Last updated: 31 December 2024

Research Summary - 10 Meter Walk Test (10MWT) - Lower Limb and Walking

Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
	N=50 (33M, 17F)	Construct Validity:		
	Mean age: 52.6 ±16.2	Strong correlation		
	years	between Self 10MWT		
<u>Willi et al. 2023</u>	Time since injury: 6.11	and 2MWT.		
	± 9.8 years	Pearson correlation		
Multicenter-		coefficient (95% Cls) r=		
observational	Tetraplegic: 24	0.964 (0.941-0.986)		
study	Paraplegic: 26			
		Strong correlation		
Switzerland	AIS A: 2	between Maximal		
	AIS B: 0	10MWT and 2MWT.		
	AIS C: 7	Pearson correlation		
	AIS D: 41	coefficient (95% Cls) r=0.974 (0.956-0.988)		
	N=35 adults with	Strong correlation		
Sinovas-Alonso	incomplete SCI	between the self		
<u>et al. 2023</u>	(24M, 11F).	10MWT and SCI Gait		
<u>ct di. 2025</u>	Average age: 35.2	Deviation Index: r=-		
Observational.	(17.2) years	.711		
cross-sectional	(17.2) 9 0010	.,		
study	N=50 non-SCI	Strong correlation		
5	participants (19M,	between the Maximal		
Spain	31F). Average age:	10MWT and SCI Gait		
	34.6 (15.2) years	deviation Index: r= -		
		0.716		
Musselman et al.	N=618	Convergent validity:		
2022	(141F)			

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Retrospective longitudinal study Canada	Average age: 48.7 years Length of inpatient rehabilitation stay: 81.6 (53.1) days AIS A: 164 AIS B: 66 AIS C: 104 AIS D: 283 AIS E: 1 Cervical: 383 Thoracic: 156 Lumbar: 72 Sacral: 7	Weak correlations between preferred speed 10MWT and the Standing and Walking Assessment Tool (SWAT). r=0.415, p=0.001 Weak correlations between fast walking speed 10MWT and the SWAT. r=0.409, p=0.001		
<u>Kahn et al. 2020</u> USA	N=12 (11M, 1F) Mean age: 55.41± 11.65 years Mean time since injury: 7.8 ± 7.8 years Chronic motor SCI AIS C=2 AIS D=10 Cervical=7 Thoracic=5	Convergent Validity: High convergent validity with Functional Gait Assessment (FGA) Spearman's Rho=0.90 (p=0.000)		

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<u>Rini et al. 2018</u>	N=25 (22M/3F)		Test-retest: ICC: 0.99	
Cohort study	Mean age: 27 years Age range: 18-60 years		[95%], SEM: 0.01	
India	Mean time since injury: 5.5 years AIS A or B			
	N=95 (15M/8F) Mean Age: 45.6 <u>+</u> 12.6	Criterion Validity:	Test-retest: ICC: 0.97-0.983	
<u>Perez-Sanpablo</u> <u>et al. 2017</u>	years Mean Time since injury: 42 <u>+</u> 117	High criterion validity with 6MWT (-0.86 to - 0.95)		
Observational, descriptive, transversal	months AIS D, motor subacute and chronic incomplete	Construct Validity: Moderate to high construct validity with WISCI-II (r=-0.37		
Mexico		to -0.795)		
		Adequate construct validity with LEMS (r= -0.4 to -0.39)		
Jorgensen et al.	N=46 (32M, 14F)	Construct validity:		
2017	Mean age: 54.5 (17.0) years	10MWT was strongly correlated with Mini		
Cross-sectional	Median time since	BESTest. Spearman's		
validation study	injury: 6.5 years	rho=-0.81; p<0.001		
Norway	AIS D: 39	10MWT was strongly correlated with Berg		

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	AIS A, B, or C: 7	Balance Scale. Spearman's rho=-0.88; p<0.001		
<u>Shah et al. 2017</u> Prospective, cross-sectional Canada	N=26 community- dwelling individuals with chronic incomplete SCI (20M, 6F) Mean age: 59.7 ±18.9 years AIS C: 5 AIS D: 21	Convergent validity: Fast 10MWT had good to excellent convergent validity with the Activity Balance Confidence (ABC) Scale scores. Pearson correlation coefficient: 0.80; p<0.001		
	N= 26 age and sex matched non-SCI participants	Self-selected 10MWT had good to excellent convergent validity with ABC Scale scores. Pearson correlation coefficient: 0.76; p<0.001		
<u>Harkema et al.</u> <u>2016</u>	N=152 (123M, 29F) Mean (SD) age: 36 (15)	Pearson's r (95%CI) with ASIA Motor Scales:		Responsiveness: Standardized Response Means after
Prospective multicenter observation; NRS 13-item version N=152	Median (range) time since SCI: 0.9 (0.1- 45.2) years	UEMS: 0.24 (0.15-0.34) LEMS: 0.69 (0.63-0.75)		All individuals: 0.51 AIS-A/B: non ambulatory

