan D. Kaye & Omar Viswanath (2019)** conducted a comprehensive review on the literature update in understanding the intervention strategies of CTS. They concluded that the condition typically presents with primary symptoms, but may be also associated with weak grip strength due to thenar muscle atrophy leading to clumsiness and poor motor skills.
- **Carlijn H. van der Zee, Marcel W. Post, Martin W. Brinkhof, Robert C. Wagenaar (2014)** conducted a study to check the validate Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-Participation) in subjects having injured spinal cord. The study used two scales; ‘the ICF Measure of Activity and Participation Screener (IMPACT-S) and the WHO Disability Assessment Schedule (WHODAS II)’. The study included 157 subjects from the Netherlands, keeping in mind that the subjects needed to be long-term patients with SCI. The study concluded that IMPACT-S has better psychometric properties as compared to WHODAS II.
- **Carlijn H. van der Zee, Annique R. Priesterbach, Luikje van der Dussen, Albert Kap, Vera PM Schepers, Johanna Visser-Meily, and Marcel WM Post (2010)** conducted a study of total 104 candidate-participants with physical disabilities were selected from Netherlands. The study focussed on the reproducibility of three scales based on ICF format. The scales used in the current study were: ‘the IMPACT-S, the USER-P and the Participation scale’. Test re-test reliability statistics indicated that all three scales were equally reproducible and acceptable for clinical use.
- **Carlijn H. van der Zee, Albert Kap, Radha Rambaran Mishre, Evert J. Schouten, and Marcel WM Post (2011)** conducted a study to evaluate the responsiveness of four scales at three different time points. The study included 509 subjects from the Netherlands. The study compared four scales: the FAI, IMPACT-SP, Participation scale and the USER-P. The results of the study depict USER-P to be an effective tool for diagnosis with good clinical responsiveness.

- **Ayhan Aşkın, Emel Atar, Aliye Tosun, Ümit Demirdal, and Özlem Koca. (2020)** conducted a research work to formulate the Turkish version of the International Classification of Functioning, Disability and Health ‘ICF Measure of Participation and Activities screener (IMPACT-S)’. The study evaluated the reliability and validity of the screener in Turkish subjects suffering from stroke. Eighty-six stroke patients both male and female participated in the research. The study used IMPACT-S and WHODAS II. Test re-test reliability and intra-class correlation coefficient were calculated. Negative correlations were reported for all the sub-scores between the two scales except “life activities/communication” and “life activities/ knowledge”. It was reported that the scales produced excellent concurrent validity.
- **Sean D. Rundell, Todd E. Davenport, and Tracey Wagner (2009)** conducted a research on management strategies for subjects with pain the lower back. The study focussed on management of pain based on the ‘International Classification of Functioning, Disability and Health’. During the study the subjects reported significant improvements in pain, disability and psychosocial factors. The data was recorded at 3 weeks and then later at 10 weeks following the rehabilitation. The results of the research are indicative of the clinical application and feasibility of the ICF format for individual disability experience and helps to select better treatment strategies.
- **Raquel Cantero-Téllez, Nancy Naughton, Lori Algar, and Kristin Valdes (2019)** conducted a systematic review for concluding the outcome measures that can be used in clinical trials after CTR in terms of the ICF framework. The results of the study indicate that functional measures of activity and participation oftentimes lack representation along with other contextual factors.

III. METHODOLOGY

3.1. Sample:

The sample of diagnosed Carpal Tunnel Syndrome patients were selected from the Northern states of India.

3.1.1. Sample size:

The sample size as estimated by G Power software, keeping a 15% dropout rate was found to be 214.

3.1.2. Inclusion Criteria:

- Subjects clinically diagnosed with ‘Carpal Tunnel Syndrome’ taking treatment as well as untreated.
- Age 20-55.
- Both genders
- Subjects fluent in the English Language, both reading and writing.

3.1.3. Exclusion Criteria:

- Long-standing diabetes (> 6 months)
- Chronic endocrine conditions (> 6 months)
- Post-traumatic Carpal Tunnel Syndrome or double crush injury
- Any history of head injury, brain damage or neurological conditions.

3.2. Procedure:

3.2.1 Research Design

Prospective Cross-sectional Study

3.2.2 Dependent Variable:

Functional Status

3.2.3 Independent Variable:

ICF Measure of Participation and Activities Screener (IMPACT-S)

Boston Carpal Tunnel Severity Questionnaire (BCTSQ)

3.3. Instrumentation:

Weighing machine to measure weight.

