Research Summary – Transfer Assessment Instrument (TAI) & Transfer Assessment Instrument – Questionnaire (TAI-Q) – Wheeled Mobility

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Abou et al. 2023 Cross-sectional study to evaluate the reliability of home-based remote and self- assessment of transfer quality using the TAI 4.0 and TAI-Q among wheelchair users with SCI. Participant's home environment.	N = 18 full-time manual wheelchair users with SCI Mean (SD) age 41.1 (14.2) years 12M, 6F Mean (SD) time since injury 7.8 (32.6) years Level of injury: Cervical (n = 3), high thoracic (n = 3), low thoracic (n = 8), lumbar (n = 2), and unknown (n = 2)		Interrater reliability of the total TAI score: ICCs = 0.57-0.90. Intrarater reliability of the total TAI score: ICC = 0.90 Moderate to good intrarater and interrater reliability were found for all TAI subscores (ICC: 0.60– 0.94) except for interrater reliability of flight/landing which was poor (ICC: 0.20). See table 1.	TAI scores: For the total TAI score, assessment #1 (live, rater 1) score was significantly higher compared to assessment #3 (asynchronous, average raters 2 & 3) and TAI-Q score (see table 2). Also, assessment #2 (asynchronous, rater 1) was significantly higher than assessment #3 (asynchronous, average raters 2 & 3) for total TAI score. The SEM and MDC for the remote home- based TAI total score range from 0.38 to 0.79 and 1.04 to 2.20,

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				respectively. The SEM and MDC for the TAI subscores range from 0.28 to 1.03 and 0.78 to 2.85, respectively (see table 2).
	Table 1 depicts ICCs for ir home-based TAI.	nterrater and intrarater	reliability for total and s	subscores of the remote
	Reliability construct	Rater	Assessment	ICC, 95% CI
	Total TAI score			
	Intrarater	Rater 1	Live	0.90
		Rater 1	Asynchronous	(0.75–0.96)
	Interrater	Rater 1	Live	0.90
		Avg Rater 2&3	Asynchronous	(0.80–0.97)
	Interrater	Rater 1	Live	0.57
		Wheelchair User	Live	(0.16–0.84)
	Interrater	Rater 1	Asynchronous	0.86
		Avg Rater 2&3	Asynchronous	(0.62–0.95)
	Wheelchair setup		1	
	Intrarater		Live	0.83
			Asynchronous	(0.56-0.94)
	Interrater		LIVE	
	Interretor	AVY Rater Z&S	Asynchronous	0.30-0.93)
			Live	
	Interrator			(0.77-0.97)
		Rateri	ASYNCHIONOUS	0.05

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			A١	/g Rater 2&3	Async	chronous	5	0.59–0.94)	
	Body setup								
	Intrarater		Ra	ater 1	Live		().75	
			Ra	ater 1	Async	chronous	5	0.31–0.91)	
	Interrater		Ra	ater 1	Live		(0.60	
			A	/g Rater 2&3	Async	chronous	5	0.12–0.85)	
	Interrater		Ra	ater 1	Live		(0.86	
			\sim	'heelchair User	Live			0.62–0.95)	
	Interrater		Ra	ater 1	Async	chronous	5 (0.69	
			A	/g Rater 2&3	Async	chronous	5	0.18–089)	
	Flight/landir	ng							
	Intrarater		Ra	ater 1	Live		().74	
			Ra	ater 1	Async	chronous	5	0.29–0.91)	
	Interrater		Ra	ater 1	Live		(0.20	
			A	/g Rater 2&3	Async	chronous	5	-1.18-0.70)
	Interrater		Ra	ater 1	Live		().94	
			\sim	'heelchair User	Live			0.83–0.98))
	Interrater		Ra	ater 1	Async	chronous	6 (D.51	
			A	/g Rater 2&3	Async	chronous	6	0.29–0.82)	
	ICC Intraclass (Table 2. Differe	Coefficient (ences betw	Correla veen a	ation, TAI Transfer verage video rate	⁻ Assessm rs, remote	ent Instr e rater, al	rument. nd self-a:	ssessment	of the TAI.
	Reliability	Rater		Assessment	TAI sco	re			
	construct				Avera	SD	P-	SEM	MD
					ae		value		C
	Total TAI sco	re			30	1	19196	I	
	Intrarater	Rater 1		Live	8.08	1.21	0.58	0.38	1.06

