Reviewer ID: Tyra Chu, Carlos L. Cano Herrera, Jane Hsieh

Last updated: August 26th, 2024

Research Summary – Spinal Cord Injury – Secondary Conditions Scale (SCI-SCS) – Other Physiological Systems

Author Year Country Research Design Setting	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
Arora et al. 2015 Psychometric study of the telephone and paper based SCI-SCS Royal North Shore Hospital, Sydney, Australia	N = 40 (32M, 8F) Median age 54, IQR: 48~63 Median years since injury: 28, IQR: 14~35 AIS A/B/C: 27/11/2 Lvls of injury: C2-C4: 4 C5-C8: 22 T1-T6: 6 T7-T12: 8	Between telephone-based & paper-based assessment (interval of 3-5 days): ICC(95%CI) = 0.90(0.83-0.95) % Agreement of two assessments that are within n-points: n=0 (identical score): 18% n=1: 60% n=2: 80% n=3: 80% n=4: 88% n=5: 93% n=6: 95%	**Test-retest, Inter-rater, Intra-rater:** Test-retest btwn two telephone-based assessments: 4-6 day ICC(95%CI) = 0.96(0.93-0.98) % Agreement of two assessments that are within n-points: n=0 (identical score): 28% n=1: 60% n=2: 85% n=3: 93% n=4: 95% n=5: 98% n=6: 100%	

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Kalpakjian et al. 2007 Data used were drawn from a larger holistic study. Data were collected from participants at 5 time points (**Time 1** (t1)= baseline **Time 2** (t2) = directly after a health promotion intervention **Time 3** (t3) = 4-month follow up **Time 4** (t4) = 1-year post-intervention **Time 5** (t5) = 2-year post intervention)	N = 65 (46M, 19F) Mean age = 43.8 Mean (SD) years since injury = 13.7 (11.0) Participants at: t1 = 65 t2 = 55 t3 = 45 t4 = 42 t5 = 35 Paraplegic/incomplete = 8 Paraplegic/complete = 26 Tetraplegic/incomplete = 13 Tetraplegic/complete = 15	Content analysis was based in the selection of items from the Seekins Secondary Conditions Questionnaire to specifically target secondary conditions associated with SCI that directly and indirectly impact health and physical functioning. Items were selected based on 3 criteria: 1) that they represent conditions that are physiologic in nature; 2) that they are measureable by patient history and physical examination, reported episodes, validated scales, or medical tests or interventions; and 3) those that can be either prevented or	**Internal consistency:** Cronbach's alpha: t1 = 0.841 t2 = 0.869 t3 = 0.809 t4 = 0.863 t5 = 0.761 Acceptable levels of internal consistency are > 0.70 Item analysis was conducted to ensure that all items had acceptable item total correlations: r ≥0.20 **Test-retest, Inter-rater, Intra-rater:** t1-t2: r = 0.698 t1-t3: r = 0.569 t1-t4: r = 0.629	**Floor/ceiling effects:** There are ceiling effects on 3 categories of secondary conditions (>20% scored in the highest category): - sexual dysfunction (26.2%) - chronic pain (32.3%) - joint and muscle pain (29.2%) There are floor effects on all 16 categories of secondary conditions (>20% scored in the lowest category): - pressure sore (76.9%) - injury caused by loss of sensation (76.9%)

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during the course of the holistic study; subsequent follow-up was done using written surveys United States		managed with medical intervention and/or health behaviours. Spearman's rho between the SCI Secondary Conditions Scale and Short Form-12 (SF-12) subscales - physical functioning, general health, and pain items and a general rating of health: Rating of health=-0.336, P=.008 Health limited moderate activities such as pushing a vacuum cleaner, climbing 1 flight of stairs/ramps=0.359, P=.004	t1–t5: r = 0.663 t2-t3: r = 0.805 t2-t4: r = 0.757 t2-t5: r = 0.716 t3-t4: r = 0.747 t3-t5: r = 0.781 t4-t5: r = 0.694 For all P<.001 Coefficients generally exceeded 0.60, suggesting generally acceptable reliability across time.	- muscle spasms (41.5%) - contractures (67.7%) - heterotopic bone ossification (89.2%) - diabetes mellitus (87.7%) - bladder dysfunction (36.9%) - bowel dysfunction (40.0%) - urinary tract infections (61.5%) - sexual dysfunction (43.1%) - autonomic dysreflexia (70.8%)