Stadiometer to measure height.

ICF Measure of Participation and Activities Screener (IMPACT-S).

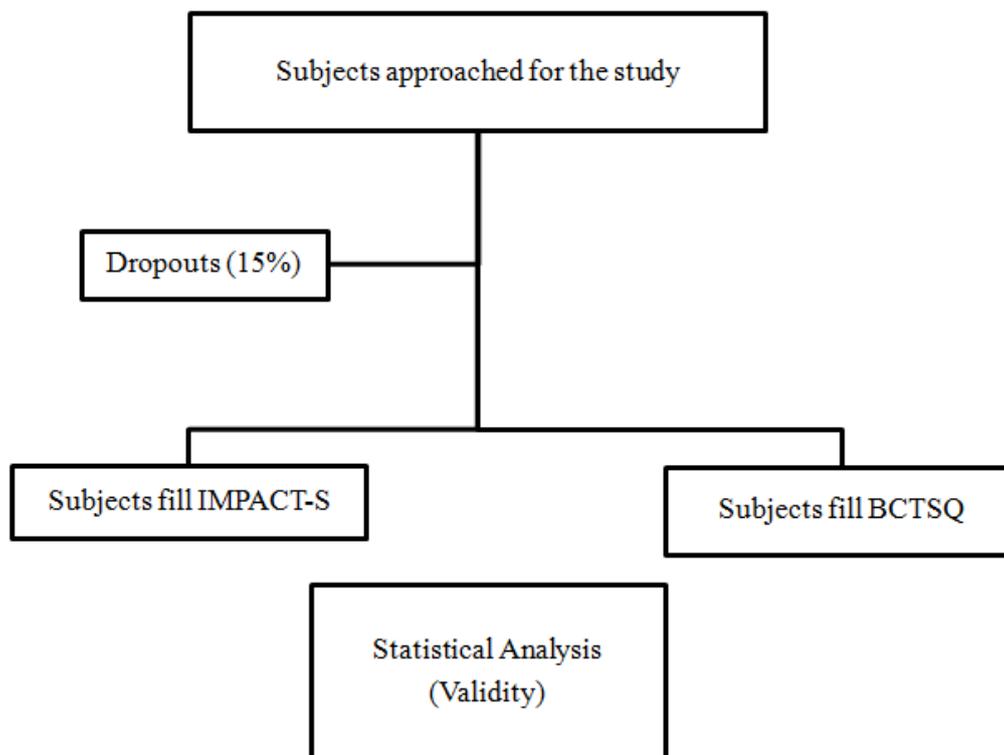
Boston Carpal Tunnel Severity Questionnaire (BCTSQ).

Computer/ Laptop.

3.4. Location of the study

Department of Physiotherapy, Teerthanker Mahaveer University.

3.5. Study Design



3.6. Protocol for Data Collection:

Patients with diagnosed Carpal Tunnel Syndrome were approached for the study. Participants were selected based on the Inclusion and Exclusion Criteria. Subjects will be explained the purpose and methodology of the study. An informed consent form was given to each of the subjects outlining their role and rights as study participants.

Once patient consent was achieved, the questionnaires were filled by the patient for calculating their total score and statistical analysis.

IV. DATA ANALYSIS

Statistical analyses of the data was done by using the SPSS software (version 26.0). Quantitative variables were described in terms of Mean and Standard deviations. To determine the normality of data Shapiro-Wilk test was employed. If data was found non-normal non-parametric test was applied. Tests with a $p < 0.05$ indicated statistical significance.

Concurrent validity was established by evaluating relationship between the scores of IMPACT-S and BCTSQ by using Spearman correlation coefficient. Depending on the value of correlation coefficient, the correlation was inferred as very weak (0.00-0.19), weak (0.20-0.39), moderate (0.40-0.59), strong (0.60-0.79), and very strong (0.8-1.0).

V. RESULT

TABLE 1
COMPARISON OF DEMOGRAPHIC DATA AT BASELINE

Variable	Mean (SD) n=374
Age (years)	46.04 (7.5)
Height (m)	1.55 (0.07)
Weight (kgs)	69.10 (4.54)
BMI (kg/m ²)	28.53 (3.03)

* Significant difference at <0.05 ; BMI: Body Mass Index

TABLE 2
DESCRIPTIVE STATISTICS AND CORRELATION COEFFICIENTS FOR BCTSQ AND IMPACT-S.

