

Research Summary – Barthel Index (BI) – Self Care and Daily Living

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
<p>Xing et al. 2021</p> <p>Study on psychometric properties to investigate the validity and reliability of a Chinese version of SCIM III</p> <p>An inpatient rehabilitation facility in China</p>	<p>Total: N = 102 64M, 38F Mean (SD) age 48.8 (15.6) years Aetiology: Sports and leisure (n = 5), assaults (n = 4), motor vehicle accidents (n = 22), fall (n = 30), other traumatic (n = 5), non-traumatic (n = 36) Level of injury: Tetraplegia (n = 50), paraplegia (n = 52) AIS grade: A (n = 19), B (n = 24), C (n = 8), D (n = 51) Median (IQR) time since injury 2 (1.0-6.8) months</p>	<p>High correlation was found between Barthel Index and SCIM III total scores (Pearson correlation coefficient = 0.88, P < 0.01).</p>		
<p>Zhang et al. 2015</p> <p>China</p>	<p>N=95 SCI cases (77 males, 18 females)</p> <p>Average Age (SD):</p>	<p>No correlation between: DBI, OIT, RIT and ALOS for all segments (P>0.05)</p>		<p>Interpretability: See table 1.</p>

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<p>Retrospective chart review</p> <p>China – Rehabilitation center charts from Anhui Provincial Hospital (2010-2013)</p>	<p>Males: 40.44 (14.98) Females: 36.83 (13.08) Total: 39.76 (14.65)</p> <p>SCI resulting from: High falls (55.79%) Traffic accidents (28.42%) Disease (8.42%) Low falls (7.37%)</p> <p>Injury type: Cervical SCI (50.49%) Thoracic SCI (24.22%) Lumbar SCI (25.29%)</p>	<p>ABI – Admission Barthel index ALOS – average length of hospital stay DBI – discharge Barthel index OIT – operation intervention RIT – rehabilitation intervention time</p>																										
<p>Table 1. Interpretability:</p> <table border="1"> <thead> <tr> <th></th> <th>OIT</th> <th>RIT</th> <th>ALOS</th> <th>ABI</th> <th>DBI</th> </tr> </thead> <tbody> <tr> <td>CSCI</td> <td>22.14 (37.65)</td> <td>70.00 (96.52)</td> <td>42.37 (35.11)</td> <td>24.70 (29.05)</td> <td>52.76 (31.84)</td> </tr> <tr> <td>TSCI</td> <td>12.48 (19.52)</td> <td>38.43 (34.20)</td> <td>36.57 (19.56)</td> <td>19.35 (14.01)</td> <td>56.30 (13.92)</td> </tr> <tr> <td>LSCI</td> <td>5.74 (9.6)</td> <td>34.35 (35.91)</td> <td>34.87 (26.40)</td> <td>18.13 (21.81)</td> <td>67.08 (22.31)</td> </tr> </tbody> </table>						OIT	RIT	ALOS	ABI	DBI	CSCI	22.14 (37.65)	70.00 (96.52)	42.37 (35.11)	24.70 (29.05)	52.76 (31.84)	TSCI	12.48 (19.52)	38.43 (34.20)	36.57 (19.56)	19.35 (14.01)	56.30 (13.92)	LSCI	5.74 (9.6)	34.35 (35.91)	34.87 (26.40)	18.13 (21.81)	67.08 (22.31)
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<p>O'Connor et al. 2004</p>	<p>Data available for 1418 patients (includes MS, stroke and SCI)</p>			<p>Total score effect size (ES) for all participants = 0.98 (0.38 to 1.16)</p>																								