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6 outpatient rehabilitation centers in the Christopher and Dana Reeve Foundation, USA	42 thoracic AIS-A/B/C/D: 43/21/39/49 Physician-referred outpatients without progressive lesions above TI1, capable of stepping using body weight support, with ability to wean off anti-spasticity medication Median (range) number of sessions of NRN-standardized locomotor training: 70 (23-520)	ASIA Motor Score: 0.63 (0.57-0.69)		AIS-C: 0.50 AIS-D: 0.98 Median (range) number of sessions of NRN-standardized locomotor training: 70 (23-520) Interpretability: Median (Range) 10MWT Speeds: All individuals: Enrollment: 0 (0-1.96) Discharge: 0 (0-2.62) AIS-A/B: Non- ambulatory AIS-C: Enrollment: 0 (0-0.49) Discharge: 0 (0-1.72) AIS-D: Enrollment: 0.25 (0- 1.96) Discharge: 0.81 (0- 2.62) * Enrollment = pre- intervention;

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				discharge = post- intervention; median (range) number of sessions of NRN- standardized locomotor training: 70 (23-520)
Tester et al. 2016	N=72 (57M, 15F) completing 20 sessions of standardized			SRD: 0.105m/s
Prospective 6 outpatient sites in the Christopher and Dana Reeve Foundation NeuroRecovery Network, USA	locomotor training Mean (SD) age: 36 (15) Median (range) time since SCI: 0.7 (0.1- 14.7) years N=45 longer than 6 months 44 cervical, 28 thoracic AIS-A/B/C/D: 17/10/20/25			
Duffell et al. 2015	N=83 57 male			Interpretability: MID=0.11m/s
Outpatient service at the	Mean age=47.28 Incomplete SCI patients (AIS-C/D, SCI IvI above TI0,			

Commented [QM1]:

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Rehabilitation Institute of Chicago , USA	12month+ post injury, able to ambulate) treated with either Lokomat, tizanidine, or no intervention			
Srisim et al. 2015 Prospective cohort study Tertiary Rehabilitation Center, Thailand	N= 83, 23 Multiple Fallers (Age: 44.21 ± 10.7): Time Since injury (months): 58.70 ± 60.03 AIS C: 9 (39%) 60 Non-multiple fallers (52.68 ± 11.21): Time Since injury (months): 46.72 ±36.42 AIS C: 12 (20%)	Unable to predict and discriminate non- multiple fallers and multiple fallers Ability of cut-off score (≥ 10 s) to predict risk of multiple falls: Sensitivity: 56% Specificity: 69% AUC: 0.57	Interrater Reliability: ICC= 0.997 (0.994- 0.998)	SEM = 0.20
<u>Forrest et al.</u> <u>2014</u> Prospective observational cohort	N= 249, 190M Mean age=42, SD=16 Median time since SCI=0.7 yrs, range=0.1-21.6 AIS-C = 20, D=179; 50 not evaluated	"Significantly higher speeds occurred with higher classifications [SCI-FAI] for both the 6MWT and 10MWT" Pearson's r with 6MWT:		SRD = 0.10m/s (Nearly no diff. btwn fast (>=0.44m/s) & slow walkers (<0.44m/s)) MCID (for SCI-FAI < 5 at enrollment

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7 outpatient clinical sites in the Christopher and Dana Reeve Foundation NeuroRecovery Network (NRN), USA	Etiology: 15 non- trauma, 83 MVA, 54 fall, 45 sporting, 25 medicine/surgery, 10 other causes Median treatment sessions: 40; range=2-353	At enrollment in the NRN: r=0.93 At discharge: r=0.94 Overall: r=0.94 Regression analysis with 6MWT shows regression differing significantly with line of agreement – 6MWT & 10MWT not redundant (p<0.001)		patients) = 0.15m/s (for slow walkers (<0.44m/s) = 0.1- 0.15m/s)
<u>Amatachaya et</u> <u>al. 2014</u> Cross-sectional Thailand	N= 95 (65M, 30 F) Age (FIM7): 49.2 ±10.0 Age (FIM6): 51.9 ±13.2 Age (FIM5): 45.2 ±13.2 Independent ambulatory individuals with SCI FIM7: 33; Time since Injury (months): 34.6 ± 26.56 FIM6: 31; Time since injury (months): 44.3 ± 43.2	Pearson's correlation with 6MWT: In FIM-L=6 patients, r = 0.74, p<0.001 In FIM-L=7 patients, r = 0.83, p<0.001 In FIM-L=5 patients, r = 0.31, p=0.113		

