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Research Summary – Neuromuscular Recovery Scale (NRS) – Lower Limb | Assistive Technology

Author Year Country Research Design Setting	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
Tester et al. 2016 Psychometric study The University of Florida and outpatient clinical centers in the Christopher and Dana Reeve Foundation NeuroRecovery Network (Frazier Rehabilitation Institute, Louisville, KY; Kessler Institute for Rehabilitation, West Orange, NJ; Magee Rehabilitation	N=72 patients with SCI who completed at least 20 sessions of a standardized locomotor training program 57M, 15F Mean age=36 (15) years AIS level: A=17, B=10, C=20, D=25 Neurological level: cervical (n=44), thoracic (n=28) Time since injury=1.2 years (0.1-53.1)			**Responsiveness:** The NRS was significantly responsive for SCI outpatients (adjusted response mean=1.05; CI=0.75-1.35).

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Hospital, Philadelphia, PA; The Ohio State University Medical Center, Columbus, OH; Shepherd Center, Atlanta, GA; and The Institute for Rehabilitation and Research Memorial Hermann, Houston, TX)				
Basso et al. 2015 Observational study Outpatient rehabilitation (The Institute for Rehabilitation and Research Memorial Hermann,	N=10 7M, 3F Mean (SD) age 43 (18) years AIS level: A=1, B=1, C=2, D=6 Level of injury: cervical (n=8), thoracic (n=2) Time since injury=36 months (3-119)		**Inter-rater reliability** (measured with the Kendall coefficient of concordance [W]): • Interrater reliability: Generally strong W=0.91-0.98, 95% CI=0.65-0.99 • Reliability for treadmill stand retraining: Lower,	

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Kessler Institute for Rehabilitation, The Ohio State University, Magee Rehabilitation Hospital, Shepherd Center, and Frazier Rehab Institute)	15 raters: PT=1; MPT=2, DPT=11, PhD=1		W=0.87, 95% CI=0.06-1 • Seated trunk extension: Lower too, W=0.82, 95% CI=0.28-0.94 * Less experienced raters assigned slightly lower scores than the expert for most items, but the difference was less than half a point and did not weaken concordance.	
Behrman et al. 2015 Multicenter observational study Five outpatient rehabilitation clinics: Frazier Rehabilitation	N=69 56M, 12F Mean age 36 (15) years; AIS level: A=18, B=17, C=13, D=21 Level of injury: cervical (n=46), thoracic (n=23) Time since injury=3.3 years (7 years)		**Test-retest reliability:** • Measurement model-derived summary score: ρ=0.99; 95% CI, 0.96–0.99). • 10/11 items had Spearman correlation coefficients of >	

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Institute, Kessler Rehabilitation Institute, Magee Rehabilitation Hospital, Shepherd Center, and Ohio State University	13 raters: PT=1, MPT=2, DPT=10		0.92. The exception was stand retraining (ρ=0.84; 95% CI, 0.68-0.96)	
Velozo et al. 2015 Psychometric study (Rasch, 1-parameter, item response theory partial-credit model) Seven outpatient clinical sites in the Christopher and Dana Reeve Foundation NRN (e.g., specialized SCI	N=188 patients with SCI 141M, 41F, missing data (n=6) Mean age=39.3 years; AIS level: A=20, B=19, C=49, D=98 Injury level: cervical (n=132, thoracic (n=53), and lumbar (n=3) Mean time since injury =1.2 years	**Construct Validity:** Acceptable overall construct validity for this study (NRS met many Rasch model criteria for construct validity)		**Floor/Ceiling Effects:** Rasch analysis identified that the NRS did not show ceiling or floor effects.

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centers like Frazier Rehab, Kessler Institute, Magee Rehabilitation Hospital, etc.)				
Behrman et al. 2012 Prospective observational cohort with longitudinal follow-up Seven outpatient rehabilitation centers from the Christopher and Dana Reeve Foundation NeuroRecovery Network (NRN) (e.g., specialized SCI centers like Kessler Institute,	N=95 patients with motor incomplete SCI who completed 20 sessions or more of a standardized locomotor training program 75M, 20F Mean age 43 (17) years Mean time post SCI 1 year (0.1,25.8) Severity: AIS level D=64, C=31 Injury level: cervical (n=72), thoracic (n=23)			**Cut-off scores:** Phases listed below indicate progression of motor function and are not cutoff scores. • Phase I (scores a-c): 50-60% Body weight support for stand retraining, < 60%, > 20% for treadmill training (0.27-0.54 m/s), > 40 % to 20% for stand retraining • Phase II (scores a-c): < 10% and > 20% body weight support for stand retraining, < 20% body weight

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Magee Rehabilitation Hospital, Shepherd Center, etc.)				support for treadmill speed (0.27-0.54 m/s), < 20% and > 10% for stand retraining • Phase III (scores a-c): 0-9% body weight support for stand retraining, < 20% body weight support treadmill speed (0.58-.89 m/s), 0-9% for stand retraining • Phase IV (only): Independent stepping and < 10% body weight support for speeds >1.52 m/s
Behrman et al. 2019 Psychometric study to determine	N=32; 17 males, 15 females Mean (SD) age 6 (3) years AIS level: AIS A (n = 6), AIS B (n = 5), AIS C (n =		**Interrater reliability:** • Strong interrater reliability for the summary score (ICC = 0.96; 95% CI, 0.89 - 0.98).	

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interrater reliability of the Pediatric NRS to classify motor capacity in children after SCI University of Louisville	2), AIS D (n = 5 Injury level: Paraplegia (n = 12), tetraplegia (n = 12), cervical (n = 18), thoracic (n = 12), lumbar (n = 2) 14 raters (14 F) Average of 11 years practice experience, 10 years pediatric experience, and 7 years pediatric SCI experience		• For the individual Pediatric NRS items: ○ 12 items exhibited concordance coefficients (Kendall's W) > 0.80. ○ 4 items demonstrated concordance coefficients of 0.69 – 0.80. The interrater reliability of the summary score was consistent across age groups and groups defined by neurological level, but lower for non-ambulatory individuals than ambulatory individuals.	