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<p>Data analysis of BI scores at admission and discharge.</p> <p>National Hospital for Neurology and Neurosurgery, London, UK.</p>	<p>diagnostic groups); mean age = 48 years</p> <p>N=237 SCI patients (135M, 102F)</p> <p>Mean (SD) age: 52 (16) yrs</p> <p>Mean (SD) length of stay in rehab: 43 (27) days</p> <p>Mean (SD) admission BI score: 11.2 (5.3)</p> <p>Mean (SD) discharge BI score: 16.4 (4.2)</p>			<p>Effect sizes for BI items for SCI group:</p> <table border="1" data-bbox="1562 521 1883 979"> <thead> <tr> <th>Items</th> <th>ES</th> </tr> </thead> <tbody> <tr><td>Bowels</td><td>0.40</td></tr> <tr><td>Bladder</td><td>0.52</td></tr> <tr><td>Grooming</td><td>0.42</td></tr> <tr><td>Toileting</td><td>0.72</td></tr> <tr><td>Feeding</td><td>0.38</td></tr> <tr><td>Transfer</td><td>0.70</td></tr> <tr><td>Mobility</td><td>0.89</td></tr> <tr><td>Dressing</td><td>0.84</td></tr> <tr><td>Stairs</td><td>1.08</td></tr> <tr><td>Bathing</td><td>1.16</td></tr> <tr><td>Total score</td><td>0.98</td></tr> </tbody> </table> <p>Item floor/ceiling effects (%) for SCI group: See table 1.</p> <p>Effect sizes for each item of the BI:</p> <table border="1" data-bbox="1562 1295 1892 1403"> <tbody> <tr><td>Bowels</td><td>0.20</td></tr> <tr><td>Bladder</td><td>0.33</td></tr> <tr><td>Grooming</td><td>0.44</td></tr> </tbody> </table>	Items	ES	Bowels	0.40	Bladder	0.52	Grooming	0.42	Toileting	0.72	Feeding	0.38	Transfer	0.70	Mobility	0.89	Dressing	0.84	Stairs	1.08	Bathing	1.16	Total score	0.98	Bowels	0.20	Bladder	0.33	Grooming	0.44
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<p>Italy</p> <p>Retrospective Examination</p> <p>Rehab Hospital in Italy</p>	<p>N=284 patients (184 M, 100 F) Mean age: 50.4±19.3 years</p> <p>Validity sample: N=76</p> <p>Traumatic or non traumatic SCLs admitted between 1997-2001. Non-traumatic etiology was present in the majority of the patients (177/284): inflammatory (4), vascular (36), neoplastic (39), degenerative (62); traumatic lesions (107/284): car accident (38), motorcycle accident (15), sport accident (&), act of violence (6), suicide attempts (6), and accidental falls (31).</p>	<p>Rivermead Mobility Index (RMI): $\rho= 0.67$</p> <p>WISCI and Barthel Index (BI) $\rho= 0.67$</p> <p>WISCI and Spinal Cord Independent Measure (SCIM): $\rho= 0.97$</p> <p>WISCI and Functional Independence Measure (FIM): $\rho= 0.70$</p> <p>RMI and BI: $\rho=0.6$</p> <p>RMI and SCIM: $\rho=0.75$</p> <p>RMI and FIM: $\rho=0.9$</p> <p>BI and SCIM: $\rho=0.7$</p> <p>BI and FIM: $\rho=0.7$</p> <p>SCIM and FIM: $\rho=0.8$</p> <p>All $P<.001$</p>		

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<p>Plantinga et al. 2006</p> <p>The Netherlands</p> <p>Cross-sectional study</p> <p>Centre for Rehabilitation of the University Medical Center Groningen, The Netherlands</p>	<p>N = 154 (72M, 82F; SCI participants = 17)</p> <p>Females: mean age = 61</p> <p>Males: mean age = 54</p>	<p>Total sample Spearman rho with the Northwick Park Dependency Score: $\rho = -0.87$</p> <p>SCI sample Spearman rho with the Northwick Park Dependency Score: $\rho = -0.86$</p> <p>Total sample Pearson's r with the Care Dependency Scale: $r = 0.75$</p> <p>SCI sample Pearson's r with the Care Dependency Scale: $r = 0.76$</p>		<p>Interpretability: 17 SCI individuals: BI Mean (SD) = 7.3 (4.9)</p>
<p>Scivoletto et al. 2003</p> <p>Italy</p>	<p>Total sample: N=284 patients (184 M, 100 F) Mean age: 50.4±19.3 years</p>			<p>Interpretability: See tables 1 and 2.</p>