Author Year Research Design Setting (country)	Demograph Injur Characteris Samp	iics and y stics of le		Validity	R	eliability	,	Respon: Interpre	siveness etability
		Rater 1		Asynchronous	8.00	0.85			
	Interrater	Rater 1		Live	8.08	1.21	<0.01	0.38	1.04
		Avg Rater	2&3	Asynchronous	7.58	1.19			
	Interrater	Rater 1		Live	8.08	1.21	<0.01	0.79	2.20
		Wheelcha User	ir	Live	7.12	1.00			
	Interrater	Rater 1		Asynchronous	8.00	0.85	0.02	0.44	1.23
		Avg Rater	2&3	Asynchronous	7.58	1.19			
	Wheelchair	setup							
	Intrarater	Rater 1		Live	6.90	1.87	0.45	0.77	2.14
		Rater 1		Asynchronous	7.20	2.36			
	Interrater	Rater 1		Live	6.90	1.87	0.37	0.82	2.25
		Avg Rater	2&3	Asynchronous	7.25	2.09			
	Interrater	Rater 1		Live	6.90	1.87	0.11	0.56	1.56
		Wheelcha User	ir	Live	6.42	2.37			
	Interrater	Rater 1		Asynchronous	7.20	2.36	0.90	0.91	2.53
		Avg Rater	2&3	Asynchronous	7.25	2.09			
	Body setup								
	Intrarater	Rater 1		Live	6.95	1.23	0.98	0.61	1.70
		Rater 1		Asynchronous	6.94	1.51			
	Interrater	Rater 1		Live	6.95	1.23	0.83	0.78	2.16
		Avg Rater	2&3	Asynchronous	6.88	1.43			
	Interrater	Rater 1		Live	6.95	1.23	0.03	0.46	1.28
		Wheelcha User	ir	Live	6.38	1.68			
	Interrater	Rater 1		Asynchronous	6.94	1.51	0.85	0.84	2.33

Author Year Research Design Setting (country)	Demograph Injur Characteris Samp	ics and / stics of le		Validity	R	eliability	,	Respon: Interpre	siveness etability
		Avg Rate	r 2&3	Asynchronous	6.88	1.43			
	Flight/landi	ng							
	Intrarater	Rater 1		Live	9.00	1.15	0.02	0.59	1.63
		Rater 1		Asynchronous	9.55	1.09			
	Interrater	Rater 1		Live	9.00	1.15	0.43	1.03	2.85
		Avg Rate	r 2&3	Asynchronous	8.57	2.09			
	Interrater	Rater 1		Live	9.00	1.15	0.25	0.28	0.78
		Wheelch User	air	Live	8.83	1.29			
	Interrater	Rater 1		Asynchronous	9.55	1.09	0.05	0.76	2.11
		Avg Rate	r 2&3	Asynchronous	8.57	2.09			
	Measuremen identify statis	t, <i>TAI</i> Trans tical signif	ifer Ass icance	essment Instrume (<i>P</i> < 0.05)	ent. Bold	values			
Worobey et al. 2022 Study to evaluate the reliability, standard error of measurement, minimum dotoctable	N = 44 wheel users 35M, 9F Mean (SD) ag (12.7) years Diagnostic ca Paraplegia (n tetraplegia (n unspecified (n other neurolo diseases (n =	chair e 56.5 tegory: = 20), = 2), SCI n = 8), ogic 14)			Moder excelle was fo scoring TAI tot subsco rater (to 0.85 ((ICC(3 0.836), rater r	ate to ent reliab und whe g remote al and ores for ir ICC(3,1): C 64), test-r ,1):0.695 t and inte eliability	ility n ly for htra- 0.687 r etest co	TAI scores For transfe score and flight/landi subscore w significant the remote compared average ac person rate 2). There w	r 1, total ing vere ly higher for e rater to the cross the in- ers (Table rere no

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
change and item-level consistency of the TAI 4.0, when used to evaluate transfer quality remotely 2017 National Veterans Wheelchair Games, Cincinnati, OH	Mean (SD) time since injury 17.4 (11.4) years		(ICC(3,5): 0.746 to 0.962). See table 1.	differences in the wheelchair setup or body setup subscores. The SEM and MDC for transfer 1 total score and wheelchair setup, body setup, and flight/landing subscores are shown in Table 2 and range from 0.42–0.88 and 1.15–2.44, respectively. Item Analysis: All items met the 75% cutoff (Table 3), with the majority of items exceeding 90% (12 out of 15 items). Fleiss Kappa is also presented in Table 3 with moderate agreement noted for scooting (item 8) and substantial agreement noted for all other items.