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	FIM5: 30; Time Since Injury (months): 36.7 ± 30.6 AIS-D=52			
	Incomplete tetraplegia = 28			
<u>Saensook et al.</u> <u>2014</u>	N=85, 59 male 30 used walkers, 7 used crutches, 11			10MWT distinguishes subjects walking with canes and subjects
Cross-sectional	used canes, 37 no device			walking with walkers (p<0.001)
Thailand	AIS-C = 22/85 59/85 paraplegia			
Poncumhak et al. 2014 Cross-sectional A tertiary rehabilitation center in Thailand	N=60 (42M,) Mean age = 49.95 Mean time since injury = 55.5 yrs 26 traumatic, 34 non-traumatic 7 AIS-C, 53 AIS-D 23 tetraplegia, 37 paraplegia 30 with walking device, 30 without device Independent ambulatory SCI patients	Score of > 0.67 m/sec "had good-to- excellent capability to determine the ability of walking without a walking device of subjects with SCI" ROC curve area: 0.96 (95%CI=0.91~1.00) Sensitivity=90% Specificity=87%	Interrater: ICC (N=20) = 0.994 (95%CI=0.988~0.998), p<0.001	SEM: 0.03

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<u>Musselman &</u> <u>Yang 2013</u> Crossover trial	N=20 (14M, 6F) Age: 46.0 ± 13.6 Time since SCI (years): 5.4 ± 8.8		Test-retest: ICC: 0.981 (self-selected pace) and 0.977 (fast pace)	SRM: With 2 month endurance training: 0.62 (Self-selected pace) and 0.75 (fast pace) With 2 month precision training: 0.64 (Self-selected pace) and 0.79 (Fast pace) MDC: 0.15 (self- selected pace) and 0.17 (fast pace) m/s SEM: 0.05 (self- selected pace) and 0.06 (fast pace) m/s
Poncumhak et al. 2013 Cross-sectional A tertiary rehabilitation center in Thailand	Validity Test: N=66 (46M, 20 F) FIM-L 6: N=33, mean age = 50.9±13.5, AIS- C=9, AIS-D=24, tetraplegia=9, paraplegia=24 FIM-L 7: N=33, mean age = 50.23±9.5, AIS- C=1, AIS-D=32, tetraplegia=13, paraplegia=20	Point biserial correlations (p<0.05): With FIM-L Scores: coefficient = 0.778 With TUGT Scores: coefficient = -0.692	Interrater: ICC = 0.999 (0.996-1.000) for FIM-L 6 (N=8); 1.000 (0.999-1.000) for FIM- L 7 (N=8)	

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	Reliability Test: N= 16 mean age = 50.8±10.3 AIS-C=2, AIS-D=15, tetraplegia=6, paraplegia=10			
<u>Scivoletto et al.</u> 2011	N= 37 (28M, 9F) Median age: 58.5 yrs (range: 19-77) 20 of 37 patients had a non-traumatic lesion		The 10 MWT was tested with static start (10m) vs dynamic start (14m): The correlation between the results of the two methods was between 0.98 and	The 10MWT was performed in a median of 19 s (25th– 75th interquartile range 13–28), with the static start and in a median of 18.4s (25th–
Test-retest analysis SCI unit of a	12 cervical 14 thoracic 11 lumbar		0.99. Inter-rater: between 0.95 and 0.98 for both the methods.	75th interquartile range 12.6–29.9) with the dynamic start (P=0.092).
rehabilitation hospital	Setting: SCI unit of a rehabilitation hospital		Intra-rater: between 0.98 and 0.99.	When examining the patients according to either high or low WISCI level, the results for static and dynamic starts were comparable. Patients (N=15) with high WISCI levels (18–20)

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				performed the test in a median of 13.17s (25th–75th interquartile range 10.8–19) with the static start and a median of 12.7s (25th–75th interquartile range 10– 18.5) with the dynamic one (P=.17). Patients (N=6) with low WISCI levels (9–12) performed the test in a median of 19.8s (25th–75th interquartile range 15– 32.3) with the static start and a median of 19.8s (25th–75th interquartile range 14.6–30.9) with the dynamic one (P=.46).
<u>Wirz et al. 2010</u> Switzerland	N= 42 (33M, 9F) mean age: 49.3±11.5 yrs AIS A: 2 AIS B: 2	The BBS correlated strongly and significantly with the 10MWT (r=.93, P<.001) 10MWT correlations		