Variables	Mean	SD	IMPACT-S	BCTSQ
IMPACT-S	25.14	6.89		$r = 0.508^{**}$
BCTSQ	47.33	13.26	$r = 0.508^{**}$	

** $p < 0.01$ (2-tailed); $n=374$; IMPACT-S: ICF Measure of Participations and Activities Screener; BCTSQ: Boston Carpal Tunnel Syndrome Questionnaire

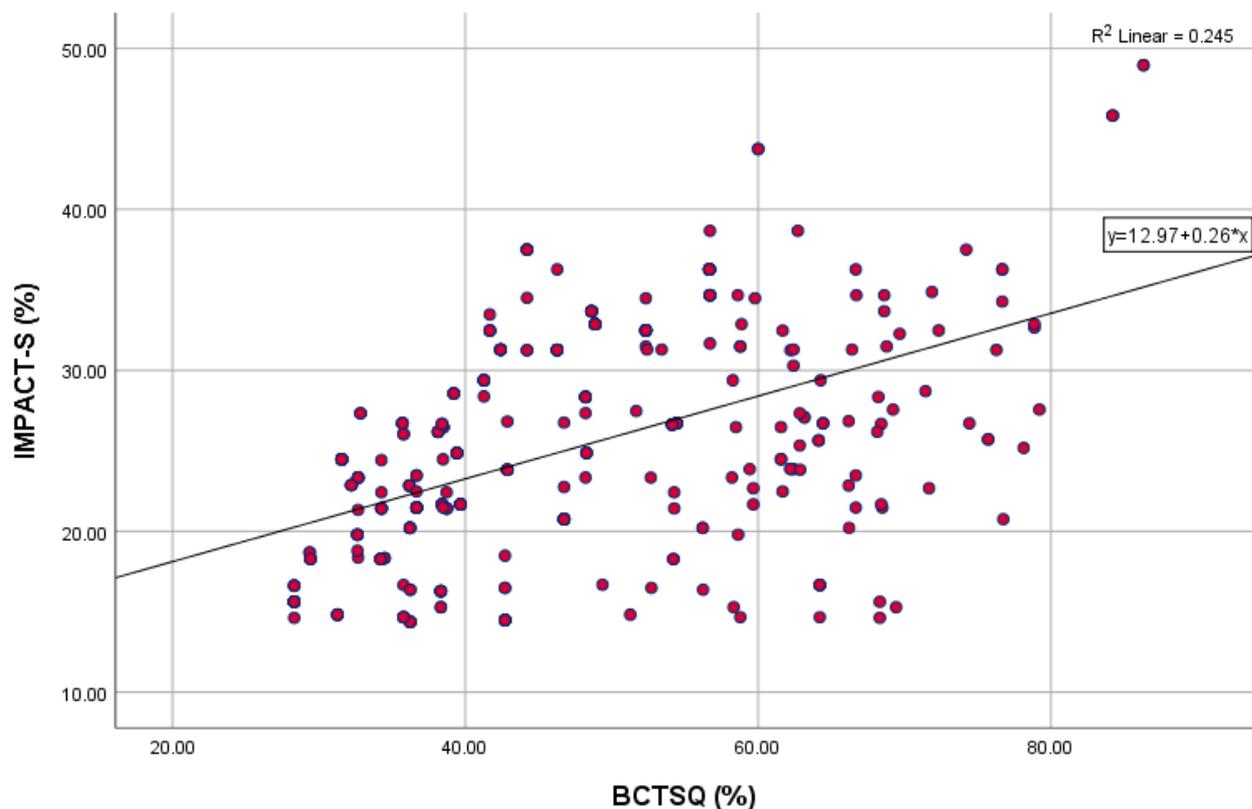


FIGURE 1: Scatter plot for Correlation Coefficients for BCTSQ and IMPACT-S.