Author Year Research Design Setting (country)	Demographics a Injury Characteristics Sample	Demographics and Injury Characteristics of Sample		Validity		Reliability			siveness etability		
		er-rate Int	er, intra-rater	Intra-rat	er Transf		est-ret	ai anu si	sfer 1 vs		
		Trans	fer 1 (n=44)	VS	2 (n=43)	-		3 (n=29)	5101105		
	Total Score	0.8	30 1	0	.687 #			0.721#			
	Wheelchair setup	0.962 *		C	.717 [#]			0.695 #			
	Body setup	0.7	46†	0	.729 [#]						
	Flight/landing	0.8	29†	0.854 †							
	*indicates excellent reliability (ICC > 0.9)										
	#	enaphi	ity (iCC. 0.75–	0.9)							
	Table 2. Transfer	I TAI Sc rosspai	cores, SEM ar rticipants for	nd MDC for t in-person a	otal, whee nd remote	elchair se	tup, boc nent.	dy setup	and		
					Tra	nsfer 1					
	TAI Score	Ra	ater	Average	SD	p- value	SEM	MDC			
	Total	In-p	person	7.56	1.01						
		Remote		7.70	1.05	0.021	0.44	1.23			
	Wheelchair	In-p	oerson	6.73 2.14							
	Setup	Re	mote	6.77	2.10	2.10 0.631		1.15			
	Body Setup	In-p	person	7.69	1.44						

Author Year Research Design Setting (country)	Demographic Injury Characterist Sample	s and	d Va	alidity	Relia		Responsiveness Interpretability				
			Remote	7.78	7.78 1.50 0.4		.8 0.80	2.22			
	Flight an	d	In-person	8.83	2.14	0.00	5 0.88	244			
	Note: In-perso Table 3. Percen TAI scores for tr	lote: In-person scores are represented as an average across all raters (n=4) ble 3. Percentage Agreement in item-level deficiencies between remote and in-person									
	Phase of		ltem	Percentage Agreement Remote vs In-Person Raters			Fleiss Kappa Across Al Raters				
	Transfer			Average	(Min - Max	x)					
		1	Distance	10	00%		1.000	0 [0.926,1.0	093]		
		2	Angle	10	00%		1.000 [0.952,1.093]		093]		
		3	Brakes	100%			1.000 [0.907,1.093]				
	Wheelchair	4	Armrest	97%	(95100)		0.954 [0.883,1.025]		025]		
	Setup	5	Sideguard	82%	(8089)		0.690) [0.614,0.	.767]		
		6	Level	98%	(98100)		0.936	5 [0.842,1	.031]		
		7	Feet	97%	(95100)		0.882	2 [0.812,0.	.952]		
		8	Scoot	84%	5 (7791)		0.527	′ [0.434,0	.621]		
		9	Trail Distance		00%			1.000			
	Body	Body Setup 11 Lea		93%	(8698)		0.786 [0.706,0.865]				
	Setup			94%	6 (9198)		0.715	[0.635,0.	795]		
		12	Lead Distance	97%	(9598)		0.722	2 [0.617,0.8	804]		
		13	Lean	89%	(7795)		0.694	í [0.501,0.	688]		

