Reviewer ID: Jane Hsieh, Carlos L. Cano Herrera, Matthew Querée

Last updated: December 31, 2024

Research Summary – Neurogenic Bladder Symptom Score (NBSS) – Other Physiological Systems

Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Welk et al. 2018 Prospective (observational) cross-sectional study to validate the Neurogenic Bladder Symptom Score (NBSS) for people with SCI United States (recruitment from community/tertiary neurology clinics)	N = 609 participants with SCI 410M (67%), 199F (33%) Mean (IQR) age 48 (36-57) years SCI level: Cervical (n = 285), thoracic (n = 265), lumbar/sacral (n = 42) ASIA class: A (n = 167), B (n = 75), C (n = 61), D (n = 42), E (n = 3), unknown (n = 258) Mean (IQR) since injury 11.5 (5.8, 22.7) years	Correlations were assessed between the NBSS or its components and other variables collected as part of the existing study protocol: • NBSS QOL question and Bladder management complications score: r = 0.29 • NBSS QOL question and SF12-physical domain: r = -0.16 • NBSS QOL question and SF12-mental domain: r = -0.28 • NBSS consequences domain and History of	**Internal consistency:** Cronbach's alpha was calculated for the incontinence (0.93), storage & voiding (0.76), consequences (0.49), and total score (0.85). The **test–retest reliability** based on an $ICC_{2,1}$ was >0.75 for all domains, the QOL question, and the total score: • Incontinence domain: 0.78 • Storage and voiding domain: 0.83 • Consequences domain: 0.76 • QOL question: 0.79 • NBSS total: 0.79	**Measurement error:** SMD: • Incontinence: 3.5 • Storage and voiding: 2.1 • Consequences: 1.5 • NBSS QOL Question: 0.6 • NBSS total: 5.2 SEM: • Incontinence: 3.2 • Storage and voiding: 1.7 • Consequences: 1.5 • NBSS QOL Question: 0.5 • NBSS total: 4.7 **Mean score (SD):** • Incontinence: 9.2 (6.9) • Storage and voiding: 6.9 (4.2)

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		renal/bladder stone procedures: r = 0.16 • NBSS consequences domain and Number of UTIs in the prior year: r = 0.51 • NBSS consequences domain and Hospitalization for UTIs in the prior year: r = 0.21 • NBSS consequences domain and Bladder management complications score: r = 0.50 • NBSS total score and Bladder management complications score: r = 0.28		• Consequences: 6.6 (4.2) • NBSS QOL Question: 2.0 (1.2) • NBSS total: 22.7 (10.3)

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		*All correlations were significant ($p < 0.05$)		
Welk et al. 2017 Prospective cohort to assess the responsiveness of the NBSS Patients with neurogenic bladder who were undergoing their first intravesical injection of onabotulinum toxin	N = 21 patients with SCI (n = 9, 43%), multiple sclerosis (n = 8, 38%), and congenital (n = 4, 19%) Mean (IQR) age 42 (28-57) years 7M (33%), 14F (67%) *Patients with SCI: Cervical level (n = 2) ASIA A (n = 6) Mean (IQR) time since injury 4.5 (1.5-5.5) years			**Responsiveness:** Standardized effect size (SES): • Incontinence domain: 1.1 • Storage & voiding domain: 0.8 • Consequences domain: 0.5 • NBSS QoL question: 2.5 • NBSS total: 1.2 Standardized response mean (SRM): • Incontinence domain: 0.9 • Storage & voiding domain: 0.9 • Consequences domain: 0.4 • NBSS QoL question: 1.1 • NBSS total: 1.0

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Author Year Research Design Setting	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
Welk et al. 2014 Psychometric study to describe score validity and reliability of the NBSS (Only abstract is available)	N = 230 patients Diagnosis: SCI (35%), MS (59%), congenital neurogenic bladder (6%)	Validity was demonstrated by the correlations with the AUASS, ICIQ-UI and SF-Qualiveen, and significant differences in NBSS scores among known groups.	**Internal consistency**: Cronbach α = 0.89. **Test-rest reliability:** $ICC_{2,1}$ = 0.91	

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Research Summary – Neurogenic Bladder Symptom Score-short form (NBSS-SF) – Other Physiological Systems

Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Welk et al. 2020 Psychometric study using data from several existing sources (Welk et al. 2014; Welk et al. 2017; Cintra et al. 2019; Myers et al. 2019) to create and perform this initial validation of the NBSS-SF	• Cohort 1 consisted of the 230 patients (35% SCI) used to validate the original NBSS (Welk et al. 2014). • Cohort 2 consisted of 1479 patients with SCI (60% male) who completed the NBSS as part of a prospective QOL study (Myers et al. 2019). • Cohort 3 consisted of 68 patients (mostly with SCI; 97%; 84% male; median age of 38.9) from Brazil who completed the NBSS as part of a cross-cultural. validation project (Cintra et al. 2019).	Correlations between NBSS full version total score to NBSS-SF total score: • Cohort 1 (n = 230): r = 0.90 • Cohort 2 (n = 1479): r = 0.94 • Cohort 3 (n = 68): 0.93 *All correlations were $p < 0.01$ Correlations between NBSS-SF total and: • Qualiveen-SF: r = 0.53 • AUA Symptom Score: r = 0.76 • ICIQ-Urinary Incontinence: r = 0.46 *All correlations were $p < 0.05$	**Internal consistency:** Cronbach's α for NBSS-SF total: • Cohort 1: 0.76 • Cohort 2: 0.75 • Cohort 3: 0.70 **Test-retest reliability:** ICCs for NBSS-SF total: • Cohort 1: 0.91 • Cohort 2: - • Cohort 3: 0.86	**Floor/Ceiling effects:** There were no obvious floor or ceiling effects.

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Research Summary – Neurogenic Bladder Symptom Score (NBSS) – Other Physiological Systems - Cross-cultural Validation Studies

Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Przydacz et al. 2020 Prospective (cohort) (validation) study to translate, culturally adapt, and validate the Polish version of the NBSS Database of the urology outpatient clinic of the Jagiellonian University Medical College, Krakow, Poland	N = 210 patients (SCI, n = 101; multiple sclerosis = 109) • Characteristics of patients with SCI: Mean (IQR) age 49.8 (35.9 – 62.1) years 73M, 28F Mean (IQR) time since injury 11.7 (2.2 – 21.9) years AIS A (n = 47), AIS B (n = 3), AIS C (n = 12), AIS D (n = 39) Level of SCI: Cervical (n = 16), thoracic (n = 68), lumbar (n = 17) N = 60 patients (30 with SCI and 30 with MS) were randomly selected to assess content validity.	**Construct/criterion validity:** • Significant correlation between the total scores of NBSS Incontinence domain and ICIQ-SF for the participants with SCI: r = .809 and P < .001. • Significant association between the total scores of NBSS Storage and Voiding domain and IPSS for the participants with SCI: r = .754 and P < .001. • Significant correlation between the total	**Internal consistency:** Cronbach's alpha coefficients for patients with SCI: • Total score: α = 0.83. • "Incontinence" domain: α = 0.82 • "Storage and Voiding" domain: α = 0.73 • "Consequences" domain: α = 0.62). **Test-retest reliability:** In patients with SCI, the ICCs for: • Total score: 0.87 • Incontinence: 0.85 • Storage and Voiding: 0.81	**Floor/Ceiling effects:** Floor/ceiling effects were not observed. For patients after SCI, three had the lowest possible total score and the highest possible total score was not indicated. Two to five per cent of the SCI respondents reported the lowest possible scores for the separate domains and 3%-7% reported the highest possible scores for the separate domains.