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<p>Block design, matching procedure</p> <p>Spinal Cord Unit, Fondazione Santa Lucia IRCCS, a large rehabilitation hospital of the centre-south of Italy.</p>	<p>Mean interval from lesion to admission: 56.9±43.9 days</p> <p>Mean length of stay in inpatient rehabilitation centre: 98.7±68.13 days</p> <p>Traumatic or non- traumatic SCLs admitted between 1997-2001.</p> <p>Lesion level: Cervical (81), thoracic (148), lumbo-sacral (55)</p> <p>AIS impairment at admission: AIS A – 84 AIS B – 19 AIS C – 129 AIS D – 52</p> <p>2 groups:</p>			

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	Group 1: Under 50 years old – N=119 Group 2: Over 50 years old – N=165																																																						
	Demographics: <table border="1" data-bbox="478 602 1094 972" style="margin-left: 20px;"> <thead> <tr> <th>Aetiology</th> <th>Group 1:</th> <th>Group 2:</th> </tr> </thead> <tbody> <tr> <td>Traumatic</td> <td>N=79</td> <td>N=28</td> </tr> <tr> <td>Street accident</td> <td>48</td> <td>5</td> </tr> <tr> <td>Falls</td> <td>12</td> <td>19</td> </tr> <tr> <td>Other</td> <td>19</td> <td>4</td> </tr> <tr> <td>Non-traumatic</td> <td>N=40</td> <td>N=137</td> </tr> <tr> <td>Inflammatory</td> <td>10</td> <td>30</td> </tr> <tr> <td>Vascular</td> <td>6</td> <td>30</td> </tr> <tr> <td>Neoplastic</td> <td>13</td> <td>26</td> </tr> <tr> <td>Degenerative</td> <td>11</td> <td>51</td> </tr> </tbody> </table> <p data-bbox="478 1024 1293 1052">Table 1. Mean (SD) Barthel Index Score for Group 1 and 2:</p> <table border="1" data-bbox="478 1062 1862 1347" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>Under 50 years old:</th> <th>Over 50 years old:</th> </tr> </thead> <tbody> <tr> <td><i>Admission</i></td> <td></td> <td></td> </tr> <tr> <td>Barthel Index score</td> <td>25.4 (22.6)</td> <td>20.3 (20.6)</td> </tr> <tr> <td><i>Discharge</i></td> <td></td> <td></td> </tr> <tr> <td>Barthel Index score</td> <td>69.3 (29.8)</td> <td>44.3 (33.1)</td> </tr> <tr> <td>Barthel Index change in score (increase)</td> <td>43.9 (27.3)</td> <td>24 (21.1)</td> </tr> <tr> <td>Barthel Index efficiency</td> <td>0.5 (0.3)</td> <td>0.3 (0.3)</td> </tr> </tbody> </table> <p data-bbox="478 1385 1129 1412">Table 2. Barthel Index item mean(SD) scores:</p>				Aetiology	Group 1:	Group 2:	Traumatic	N=79	N=28	Street accident	48	5	Falls	12	19	Other	19	4	Non-traumatic	N=40	N=137	Inflammatory	10	30	Vascular	6	30	Neoplastic	13	26	Degenerative	11	51		Under 50 years old:	Over 50 years old:	<i>Admission</i>			Barthel Index score	25.4 (22.6)	20.3 (20.6)	<i>Discharge</i>			Barthel Index score	69.3 (29.8)	44.3 (33.1)	Barthel Index change in score (increase)	43.9 (27.3)	24 (21.1)	Barthel Index efficiency	0.5 (0.3)	0.3 (0.3)
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		<i>Admission</i>		<i>Discharge</i>		<i>Increase</i>	
		Under 50	Over 50	Under 50	Over 50	Under 50	Over 50
	Feeding	7.4 (4)	6.3 (4.3)	8.8 (2.9)	8.1 (3.5)	1.4 (2.9)	1.8 (3)
	Grooming	2.8 (2.5)	1.7 (2.4)	4.3 (1.7)	3.1 (2.4)	1.5 (2.3)	1.4 (2.2)
	Bathing	0.8 (0.6)	0.8 (0.6)	1.9 (2.4)	0.7 (1.7)	1.8 (2.4)	0.6 (1.6)
	Dressing	1.1 (2.8)	0.8 (1.8)	6.5 (4.1)	3.2 (4)	5.4 (2.4)	2.4 (3.6)
	Bladder management	1.8 (3.7)	1.6 (3.4)	7.8 (4)	4.6 (4.8)	6 (4.7)	2.9 (4.3)
	Bowel management	2.2 (4.1)	1.9 (3.7)	7.9 (4)	4.6 (4.8)	5.3 (4.8)	2.7 (4.2)
	Wheelchair use	3.9 (3.7)	3.3 (3.8)	7.5 (4.2)	4.7 (4.4)	3.5 (2.9)	1.3 (1.6)
	Transfers	4.2 (3.9)	3.5 (3.9)	12.5 (3.9)	8.1 (4.8)	8.3 (4.1)	4.5 (3.3)
	Locomotion	2.3 (4.1)	2.2 (3.8)	9.2 (5.2)	6.2 (5.2)	6.9 (4.9)	4 (3.5)
	Stair climbing	0.2 (1.1)	0.1 (0.9)	3.5 (4.2)	1.7 (3.4)	3.2 (4)	1.5 (3.2)