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		Health limited climbing several flights of stairs/ramps=0.437, P<.001 Accomplished less than would like due to health problems=0.317, P=.012 Limited in the kind of work or other activities due to health problems=0.442, P<.001 Degree pain interfered with normal work (in and out of the home)=0.644, P<.001 How much of the time physical health (and emotional well-being) interfered with social activities=0.475, P<.001		- postural hypotension (80.0%) - circulatory problems (50.8%) - respiratory problems (80.0%) - chronic pain (33.8%) - joint and muscle pain (29.2%) **Interpretability:** Please see Table 1 Below.

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<table>
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Interpretability</th></tr>
<tr><td></td><td></td><td>There are significant correlations between the SCI-SCS total score and the 6 SF-12 items. Most associations were moderate and in expected directions.</td><td></td><td></td></tr>
<tr><td></td><td colspan="4">Table 1
Proportion of sample reporting degree of problems with secondary conditions (time 1, n=65):
<table><tr><th>Health problem:</th><th>% reporting significant or chronic problem (score = 3)</th><th>% reporting moderate or occasional problem (score = 2)</th><th>% reporting mild or infrequent problem (score = 1)</th><th>% reporting not a problem (score = 0)</th></tr></table></td></tr>
</table>

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	Pressure sore(s)	3.1	1.5	18.5	76.9
	Injury caused by loss of sensation	4.6	4.6	1.8	76.9
	Muscle spasms (spasticity)	18.5	10.8	2.72	41.5
	Contractures	10.8	9.2	12.3	67.7
	Heterotopic bone ossification	0.0	4.6	6.2	89.2
	Diabetes mellitus	4.6	4.6	3.1	87.7
	Bladder dysfunction	13.8	16.9	32.3	36.9
	Bowel dysfunction	13.8	12.3	33.8	40.0
	Urinary tract infections	9.2	9.2	18.5	61.5
	Sexual dysfunction	26.2	12.3	18.5	43.1
	Autonomic dysreflexia	6.2	3.1	20.0	70.8
	Postural hypotension	4.6	4.6	10.8	80.0
	Circulatory problems	13.8	9.2	26.2	50.8
	Respiratory problems	3.1	4.6	10.8	80.0
	Chronic pain	32.3	10.8	23.1	33.8

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<tr><td></td><td colspan="4"><table>
<tr><td>Joint and muscle pain</td><td>29.2</td><td>24.6</td><td>16.9</td><td>29.2</td></tr>
</table>
Using Time 1 data, on average, the sample reported some degree of problem with an average of 6±3 secondary conditions.</td></tr>
</table>

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Research Summary – Spinal Cord Injury – Secondary Conditions Scale (SCI-SCS) – Other Physiological Systems - Cross-cultural Validation Studies

Author Year Country Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Vasilchenko et al. 2022 Psychometric study to conduct a cross-cultural adaptation of the Russian version Work Rehabilitation Questionnaire (WORQ) and test its psychometric properties in a sample of SCI Inpatient setting of the Department of Neurosurgery of	N = 304 (247M, 57F) in-patient traumatic SCI; N = 222 participants completed SF-36, SCIM-III, SCI-SCS and FIM. Mean (SD) age 38 (11.3) years Mean (SD) time since injury 7.2 (7.1) years Paraplegia (n = 158), tetraplegia (n = 146) AIS A (n = 95), AIS B (n = 83), AIS C (n = 79), AIS D (n = 47) Employed (n = 46), unemployed (n = 258)	The WORQ-R score showed a moderate positive correlation with SCI-SCS (Spearman's Rank Correlation = 0.471, $p < 0.001$) meaning individuals with higher work functioning had lesser comorbidities.		