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		scores of NBSS Quality of Life and SF-Qualiveen for the participants with SCI: *r* = .698 and *P* < .001).	Consequences: 0.72	
Guler et al. 2022 Psychometric study to assess the psychometric properties of the Turkish version of the NBSS in patients with SCI and multiple sclerosis Rehabilitation clinic in Gaziosmanpasa Training and Research Hospital	N = 102 participants Diagnosis: SCI (n = 84), MS (n = 18) 54M, 48F Mean (SD) age 40.18 (10.87) years Etiology of SCI: Falls (n = 31), motor vehicle accidents (n = 24), iatrogenic (n = 13), spina bifida (n = 3), industrial accidents (n = 3), diving accidents (n = 5), transvers myelitis (n = 2), spinal tumors (n = 3) Mean (SD) injury or diagnosis time 47.30 (61.39) months Neurological level of SCI: Cervical (n = 42), thoracic (n = 24), lumbar/sacral (n = 18)	**Concurrent validity:** Spearman's rank correlation coefficients between Total score of NBSS and: • King's Health Questionnaire (KHQ), GHP: r = 0.640 • KHQ, II, r = 0.436 • KHQ, RL, r = 0.436 • KHQ, PL, r = 0.637 • KHQ, SL, r = -0.080 (P > 0.05) • KHQ, PL, r = 0.348 • KHQ, E, r = 0.269 • KHQ, SE, r = 0.267 • KHQ, SM, r = 0.369 • KHQ, SSS, r = 0.813	**Internal consistency:** • Total score: α = 0.903 • "Incontinence" domain: α = 0.918 • "Storage and Voiding" domain: α = 0.811 • "Consequences" domain: α = 0.637 **Test-retest reliability**: ICC was 0.918 for the total score and was 0.912 for the urinary incontinence subdomain, 0.861 for storage and voiding, and 0.813 for consequences.	

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	ASIA unknown (n = 2), ASIA A (n = 23), ASIA B (n = 19), ASIA C (n = 19), ASIA D (n = 20), ASIA E (n = 1)	• Short Form-12, MH, r = -0.315 • Short Form-12, PH, r = -0.309 *All other correlations were significant (p < 0.05)		
Moreno-Palacios et al. 2021 Psychometric study to perform a cross-cultural adaptation and validation of the NBSS to Spanish in patients with neurogenic lower urinary tract dysfunction Three different centers (one in	N = 82 (multiple sclerosis, n = 29; SCI, n = 22; others, n = 31) 37M, 45F Mean (range) age 43.9 (18-78) years	**Construct Validity:** Pearson correlation between NBSS and Qualiveen-SF showed a moderate correlation: r = 0.57 (p< 0.0001).	**Internal consistency:** Cronbach α = 0.86 (95% CI, 0.81–0.90). **Test-retest reliability**: • Overall score: ICC = 0.91 • Incontinence domain: ICC = 0.92 • Storage and voiding: ICC = 0.93 • Consequences domain: ICC = 0.96	

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Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Mexico and two in Argentina)				
Cintra et al. 2019 Psychometric study to cross-culturally adapt and check for the reliability and validity of the NBSS to Brazilian portuguese, in patients with SCI and multiple sclerosis Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, Brasil	N = 68 (SCI, n = 66; multiple sclerosis, n = 1; did not answer, n = 1) 57M, 11F Mean (SD) age 38.9 (14.7) years Mean (SD) time since injury 41 (42.6) months Injury level: Cervical (n = 34), Thoracic (n = 28), low back (n = 3), sacral (n = 1), NA (n = 2) ASIA Grade: A (n = 42), B, C, D, or E (n = 22) Data from 46 patients who completed the test and retest phases were used for the test-retest reliability analysis.	**Construct Validity:** Correlation between NBSS and the Qualiveen-SF: r = 0.66 ([0.40-0.82]; p < 0.0001).	**Internal consistency:** Cronbach α = 0.81. **Test-retest reliability:** • Overall score: ICC = 0.86 [0.76-0.92] (p < 0.0001). • Incontinence domain: ICC = 0.83 [0.71-0.91]. • Storage and Voiding: ICC = 0.81 [0.75-0.90]. • Consequences: ICC = 0.80 [0.66-0.87]	

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Research Summary – Neurogenic Bladder Symptom Score-short form (NBSS-SF) – Other Physiological Systems - Cross-cultural Validation Studies

Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Khadour et al. 2024 Psychometric study to provide a translated and validated version of the SF-Qualiveen Questionnaire Arabic Version (short form) Four neurorehabilitation centers in the Syrian Provinces of Damascus and Latakia	108 participants with SCI Mean (± SD) age 39.54 (± 11.34) years 77M, 31F Mean (± SD) time since injury 31.22 (± 11.6) months Level of injury: Cervical (n = 39), thoracic (n = 36), lumbar/sacral (n = 33) ASIA grade: A (n = 20), B (n = 54), C (n = 34)	• A significant strong association was observed between the QoL item of the NBSS-SF and the SF-Qualiveen overall score (r=0.82, p 0.003) and bother with limitations domain of the SF-Qualiveen (r=0.76, p 0.004). • There was a substantial moderate positive association between the overall scores on the NBSS-SF and the domains of the SF-Qualiveen, involving bother with limitations (r=0.53, p=0.02), fears (r=0.44,		