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	AIS D: 3 Inclusion criteria: Received either inpatient rehabilitation or out- patient physiotherapy between January 1998 and September 2007 experienced an SCI at least 1 year prior to enrollment able to walk for a minimum distance of 15 m	Falls total: r=10 (P=.52) Spinal Cord Independence Measure (SCIM) mobility score: r=.89 (P<.001) WISCI: r=.81 (P<.001) Falls Efficacy Scale (FES-1): r=83 (P<.001) Motor scores: r=.60 (P<.001)		
Lemay & Nadeau 2010 Longitudinal An intensive rehabilitation center in Montreal, Canada (Institut de readaptation	N= 32 (25M, 7F) mean age: 47.9±12.8 yrs Neurological level: 15 paraplegic, 17 tetraplegic Level of injury: 17 cervical, 10 thoracic, 5 lumbar Type of injury: 21 traumatic, 11 non- traumatic	Spearman's correlations of 10MWT with other walking scales: (all P<.01) BBS: 0.792 Spinal Cord Injury – Functional Ambulation Inventory		Mean (SD) 10-MWT score (m/s): All participants: 0.81 (0.34), range: 0.08-1.43 Paraplegia subgroup: 0.73 (0.32), range: 0.08-1.35 Tetraplegia subgroup: 0.87 (0.34), range: 0.34-1.43

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Gingras-Lindsay de Montreal)	Inclusion criteria: (1) Adults with SCI AIS D either of traumatic or nontraumatic etiology and (2) the ability to walk 10m independently with or without upper-extremity assistive devices.	(SCI-FAI) parameter: 0.777 SCI-FAI assistive devices: 0.788 SCI-FAI mobility: 0.756 WISCI II: 0.795 The following are Pearson's product moment correlation instead of Spearman's ρ): 1. 2MWT: 0.932 2. TUG: -0.646		
Van Hedel et al. 2009 Euopean Multicenter Study for Human Spinal Cord Injury (EM- SCI)	N= 886 413 AIS A subjects: 39±18 yrs, 65% paraplegic, 19% female 113 AIS B subjects: 42±18 yrs, 44% paraplegic, 27% female	(all P<.01) 10 MWT vs 5 functional ambulation categories constructed from SCIM II: Correlation coefficients after:		

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	137 AIS C subjects: 48±20 yrs, 47% paraplegic, 32% female 223 AIS D subjects: 47±17 yrs, 37% paraplegic, 22% female	1 month: ρ=.84 (P<.001) 3 months:ρ=.93 (P<.001) 6 months:ρ=.95 (P<.001) 12 months: ρ=.97(P<.001)		
Datta et al. 2009 Cohort The	N= 97 (71M, 26F) Mean Age: 38±17y Mean time since SCI = 11.9 months Incomplete SCI	Correlation between the first principle component of changes in BBS item in ten-meter walk		
NeuroRecovery Network (NRN), a specialized network of treatment centers providing standardized, activity-based	AIS C or D Mechanism of Injury: Motor Vehicle Accident = 34 Fall = 29 Sporting Accident = 16 Other nontrauma =	speed: Kendall τ = 0.34 Spearman p = 0.46 P< 0.01 for all		
therapy for patients with SCI, USA Jackson et al. 2008	8 Medical/surgical = 6 Violence = 4 N = 54 expert raters	Content Validity: Expert Evaluations (53 votes):		

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Subcommittee of internal experts evaluated locomotion measures		Valid or Useful: 32 (60%) Useful but requires validation: 20 (38%)		
		Not useful or valid for research: 1 (2%)		
				SEM: 0.05 m/s
				MDC: 0.13 m/s
<u>Lam et al. 2008</u> Meta-analysis				Mean change between 1 and 3 months post-injury: effect size = 0.92
				Mean change between 3 and 6 months post-injury: effect size = 0.47
<u>Ditunno et al.</u> 2007	N= 146 (114M, 32F) Mean age = 32 years	10MWT speed:		
	(range 16 – 69 years)	Spearman correlation w/Walking Index for		
Single-blinded, paralleled-group, multicenter RCT	Incomplete spinal cord injury patients who had a Functional	SCI (all P<.001) At 3 months: r = 0.78 At 6 months: r = 0.85 At 12 months: r = 0.77		