IMPACT-S: ICF Measure of Participations and Activities Screener; BCTSQ: Boston Carpal Tunnel Syndrome Questionnaire

The Spearman's rank-order correlation was determined the relationship between IMPACT-S and BCTSQ scales. There was a moderate, positive correlation between IMPACT-S and BCTSQ scales, which was statistically significant [$r_s(374) = 0.508$, $p < 0.01$]

VI. DISCUSSION

The current research work was aimed at establishing the validity of IMPACT-S in subjects with Carpal Tunnel Syndrome. The results of this study indicate that ICF Measure of Participation and Activities- Screener (IMPACT-S) is a moderately valid tool to assess the disability resulting from Carpal tunnel syndrome [$r_s(374) = 0.508, p < 0.01$] when correlated with BCTQ: Boston Carpal Tunnel Questionnaire.

Woolf and Pfleger, 2003 concluded in their study that musculoskeletal disorders pose a health burden that can be evaluated by assessing pain, disability associated with disease processes of the joint or trauma. This global burden on the individual is explained in the Bone and Joint Decade 2000–2010 as well by the WHO and the United Nations.

The Chinese version of Boston Carpal Tunnel Questionnaire used in another study, was found to have satisfactory validity, reliability and responsiveness for patients with carpal tunnel syndrome¹⁴.

Stucki et al., 2009 defined a cross-cultural clinical measure of functioning integrating the various ICF framework based subsets. The results of the study indicated the applicability of the ICF format to clinical practice and the feasibility of its adoption into daily assessments.

A study by Rudolf et al., 2010 suggested the use of a comprehensive clinical framework for assessment of patients with various conditions of the hand according to the International ICF Consensus Conference for patients in acute care hospitals and rehabilitation centres.

A study by Franklin et al., 2005 indicated the need for proper diagnostic criteria for subjects with Carpal Tunnel Syndrome. This is suggested to improve the treatment strategies for early management and disability risk reduction. The overall effect of this holistic approach is to reduce the cost of intervention and thereby reduce the global burden.

The relation of Carpal tunnel Syndrome and other musculoskeletal injuries in manual labourers is depicted in a research work by Quandt et al., 2016. The study has concluded that the prevalence of Carpal Tunnel Syndrome is greater in patients with pre-existing Rotator Cuff injury. It was suggested that the cause-effect relationship between the two be further explored and the sequence be better defined. This is in similarity with use of the IMPACT-S being used for the assessment of various clinical conditions at once. Another systematic review by Van Rijn et al., 2009 indicated that carpal tunnel Syndrome was found to be related with the force exertion of hand on average and repetitive hand movements at work.

The responsiveness and test-retest reliability of 'Boston Carpal Tunnel Questionnaire' and 'Disability of Arm Shoulder and Hand (DASH)' were compared in a research work by Warwick et al., 2004. The results of the research work indicate that DASH has good clinical reliability and responsiveness for evaluation of disability experienced by patients with Carpal Tunnel Syndrome.

A case report by Akinson et al., 2011 explained the use of a clinical reasoning and reflection tool for the effective utilization of the ICF format. The study reported a patient oriented management model. It was suggested that this technique will be especially helpful for physical therapists to make informed decisions of patient care, professional and personal growth. The use of ICF framework ensures reflection stimulated dialog between therapists as well as patients.

Jelsma and Scott, 2011, in a retrospective study indicated that promotion of the use of ICF format among physical therapy students will improve clinical reasoning for problem solving in patient settings. A 'holistic approach' for identifying illnesses and for management strategies can be beneficial for patient outcomes.

VII. CONCLUSION

In summary, the present study showed that the use of the ICF Measure of Participation and Activities screener (IMPACT-S) and the Boston Carpal Tunnel Severity Questionnaire (BCTSQ) have moderate validity to assess the disability resulting from Carpal Tunnel Syndrome. It can be safely assumed that IMPACT-S can be used in clinical practice for evaluation of Carpal Tunnel Syndrome as part of the WHO ICF core set assessment technique.

LIMITATIONS AND FUTURE RECOMMENDATIONS

The current study has established that IMPACT-S has moderate validity for Carpal Tunnel Syndrome patients. The current study was conducted during September 2020 and May 2021 and the data collection was hampered by the COVID-19 pandemic. Since the concurrent validity of the scale was assessed, it is recommended that future researches evaluate construct and content validity as well as reliability of the scale.