Research Summary – Modified Barthel Index (BI)– Self Care and Daily Living

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
<p>Ferfeli et al. 2023</p> <p>Observational study to adapt the Modified Barthel Index (MBI) for use in Greece and measure its reliability and validity on a Greek neuro-rehabilitation population</p> <p>KAT Hospital Rehabilitation Clinic and National Rehabilitation Centre in Athens, Greece</p>	<p>100 neuro-rehabilitation patients (50 with stroke and 50 with SCI) Mean (SD) age 60.3 (15.3) years</p> <p>N = 50 participants with SCI 41M, 9F ASIA A (n = 9), B (n = 5), C (n = 13), D (n = 23)</p> <p>The unidimensionality solution was rejected and a two-factor solution was adopted based on exploratory and confirmatory factor analysis (Factor 1 - Transfers and Activities of Daily Living, Factor 2 -</p>	<p>Convergent or criterion validity:</p> <ul style="list-style-type: none"> - Very high correlation presented between Katz Index score with MBI Factor 1 (r=0.89, P<0.001) and total score (r=0.87 P<0.001) respectively and high correlation with MBI Factor 2 (r=0.56, P<0.001). - High correlation was observed between the SF-36 physical functioning subscale score with MBI Factor 1 (r=0.52, P<0.001), MBI Factor 2 (r=0.59, P<0.001) and MBI Total 	<p>Internal consistency: The internal consistency of the MBI factor 1, factor 2 and Total score was measured with Cronbach's alpha and estimated as 0.92, 0.86 and 0.92 respectively. Also, satisfactory internal consistency was observed in both the stroke and SCI groups by Cronbach's alpha, estimated as 0.94 and 0.91 respectively.</p> <p>Test-retest reliability: The paired samples t-test between initial assessment and reassessment of MBI subscales and total</p>	<p>Interpretability (floor or ceiling effects): The percentage of patients scoring at the lowest possible level of the scale and at the highest possible level were for the MBI Factor 1 (5%, 1%), Factor 2 (21%, 6%) and Total score (5%, 2%) respectively. The critical value of 15% was surpassed only for Factor 2 presenting floor effect. The MIC were for Factor 1, Factor 2 and Total score 11.1, 3.6, 13.7 respectively.</p> <p>Measurement error: The error associated with the MBI Factor 1, Factor 2 and Total score at a given point</p>