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample		Va	Validity		Reliability	Responsiveness Interpretability	
	Flight / 14 Betv		etween urfaces	98%	(98100) 0.9		933 [0.839,1.026]	
	Landing	15 La	Inding	97%	(95100) 0.	710 [0.617,0.804]	
	Item-level defici Percentage agr remote vs in-pe	encies are defined as scores <1 eement with in-person raters presented as the average across raters fo rson as well as the minimum and maximum						
Worobey et al. 2020 Study to evaluate the psychometric properties of the TAI-Q 2017 National Veterans	N = 44 wheelcha users 35M, 9F Mean (SD) age 56 (12.7) years Diagnostic categ Paraplegia (n = 2 tetraplegia (n = 2 unspecified (n = 2 other neurologic diseases (n = 14) Mean (SD) time s injury 17.4 (11.4) yea	Wheelchair F (SD) age 56.5 /ears lostic category: legia (n = 20), legia (n = 2), SCI ecified (n = 8), neurologic ses (n = 14) (SD) time since		Concurrent validity: Agreement between the TAI and TAI-Q was poor-to-moderate for session 1 but improved to moderate-to- acceptable after video review and to acceptable-to-strong for session 2. See table 1.		video review of transfer, btable levels of ility were onstrated for TAI-Q score for rater (intraclass lation [ICC],) and test- t reliability (ICC,). able 1.	SEM and MDC: The SEMs were 0.80, 0.71, and 0.59 for session 1 pre-video review, session 1 post- video review, and session 2, respectively. The MDCs were 2.21, 1.97, and 1.63 for session 1 pre-video review, session 1 post- video review, and session 2, respectively.	
Wheelchair			 	o TAL and intra				
Games, Cincinnati, OH	total and subsco	res	aity with th	e tai and intra	latera	ind test-retest re	hability for the fal-Q	
	Score	Conc	current Vali	dity (TAI-Q vs ⁻	TAI Intrarater (TAI-Q		Q) Test-retest (TAI- Q)	

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample		Validity		Reliability		Responsiveness Interpretability		
		Sessio	on 1	Session 1	Sessio	on 2	Session 1 Post-	Session 1 Post-	
		Pre-		Post-video	Post-	video	video vs Session	Video vs Session	
		video					2 Post-video	3 Post-video	
	Total score	0.411*		0.554*	0.740	V	0.627 ^y	0.705 ^y	
	Wheelchair setup	0.508*	*	0.604 ^y	0.657	у	0.643 ^y	0.668 ^y	
	Body setup	0.457	*	0.676 ^y	0.836	Z	0.775 ^y	0.549*	
	Flight/landing	0.289		0.495*	0.669	У	0.533*	0.380	
	remainder of sessions, all self-scoring was completed after video review. * Moderate reliability. † Acceptable reliability. ‡ Strong reliability.								
<u>Worobey et al.</u>	n=44 full-time		Con	current Valio	lity:	Test-	retest, Inter-	Responsiveness:	
2018	wheelchair users		(acro	oss all transfe	rs)	rater,	, Intra-rater:	TAI 4.0 SEM:	
	35 male, 9 female		Mea	n TAI 4.0 (SD)) =	Inter-	rater reliability	Session 1 = 0.24;	
Repeated	Mean age (SD) = 56	6.5	7.58	± 1.12		(ICC):	T I I I I	Session 2 = 0.23	
measures	(12.7)		Mea	n VAS (SD) = '	7.44	lotal	IAI 4.0:		
Evaluation of	Diagnosis:		± 1.78	3		Sessio	on 1 = .80;	TAI 4.0 MDC:	
TAI Version 4.0	SCI = 30; MS = 1; Transverse myelitis	s = 1;	(r = 0).52-0.7)		Sessio	on 2 = .85	Session 1 = 0.68; Session 2 = 0.63	
2017 National	Amputation = 5;					Intra-	rater reliability		
Veterans	Guillain-Barré = 1;					(ICC)	session 1 vs. 2:		
Wheelchair	Stroke =1					Total	TAI 4.0:		

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Games in Cincinnati, OH.	Time since injury/diagnosis (SD): 17.4 (11.4) Type of wheelchair (%) Manual wheelchair = 75; Power wheelchair = 25 Inclusion criteria: Participants could independently transfer to/from a wheelchair surface within 30 seconds.		Rater 1 = .69; Rater 2 = .76; Rater 3 = .60; Rater 4 = 0.71 Test-retest reliability (ICC) session 1 vs. 3: Total TAI 4.0: Rater 1 = .70; Rater 2 = .76; Rater 3 = .55; Rater 4 = 0.60	
Baghel et al. 2018 Repeated measures Evaluation of TAI Version 3.0 Rehabilitation department of Indian spinal	n=30 first-time manual wheelchair users 25 male, 5 female Mean age (SD) = 31.9 (12.3) Injury level: 6 tetraplegia; 5 high paraplegia (T2-T7); 19 low paraplegia (T8-L4)	Pearson Correlations: (p=0.001) Rater 1 = 0.89 Rater 2 = 0.89 Rater 3 = 0.88 Rater 4 = 0.90	Test-retest, Inter- rater, Intra-rater: Inter-rater reliability (ICC): TAI 3.0 Part 1: Session 1 = .671; Session 2 = .697 Part 2: Session 1 = .516; Session 2 = .511	Responsiveness: MDC: Interrater Time 1= 0.47 Interrater Time 2= 0.44 Intrarater Total 1= 0.64 Intrarater Total 2= 0.40 Intrarater Total 3= 0.86