REFERENCES

- [1] Aşkın, A., Atar, E., Tosun, A., Demirdal, Ü., & Koca, Ö. (2020). Activities and participation after stroke: validity and reliability of the Turkish version of IMPACT-S questionnaire. *Disability and rehabilitation*, 42(13), 1912-1917.
- [2] Atkinson, H. L., & Nixon-Cave, K. (2011). A tool for clinical reasoning and reflection using the international classification of functioning, disability and health (ICF) framework and patient management model. *Physical Therapy*, 91(3), 416-430.
- [3] C.R Kothari, (2004). *Research Methodology Methods & Techniques*; 2nd revised edition (pp. 73-74).
- [4] Cantero-Téllez, R., Naughton, N., Algar, L., & Valdes, K. (2019). Linking hand therapy outcome measures used after carpal tunnel release to the International Classification of Functioning, Disability and Health: A systematic review. *Journal of Hand Therapy*, 32(2), 233-242.
- [5] Cartwright, M. S., Yeboah, S., Walker, F. O., Rosenbaum, D. A., Newman, J. C., Arcury, T. A., ... & Quandt, S. A. (2016). Examining the association between musculoskeletal injuries and carpal tunnel syndrome in manual laborers. *Muscle & nerve*, 54(1), 31-35.
- [6] Cazares-Manríquez, M. A., Wilson, C. C., Vardasca, R., García-Alcaraz, J. L., Olguín-Tiznado, J. E., López-Barreras, J. A., & García-Rivera, B. R. (2020). A Review of Carpal Tunnel Syndrome and Its Association with Age, Body Mass Index, Cardiovascular Risk Factors, Hand Dominance, and Sex. *Applied Sciences*, 10(10), 3488.
- [7] Cieza, A., Hilfiker, R., Chatterji, S., Kostanjsek, N., Üstün, B. T., & Stucki, G. (2009). The International Classification of Functioning, Disability, and Health could be used to measure functioning. *Journal of clinical epidemiology*, 62(9), 899-911.
- [8] Daniell, W. E., Fulton- Kehoe, D., Chiou, L. A., & Franklin, G. M. (2005). Work- related carpal tunnel syndrome in Washington State workers' compensation: Temporal trends, clinical practices, and disability. *American journal of industrial medicine*, 48(4), 259-269.
- [9] Fischer, J., Thompson, N. W., & Harrison, J. W. (2014). A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. In *Classic Papers in Orthopaedics* (pp. 349-351). Springer, London.
- [10] Greenslade, J. R., Mehta, R. L., Belward, P., & Warwick, D. J. (2004). Dash and Boston questionnaire assessment of carpal tunnel syndrome outcome: what is the responsiveness of an outcome questionnaire?. *Journal of Hand Surgery*, 29(2), 159-164.
- [11] Jelsma, J., & Scott, D. (2011). Impact of using the ICF framework as an assessment tool for students in paediatric physiotherapy: a preliminary study. *Physiotherapy*, 97(1), 47-54.
- [12] Karne, S. S., & Bhalerao, N. S. (2016). Carpal tunnel syndrome in hypothyroidism. *Journal of clinical and diagnostic research: JCDR*, 10(2), OC36.
- [13] Kostopoulos, D. (2004). Treatment of carpal tunnel syndrome: a review of the non-surgical approaches with emphasis in neural mobilization. *Journal of bodywork and movement therapies*, 8(1), 2-8.
- [14] Lue, Y. J., Lu, Y. M., Lin, G. T., & Liu, Y. F. (2014). Validation of the Chinese version of the boston carpal tunnel questionnaire. *Journal of occupational rehabilitation*, 24(1), 139-145.
- [15] Mohammadi, S., Roostayi, M. M., Naimi, S. S., & Baghban, A. A. (2019). The effects of cupping therapy as a new approach in the physiotherapeutic management of carpal tunnel syndrome. *Physiotherapy Research International*, 24(3), e1770.
- [16] Perenboom, R. J., & Chorus, A. M. (2003). Measuring participation according to the International Classification of Functioning, Disability and Health (ICF). *Disability and rehabilitation*, 25(11-12), 577-587.
- [17] Post, M. W., de Witte, L. P., Reichrath, E., Verdonschot, M. M., Wijnhuizen, G. J., & Perenboom, R. J. (2008). Development and validation of IMPACT-S, an ICF-based questionnaire to measure activities and participation. *Journal of Rehabilitation Medicine*, 40(8), 620-627.
- [18] Ram, S. (2019). "Carpal tunnel syndrome:" A bibliometric study of 35 years of research.
- [19] Roquelaure, Y., Ha, C., Fouquet, N., Descatha, A., Leclerc, A., Goldberg, M., & Imbernon, E. (2009). Attributable risk of carpal tunnel syndrome in the general population: implications for intervention programs in the workplace. *Scandinavian journal of work, environment & health*, 35(5), 342.
- [20] Rudolf, K. D., Kus, S., Chung, K. C., Johnston, M., LeBlanc, M., & Cieza, A. (2012). Development of the International Classification of Functioning, Disability and Health core sets for hand conditions—results of the World Health Organization International Consensus process. *Disability and rehabilitation*, 34(8), 681–693. <https://doi.org/10.3109/09638288.2011.613514>.
- [21] Rudolf, K. D., Kus, S., Coenen, M., Dereskewitz, C., van de Ven-Stevens, L. A., & Cieza, A. (2010). Report on the International ICF Consensus Conference on the ICF core sets for hand conditions. *Hand Therapy*, 15(3), 73-76.
- [22] Rundell, S. D., Davenport, T. E., & Wagner, T. (2009). Physical therapist management of acute and chronic low back pain using the World Health Organization's International Classification of Functioning, Disability and Health. *Physical Therapy*, 89(1), 82-90.
- [23] Silva Drummond, A., Ferreira Sampaio, R., Cotta Mancini, M., Noce Kirkwood, R., & Stamm, T. A. (2007). Linking the Disabilities of Arm, Shoulder, and Hand to the International Classification of Functioning, Disability, and Health. *Journal of hand therapy : official journal of the American Society of Hand Therapists*, 20(4), 336–344. <https://doi.org/10.1197/j.jht.2007.07.00>.
- [24] Stier-Jarmer, M., Cieza, A., Borchers, M., & Stucki, G. (2009). How to apply the ICF and ICF core sets for low back pain. *The Clinical journal of pain*, 25(1), 29-38.
- [25] Stucki, G., Cieza, A., Ewert, T., Kostanjsek, N., Chatterji, S., & Ustun, T. B. (2002). Application of the International Classification of Functioning, Disability and Health (ICF) in clinical practice. *Disability and rehabilitation*, 24(5), 281-282.
- [26] Urits, I., Gress, K., Charipova, K., Orhurhu, V., Kaye, A. D., & Viswanath, O. (2019). Recent advances in the understanding and management of carpal tunnel syndrome: a comprehensive review. *Current pain and headache reports*, 23(10), 1-8.