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the Federal Centre of Disability Rehabilitation of Novokuznetsk, Russia				
Jorgensen et al. 2021 Cross-sectional validation sub-study (Swedish/Norwegian) Two largest rehabilitations facilities in Norway and Sweden (Sunnaas Rehabilitation Hospital and Spinalis Clinic at Aleris Rehab Station)	N = 224 participants with SCI (173M, 51F) attending regular follow-up at least 1 year after a traumatic SCI (n = 211 who answered all SCI-SCS items). Mean (SD) age 49.6 (14.9) Median (IQR) duration of injury 15.0 (6.0 – 25.0) years Injury level: Cervical (n = 114), thoracic 1-6 (n = 33), thoracic 7-12 (n = 59), lumbar (n = 18) AIS A (n = 100), AIS B (N 31), AIS C (n = 20), AIS D (n = 73)	**Structural validity.** Two out of four earlier reported latent factors ("Genitourinary and bowel", "Muscle structures and pain") were confirmed. **Hypothesis testing:** The SCI-SCS sum score showed low correlation to quality of life (QoL) measured by: - EQ5 VAS (rs = −0.47, p < 0.001). - QoL-general and QoL-physical health (International SCI QoL Basic	**Internal consistency:** Cronbach's alpha showed the SCI-SCS scale to reach a moderate value, α = 0.65. The correlations between the scale items were generally low, with only two correlations above 0.3, bladder dysfunction/bowel dysfunction (r = 0.41) and bladder dysfunction/urinary tract infections (r = 0.39). However, no items appeared to be	**Floor and ceiling effect:** There were no floor or ceiling effects on SCI-SCS sum score. Two participants scored zero and one scored 31 out of 48 points, which was the highest score.

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		Dataset) (rs = −0.36, p < 0.001 and rs = −0.37, p < 0.001, respectively). The scale item Muscle Spasms correlated moderately to ratings on Spasm Frequency (rs = 0.59, p < 0.001) and Spasm Intensity (rs = 0.56, p < 0.001) scales. Chronic Pain and Joint and Muscle Pain correlated to patient reported number of pain sites and level of pain (International SCI Pain Basic Dataset 1.0) (rs = 0.31 p < 0.001 and rs = 0.47, p < 0.001, respectively)	worthy of removing as the alpha did not change to a higher value.	
Conti et al. 2019 Validation cross-sectional study	N = 156 (126M, 30F) Mean age: 50.17	Modified Barthel Index (MBI) p-value = 0.016 Pearson's r = -0.20	**Internal consistency:** Cronbach's alpha:	**Floor/ceiling effects:** Floor and ceiling effects deemed present if 15% or more participants scored

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of the Italian version Multicetnre study in outpatient clinics of three urban spinal units across Italy	Tetraplegia: 55 Incomplete Injury (ASIA B,C,D): 97 Non-traumatic injury: 24	SF-8 Physical component (PCS) p-value = <0.001 Pearson's r = -0.36 SF-8 Mental component summary (MCS) p-value = 0.014 Pearson's r = -0.21 Patient Health Questionnaire (PHQ-9) p-value = <0.001 Pearson's r = 0.43 General anxiety disorder 7 (GAD-7) p-value = <0.001 Pearson's r = 0.30 Tetraplegia p-value = 0.003 Pearson's r = 0.29	Genitourinary and bowel = 0.72 Muscle structures and pain = 0.70 Skin, breathing, and metabolism = 0.59 Circulatory and autonomic = 0.62 Italian SCI-SCS total score = 0.73 a-coefficient of total 15 items = 0.73 **Test-retest, Inter-rater, Intra-rater:** ICC & Kappa Coefficient Test-retest reliability= 0.91 (C.I. = 0.78 – 0.96) Genitourinary and bowel = 0.90 (C.I. = 0.76 – 0.96) Muscle structures and pain = 0.89 (C.I. =	the lowest or the highest attinable values on the SCI-SCS - Skin, breathing, and metabolism (27%) - Circulatory and autonomic (25%)

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			0.72 – 0.95) Skin, breathing, metabolism = 0.86 (C.I. = 0.65 – 0.95) Circulatory and Autonomic = 0.87 (C.I. = 0.70 – 0.95)	