

# 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

### You Will Need

**Length:**

AIS: approx. 10-15 minutes

ISNCSCI: approx. 30-60 minutes

Pin Prick: 56 locations

Light Touch: 56 locations

Upper Motor: 10 locations

Lower Motor: 10 locations

**Scoring:**

The AIS is scored on a 5 point ordinal scale from A (sensory & motor complete SCI) to E (normal sensory and motor function).

On the ISNCSCI, Sensory scores rated 0 (sensation absent), 1 (impaired) and 2 (normal) for each dermatome. Light Touch & Pin Prick each scored out of 112 (28 locations bilaterally with a max score of 2 at each location).

Muscle function rated 0 (total paralysis) to 5 (active movement, full ROM against significant resistance) for each myotome.

UEMS & LEMS each scored out of 50; ASIA Motor Score scored out of 100.

The presence of anal sensation

### 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 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 7<sup>th</sup> 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).

and voluntary anal contraction are assessed as a yes/no. Results can be entered into [www.isncscialgorithm.com](http://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

## Availability

Motor Exam Guide from:

[http://asia-spinalinjury.org/wp-content/uploads/2016/02/Motor\\_Exam\\_Guide.pdf](http://asia-spinalinjury.org/wp-content/uploads/2016/02/Motor_Exam_Guide.pdf)

Sensory Exam Guide from:

[http://asia-spinalinjury.org/wp-content/uploads/2016/02/Key\\_Sensory\\_Points.pdf](http://asia-spinalinjury.org/wp-content/uploads/2016/02/Key_Sensory_Points.pdf)

Scoring Diagram and Worksheet:

[http://asia-spinalinjury.org/wp-content/uploads/2016/02/International\\_Stds\\_Diagram\\_Worksheet.pdf](http://asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf)

Online ISNCSCI calculator: [www.isncscialgorithm.com](http://www.isncscialgorithm.com)

Video: <https://www.scireproject.com/outcome-measures/video/how-to/>

## Assessment Interpretability

### Minimal Clinically Important Difference

Total Motor Score\*: 4.48

Total Sensory Score: 5.19

ASIA UEMS: 2.72

ASIA LEMS: 3.66

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

\*ASIA Motor Score

### 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

### Typical Values

**Mean (SD) Scores:**

ASIA motor at 1 year post-injury:

45.2 (22.8)

ASIA motor at 5 years post-injury:

46.6 (23.3)

(Kirshblum et al., 2004; N=559 from Model SCI Systems Database; traumatic SCI; reported in Furlan et al., 2008)

**Median (IQR) Scores:**

ASIA motor at discharge:

50 (31-70)

ASIA UEMS at discharge:

44 (23-50)

ASIA LEMS at discharge:

0 (0-30)

(Marino & Graves 2004; n=4338, 3443 males, from Model SCI Systems Database; mixed injury types; median (IQR) time since injury = 15 (9-28) days)

## Measurement Properties

### Validity – **Moderate** to **High**

#### **High** correlation with Quadriplegia index of function:

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

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)

**Number of studies reporting validity data: 26**

### 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 reliability data: 5**

## Responsiveness

#### **Floor/Ceiling Effect:**

ASIA UEMS:  
42% of subjects at ceiling (score 50)

ASIA LEMS:  
53% of subjects at floor (score 0)

(Marino & Graves 2004; n=4338, 3443 males; mixed injury types; median (IQR) time since injury = 15 (9-28) days)

#### **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  
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)

**Number of studies reporting responsiveness data: 5**