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6 regional SCI inpatient rehabilitation centers	Independence Measure locomotor score for walking of < 4 on entry.	Spearman correlation w/6-Minute Walking Test (all P<.001) At 3 months: r = 0.95 At 6 months: r > 0.80 At 12 months: r = 0.92 Spearman correlation w/Berg Balance Scale (BBS) (all P<.001) At 3 months: r = 0.81 At 6 months: r > 0.80 (r=0.86) At 12 months: r = 0.78 Spearman correlation w/Functional Independence Measure (FIM) (P<.001) At 3 months: r = 0.57 Spearman correlation w/FIM Locomotor Score (all P<.001) At 3 months: r = 0.80		

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		At 6 months: r > 0.80 At 12 months: r = 0.66		
		Spearman correlation w/Lower Extremity Motor Score (all P<.001) At 3 months: r = 0.64 At 6 months: r > 0.80 At 12 months: r = 0.92		
	N= 22 (18M, 4F) Mean age=45.5±16.7 years	10MWT time: Spearman correlation w/Lower Extremity		Responsiveness: The 10MWT differed between 1
<u>van Hedel et al.</u> <u>2006</u>	All subjects have incomplete injuries	Motor Score Within 1 month: r = -		month and 3 months (mean time taken to
Longitudinal study	and have achieved walking capacity in early stages after	0.45 [P=.04] After 3 months: r = - 0.30 [P=.18]		complete the test decreased from 13 to 8 seconds,
European Multicenter Study of Human SCI	injury. Cervical =13 Thoracic = 1 Lumbar = 7 Sacral = 1	After 6 months: r = - 0.40 [P=.06] After 12 months: r = - 0.39 [P=.07]		P<.001) and between 3 months and 6 months (mean time taken to complete the
		Spearman correlation w/Walking Index for SCI II		test stayed at 8 seconds, P=.005) but not between 6 months and 12

Within 1 month: r = - 0.79 [P<.00]	Author Year Research Design Setting	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			0.79 [P<.001] After 3 months: r = - 0.21 [P=.35] After 6 months: r = - 0.37 [P=.09] After 12 months: r = - 0.37 [P=.09] Spearman correlation w/ 6 minute Walk Test Within 1 month: r = - 0.91 [P<.001] After 3 months: r = - 0.90 [P<.001] After 6 months: r = - 0.87 [P<.001] After 12 months: r = -		time taken to complete the test stayed at 8 seconds, P=.91) Friedman's test (α = 0.05) between 4 intervals: DF = 3 F, = 41.4 P < 0.001 Pair-wise comparisons via Wilcoxon's signed rank test: Between intervals 1 and 2: P<.001 Between intervals 2 and 3: P=.005 Between intervals 3

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				10 MWT scores in seconds: Mean (SD), Median
				Within 1 st month: 13 (6.8), 11 After 3 months: 8 (3.2), 8 After 6 months: 8 (2.6), 7 After 12 months: 8 (2.6), 7
	Validity:	10MWT and Timed Up and Go (TUG): r = 0.89,	Intrarater : r = 0.983, P<.001	
	N = 75 (45M, 30F)	n=70	Interrater: r = 0.974,	
<u>van Hedel et al.</u> <u>2005</u>	Mean age = 54±20 years Cervical = 25	6 Minute Walk Test (6MWT) and 10MWT: ρ = -0.95, n=62	P<.001 Bland-Altman plot: No significant	
Cross-sectional study with repeated	Thoracic = 21 Lumbar = 21 Sacral = 8	Subgroups: Walking Index for Spinal Cord Injury (WISCI) scores	differences between intra-rater (0.5±6.0s) and inter-rater (- 0.1±7.0s) assessment	
assessment	Reliability:	of 0 to 10:10MWT and		
Switzerland	N = 22 (14M, 8F) Mean age = 52±20 years	TUG: r=0.92, n=23 6MWT and 10MWT: r=- 0.96, n=15		
	Cervical = 7 Thoracic = 7	WISCI scores of 11 to 20		

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	Lumbar = 7 Sacral = 1	10MWT and TUG: r=0.79, n=47 6MWT and 10MWT: r=- 0.93, n=47 Dependent walking group: 10MWT and TUG: r=0.88, n=27 6MWT and 10MWT:		
		p=-0.92, n=19 Independent walking group: 10MWT and TUG: r=0.86, n=43 6MWT and 10MWT: p=-0.94, n=43		
		10MWT with WISCI II: Overall: ρ=-0.68, n=67 <u>Subgroups:</u>		
		WISCI II scores of 0 to 10: ρ = -0.24, n=20 WISCI II scores of 11 to 20: ρ = -0.49, n=47 WISCI II dependent walking group: ρ = - 0.35, n=24		

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		WISCI II independent walking group: ρ = - 0.48, n=43		