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	Mobility).	<p>score ($r=0.58$, $P<0.001$) respectively.</p> <p>In the stroke and SCI groups separately, very high correlation was observed between the MBI Total score and the Katz Index score ($r=0.90$, $P<0.001$ and $r=0.87$, $P<0.001$ respectively) and high correlation was recorded with the SF-36 physical functioning subscale ($r=0.59$, $P<0.001$ and $r=0.57$, $P<0.001$, respectively).</p> <p>Known-groups validity:</p> <p>The MBI Factor 1, Factor 2 and Total score well discriminated between sub-groups of patients on the</p>	<p>score indicated no statistically significant difference. ICC between initial assessment and reassessment of the MBI factor 1, Factor 2 and Total score were 1.00, 0.996 and 0.99 ($P<0.001$) respectively. (see table 2).</p>	<p>in time (SEM) was 0.35, 0.11 and 0.41 respectively. The corresponding MDC values were 0.95, 0.3 and 1.11 respectively.</p> <p>The cut-off points of MBI Total score, Factor 1 and Factor 2:</p> <p>The area under the curve (AUC) of MBI Total score was 0.95 (95% CI 0.92-0.99, $P<0.001$) with cut-off point 47 sensitivity 76.5% and specificity 100%.</p> <p>The area under the curve (AUC) of MBI Factor 1 and Factor 2 were 0.97 (95% CI 0.94-1.00, $P<0.001$) with cut-off point 46.5, sensitivity 84% and specificity 100% and 0.84 (95% CI 0.76-0.92, $P<0.001$) with cut-off</p>

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		basis of their mobility. MBI Factor 1, Factor 2 and Total score were higher for patients with independent mobility compared to those with dependent or no mobility (Table V). See table 1.		point 3.5, sensitivity 76% and specificity 92%.																																														
<p>Table 1. Known-groups validity:</p> <table border="1" data-bbox="474 812 1829 1182"> <thead> <tr> <th>Parameter</th> <th>Mobility</th> <th>Mean±SD</th> <th>P value</th> </tr> </thead> <tbody> <tr> <td rowspan="3">MBI Factor 1 (Transfers and ADL)</td> <td>No</td> <td>35.49±21.58*</td> <td><0.001</td> </tr> <tr> <td>Dependent</td> <td>37.62±15.93*</td> <td></td> </tr> <tr> <td>Independent</td> <td>63.22±9.23</td> <td></td> </tr> <tr> <td rowspan="3">MBI Factor 2 (Mobility)</td> <td>No</td> <td>2.14±2.00*</td> <td><0.001</td> </tr> <tr> <td>Dependent</td> <td>6.77±3.63*</td> <td></td> </tr> <tr> <td>Independent</td> <td>19.67±4.72</td> <td></td> </tr> <tr> <td rowspan="3">MBI Total</td> <td>No</td> <td>37.64±23.18*</td> <td><0.001</td> </tr> <tr> <td>Dependent</td> <td>33.46±18.07*</td> <td></td> </tr> <tr> <td>Independent</td> <td>82.89±12.25</td> <td></td> </tr> </tbody> </table> <p>*Statistically significant difference.</p> <p>Table 2. Test-retest reliability:</p> <table border="1" data-bbox="474 1305 1829 1375"> <thead> <tr> <th rowspan="2">Parameter</th> <th rowspan="2">ICC (95% CI)</th> <th colspan="2">Paired samples t-test</th> <th rowspan="2">P value</th> </tr> <tr> <th>Initial</th> <th>Reassessment</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					Parameter	Mobility	Mean±SD	P value	MBI Factor 1 (Transfers and ADL)	No	35.49±21.58*	<0.001	Dependent	37.62±15.93*		Independent	63.22±9.23		MBI Factor 2 (Mobility)	No	2.14±2.00*	<0.001	Dependent	6.77±3.63*		Independent	19.67±4.72		MBI Total	No	37.64±23.18*	<0.001	Dependent	33.46±18.07*		Independent	82.89±12.25		Parameter	ICC (95% CI)	Paired samples t-test		P value	Initial	Reassessment					
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	MBI Factor 1 (Transfers and ADL)	0.996* (0.99- 1.00)	34.12±20.77	34.29±21.14	0.567	
	MBI Factor 2 (Mobility)	0.994* (0.99- 1.00)	3.27±4.89	3.22±4.76	0.570	
	MBI Total	0.996* (0.99- 1.00)	45.24±27.40	45.36±27.38	0.612	
*Statistically significant difference.						
<p>Cho et al. 2020</p> <p>Study to develop a new Korean version of the SCIM III and to investigate its reliability and validity</p> <p>Korean National Rehabilitation Center spinal cord unit</p>	<p>N = 40 32M, 8F Mean (SD) age 47.32 (14.27) years AIS A (n = 14), AIS B (n = 5), AIS C (n = 8), AIS D (n = 13) Cause of lesion: Traffic accident (n = 13); falls (n = 14); operation (n = 5); and others (n = 8), such as multiple sclerosis (n = 2), decompressive operation (n = 4), tuberculosis meningitis (n = 1), and</p>		<p>Correlation Between the KSCIM-III and MBI:</p> <p>The correlation coefficient between KSCIM-III and MBI was statistically significant (r = 0.953, P < 0.0001). The matches items between each area of the KSCIM-III and MBI were as follows:</p> <ul style="list-style-type: none"> • Feeding / Feeding: 0.973 • Bathing / bathing self: 0.962. 			