- [27] van der Zee, C. H., Kap, A., Mishre, R. R., Schouten, E. J., & Post, M. W. (2011). Responsiveness of four participation measures to changes during and after outpatient rehabilitation. *Journal of rehabilitation medicine*, 43(11), 1003-1009.
- [28] van der Zee, C. H., Post, M. W., Brinkhof, M. W., & Wagenaar, R. C. (2014). Comparison of the Utrecht Scale for Evaluation of Rehabilitation-Participation with the ICF Measure of Participation and Activities Screener and the WHO Disability Assessment Schedule II in persons with spinal cord injury. *Archives of physical medicine and rehabilitation*, 95(1), 87-93.
- [29] van der Zee, C. H., Priesterbach, A. R., van der Dussen, L., Kap, A., Schepers, V. P., Visser-Meily, J. M., & Post, M. W. (2010). Reproducibility of three self-report participation measures: The ICF Measure of Participation and Activities Screener, the Participation Scale, and the Utrecht Scale for Evaluation of Rehabilitation-Participation. *Journal of rehabilitation medicine*, 42(8), 752-757. <https://doi.org/10.2340/16501977-0589>.
- [30] Van Rijn, R. M., Huisstede, B. M., Koes, B. W., & Burdorf, A. (2009). Associations between work-related factors and the carpal tunnel syndrome—a systematic review. *Scandinavian journal of work, environment & health*, 19-36.
- [31] Woolf, A. D., & Pfleger, B. (2003). Burden of major musculoskeletal conditions. *Bulletin of the world health organization*, 81, 646-656.
- [32] World Health Organization. (2007). *International Classification of Functioning, Disability, and Health: Children & Youth Version: ICF-CY*. World Health Organization.