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		p=0.03), feelings (*r*=0.49, *p*=0.04), and frequency of limitations (*r*=0.46, *p*=0.02). • The majority of the SF-Qualiveen domain demonstrated a moderate association with the quality of life and the storage and voiding domains. • The results of SF-Qualiveen showed weak correlation scores for the consequences domains of NBSS-SF.		
Khadour et al. 2023 Psychometric study to provide the translation,	N = 136 (n = 97 SCI and N = 39 MS) 101M 35F Mean (SD) age 38.7 (11.4) years Mean (SD) injury time	**Construct Validity:** The NBSS-SF total score was correlated with Qualiveen total score: r = 0.720 (p = 0.008).	**Internal consistency:** Cronbach's alpha coefficients: • Total score: α = 0.82.	

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Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
cultural adaptation, and validation of the Arabic NBSS-SF in patients with multiple sclerosis and SCI Four neurorehabilitation centers in two Syrian provinces (Damascus and Lattakia)	29.7 (12.3) months Level of injury: Cervical (n = 37), Thoracic (n = 31), Lumbar/sacral (n = 29) ASIA Grade: A (n = 18), B (n = 49), C (N = 30)		• "Incontinence" domain: α = 0.84 • "Storage and Voiding" domain: α = 0.73 • "Consequences" domain: α = 0.53. **Test-retest reliability:** • Total score: ICC = 0.93 • "Incontinence" domain: ICC = 0.96 • "Storage and Voiding" domain: ICC = 0.75 • "Consequences" domain: ICC = 0.91.	
Khadour et al. 2023 Psychometric study to translate and	N = 101 participants with SCI 73M 28F Mean (SD) age 38.4 (11.2) years Mean (SD) injury time	**Construct validity:** • Significant strong positive correlation between question 2 of NBSS-SF and	**Internal consistency:** • Total score: α = 0.82. • "Incontinence" domain: α = 0.84	

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validate the Arabic NBSS-SF in Syria and evaluate its characteristics among Arabic-speaking patients with SCI Four neurorehabilitation centers in the Syrian Provinces of Damascus and Latakia	30.4 (12.8) months Level of injury: Cervical (n = 38), Thoracic (n = 33), Lumbar/sacral (n = 30) ASIA Grade: A (n = 19), B (n = 51), C (N = 31)	the Qualiveen (r=0.73, p<0.001). • Significant moderate negative correlations between question 2 of NBSS-SF with both the SF-12 mental health and physical health subdomains (r = − 0.52, p = 0.004 and r = − 0, 41, p = 0.002, respectively).	• "Storage and Voiding" domain: α = 0.72 • "Consequences" domain: α = 0.57 **Test–retest reliability:** ICC of 0.91 (95% CI 0.90–0.94, p<0.001) for the overall score, and for every subdomain separately (ICC of 0.94 for incontinence, 0.72 for storage and voiding, and 0.90 for consequences).	
Berradja et al. 2022 Prospective study to empirically validate a French version of the	N = 105 patients with a neurological condition 46M, 49F Mean (SD) age 53 (14.7) years Patients presented with various neurological disorders: MS (n = 58), SCI (n =		**Internal consistency:** • Total score: α = 0.79. • "Incontinence" domain: α = 0.91	

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Neurogenic Bladder Symptoms Score-Short From (NBSS-SF) Neurourology clinic	17), and other neurological conditions, such as Parkinson's disease, spina bifida, or cauda equina syndrome (n = 30)		• "Storage and Voiding" domain: α = 0.69 • "Consequences" domain: α = 0.25 **Test-retest reliability**: ICC was 0.90 for the total score and was 0.73 for the urinary incontinence subdomain, 0.79 for storage and voiding, and 0.75 for consequences.	