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
	SCI metastasis (n = 1) Injury level: Paraplegia (n = 15), Tetraplegia (n = 25)	<ul style="list-style-type: none"> • Dressing / dressing: 9.987. • Grooming / personal hygiene: 0.964. • Sphincter management-bladder / bladder control: 0.677. • Sphincter management-bowel / bowel control: 0.581. • Use of toilet / toilet: 0.964. • Mobility – bed to wheelchair / chair/bed transfer: 0.987. • Mobility – indoors and outdoors on even surface / ambulation: 0.762. 		

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		<ul style="list-style-type: none"> Stair management / stair climbing: 0.942. <p>All areas were statistically significant (P < 0.001).</p>		
<p>Conti et al. 2019</p> <p>Validation cross-sectional study of the Italian version of the SCI-SCS</p> <p>Multicentre study in outpatient clinics of three urban spinal units across Italy</p>	<p>N = 156 (126M, 30F)</p> <p>Mean age: 50.17</p> <p>Tetraplegia: 55 Incomplete Injury (ASIA B,C,D): 97 Non-traumatic injury: 24</p>	<p>Modified Barthel Index (MBI)</p> <p>p-value = 0.016</p> <p>Pearson's r = -0.20</p>		
<p>Küçükdeveci et al. 2000</p> <p>Turkey</p>	<p>Total sample 100 (50 patients with SCI and 50 patients with stroke).</p>	<p>Correlations between the MBI and ASIA (American Spinal Injury Association) motor scores were Moderate at</p>	<p>Internal consistency of the Modified BI is High at admission (Cronbach's α = 0.88) and discharge (Cronbach's α = 0.90).</p>	

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Only abstract available		admission (r = 0.55) and High at discharge (r = 0.76). Correlations were weaker between the MBI and ASIA sensory scores; Moderate at both admission (r = 0.43) and discharge (r = 0.51).	Inter-rater reliability for MBI items range from Moderate to High (ICC= 0.50-0.78). Inter-rater reliability for the total MBI scale is Moderate (ICC = 0.77)	