The American Spinal Injury Association Impairment Scale (AIS): International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI)

Assessment Overview

Assessment Area

**ICF Domain:**
Body Function

**Subcategory:**
Neuromusculoskeletal & Movement-related Functions and Structures

Summary

The **ASIA (American Spinal Injury Association) Impairment Scale (AIS)**, based on the Frankel scale, is a clinician-administered scale used to classify the severity (completeness) of injury in individuals with SCI. It identifies sensory and motor levels indicative of the highest spinal level demonstrating “unimpaired” function. Preservation of function in the sacral segments (S4-S5) is a key for determining the AIS grade. AIS scores are considered essential when classifying persons with SCI as to their neurological status.

The **International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI)** is a comprehensive clinician-administered neurological exam for SCI. It is widely used for research and clinical (neurologic) description for to fully assess sensory and motor functioning and level of injury in traumatic SCI. From the ISNCSCI, several measures of neurological damage can be determined, such as: Sensory and Motor Levels (on right and left sides), Neurological Level of Injury (NLI), Sensory Scores (ASIA Pin Prick and Light touch Score), Motor Scores (ASIA Upper Extremity and Lower Extremity Motor Score (UEMS & LEMS), combined to give ASIA Motor Score), and Zone of Partial Preservation. The entire examination is conducted by testing and scoring 28 key points (dermatomes) for Sensory and 10 key paired-points (myotomes) for Motor.

- The ISNCSCI exam should be performed in the supine position (except for the rectal examination that can be performed side-lying) to ensure scores collected are standard and comparable.
- The exam is generally well tolerated although sensory testing for those with severe hypersensitivity may be uncomfortable and testing for anal sensation/voluntary contraction can result in the stimulation of a bowel movement.
- The test may pose a significant clinician/patient burden unless the clinician is experienced and well-practiced in the test.

*The ISNCSCI is currently on its 7th edition, updated in 2015. Some research that supported the development of the ISNCSCI relates only to certain portions of the entire exam (e.g., the ASIA Motor Score).
The presence of anal sensation and voluntary anal contraction are assessed as a yes/no. Results can be entered into www.isncscialgorithm.com to calculate the key scores for neurological classification.

**Training:**
Training is mandatory. The test may pose a significant clinician/patient burden and results may be inaccurate unless the clinician is experienced and well-practiced in the test.

**Equipment:**
No special equipment required.

### Assessment Interpretability

<table>
<thead>
<tr>
<th></th>
<th>Statistical Error</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Minimal Detectable Change:</strong></td>
<td><strong>Mean (SD) Scores:</strong></td>
</tr>
<tr>
<td><strong>Total Motor Score</strong>:</td>
<td>4.48</td>
<td>ASIA motor at 1 year post-injury: 45.2 (22.8)</td>
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<tr>
<td><strong>Total Sensory Score</strong>:</td>
<td>5.19</td>
<td>ASIA motor at 5 years post-injury: 46.6 (23.3)</td>
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<tr>
<td><strong>ASIA UEMS</strong>:</td>
<td>2.72</td>
<td>(Kirshblum et al., 2004; N=559 from Model SCI Systems Database; traumatic SCI; reported in Furlan et al., 2008)</td>
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<tr>
<td><strong>ASIA LEMS</strong>:</td>
<td>3.66</td>
<td><strong>Median (IQR) Scores:</strong></td>
</tr>
<tr>
<td><strong>ASIA Motor Score</strong>:</td>
<td>2.72</td>
<td>ASIA motor at discharge: 50 (31-70)</td>
</tr>
</tbody>
</table>

(Scivoletto, et al. 2013; n=661, 478 males; mixed injury types; mean (SD) time since injury = 51.6(36.8) days)

**Statistical Error**

- **Minimal Detectable Change:**
  - Total Motor Score*: 1.87
  - Total Sensory Score: 3.87

- **Standard Error of Measurement:**
  - Total Motor Score*: 0.67
  - Total Sensory Score: 1.40

(Scivoletto, et al. 2013; n=661, 478 males; mixed injury types; mean (SD) time since injury = 51.6(36.8) days)

*ASIA Motor Score

### Availability

Guides and ISNCSCI Worksheet are available; Motor Exam Guide from:
Sensory Exam Guide from:
Scoring Diagram and Worksheet:
Online ISNCSCI calculator: www.isncscialgorithm.com
Video: https://www.scireproject.com/outcome-measures/video/how-to/
## Measurement Properties

### Validity – Moderate to High

*High* correlation with Quadruplegia index of function (QIF):
- ASIA Motor = 0.91
- ASIA Light Touch = 0.64
- ASIA Pin Prick = 0.65

*Moderate to High* correlation with Functional Independence Measure (FIM):
- ASIA Motor = 0.91
- ASIA Light touch = 0.58
- ASIA Pin Prick = 0.55
  (Yavuz et al. 1998; n=29, 20 males; tetraplegia; mean (range) time since injury = 20 (2-72) weeks)

*Moderate to High* correlation with 6 Minute Walk Test (6MWT):
- ASIA Motor = 0.64
- ASIA Motor (UEMS) = 0.24
- ASIA Motor (LEMS) = 0.70

*Moderate to High* correlation with 10 Meter Walk Test (10MWT):
- ASIA Motor = 0.63
- ASIA Motor (UEMS) = 0.24
- ASIA Motor (LEMS) = 0.69

*Moderate to High* correlation with Berg Balance Scale (BBS):
- ASIA Motor = 0.75
- ASIA Motor (UEMS) = 0.30
- ASIA Motor (LEMS) = 0.79
  (Harkema et al. 2016; N=152, 123 male; mixed injury type; median (range) time post-SCI = 0.9 (0.1-45.2) years)

*Moderate* correlation with Walking Index for SCI:
- ASIA Motor (LEMS) = 0.58
  (Morganti et al. 2005; N=200; mixed injury types; mean (SD) time since injury = 56.9 (43.9) days)

### Reliability – High

*High* Inter-rater Reliability:
- ASIA Motor Score: ICC = 0.999
- ASIA Light Touch: ICC = 0.997
- ASIA Pin Prick: ICC = 0.988
  (Savic et al. 2007; n=45, 38 males; mixed injury types; 3 months to 43 years post-SCI)

*High* Intra-rater Reliability:
- ASIA UEMS: ICC = 0.98
- ASIA Light Touch: ICC = 0.99
- ASIA Pin Prick: ICC = 0.99
  (Marino et al. 2008; n = 16 patients, n = 16 examiners, 10 male patients; mixed injury type; acute SCI)

### Number of studies reporting validity data: 26

### Responsiveness

**Floor/Ceiling Effect:**
- ASIA UEMS: 42% of subjects at ceiling (score 50)
- ASIA LEMS: 53% of subjects at floor (score 0)

**Effect Size:**
- ASIA UEMS: 0.69-1.29
- ASIA Light Touch: -0.08-0.30
  (Velstra et al. 2015; n=74, 51 males; mixed injury types; acute SCI at study enrollment, measured 1,3,6,12 months post-SCI)

**Standardized Response Mean:**
- ASIA Motor: 0.33

**Number of studies reporting responsiveness data: 5**
ASIA Motor (UEMS): 0.38
ASIA Motor (LEMS): 0.23

(Post locomotor training; breakdown by AIS levels available in research summary; Harkema et al. 2016; N=152, 123 male; mixed injury type; median (range) time post-SCI = 0.9 (0.1-45.2) years)