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injuries center, New Delhi.	ASIA: A=11; B=11; C=5; D=3 Duration (months) of SCI (SD): 1.33 (0.47) Type of transfer (%) Independent sitting pivot = 66.7 Assisted sitting pivot = 33.3 Inclusion criteria: Participants were able to sit with/without hand support for 30s.		Intra-rater reliability (ICC): TAI Part 1 = 0.93-0.95 TAI Part 2 = 0.97-0.98	Intrarater Total 4= 0.78 SEM: Interrater Time 1= 0.17 Interrater Time 2= 0.16 Intrarater Total 1= 0.23 Intrarater Total 2= 0.23 Intrarater Total 3= 0.23 Intrarater Total 4= 0.28
McClure et al. 2011 Repeated measures 2009 National Veterans Wheelchair Games in Spokane, WA	n=40 full-time wheelchair users 34 male, 6 female Mean age (SD) = 51.7 (11.3) Diagnoses: SCI = 32; MS = 4; TBI = 1; Amputation = 2; Guillain-Barré = 1 Time since SCI (n=31) = 16.9(10.7)	Concurrent Validity: An independent therapist rated the study participants on a global rating scale to assess the overall quality of the transfer. Spearman rank correlation coefficients were calculated for each	Test-retest, Intra- rater, Inter-rater: Inter-rater reliability (ICC): Part 1: Session 1 = .98; Session 2 = .99 Part 2: Session 1 = .99; Session 2 = .99 Total score:	Floor/ceiling effect: Three items (items 9 and 15 in part 1and item 7 in part 2) had a potential ceiling effect. Interpretability: Item breakdown of mean (SD) scores for the TAI is available in

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	Method of transfer: Sitting pivot = 30;Standing pivot=10 Type of wheelchair (%) Manual wheelchair=28; Power wheelchair = 11 Type of transfer (%) Independent=33; Human-assisted=7	rater to evaluate the correlation of the TAI scores (total) with a global assessment of transfer skills. Correlations: Rater 1 = .279 (p=116) Rater 2 = 192 (p=.285) Rater 3 = .690 (p.000)* Study participants reported that the assessment was not difficult and they did not feel uncomfortable with any of the transfers the evaluators asked them to do.	Session 1 = .99; Session 2 = .99 Intra-rater reliability (ICC): Part 1: Rater 1 = .634; Rater 2 = .34; Rater 3 = .804 Part 2: Rater 1 = .724; Rater 2 = .35; Rater 3 = .875 Total score: Rater 1 = .741; Rater 2 = .35; Rater 3 = .893	Table 2 of McClure et al. 2011.
<u>Tsai et al.</u> 2013	n=41 wheelchair users 31 male, 10 female Mean age (SD) = 49.9	In version 3.0, 2 items were removed due to low intra-rater	Test-retest, Intra- rater, Inter-rater: Inter-rater reliability	Responsiveness: See table 1.
measures	(12.7)	feedback. 13 items were reworded to	Part 1:	Interpretability: Item breakdown of

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Evaluation of TAI Version 3.0 A winter sports clinic for disabled veterans.	Type of disability: Tetraplegia=8; High paraplegia (T2-7)=7; Low paraplegia (T8 to L4)=14; Multiple sclerosis & brain injury=7; LMN injuries & amputee=5 Type of transfer: Sitting pivot=36; Standing pivot=3; Dependent without lift=1; Device assisted=1 Length of wheelchair use, years (n=40) = 9.9 (9.0) No. of transfers per day (n=40) = 12.3 (7.4)	clarify meaning and remove ambiguity. A revised comprehensive clinician training program was also developed. There were no significant differences in final TAI scores among subgroups of people with tetraplegia, high paraplegia, and low paraplegia (F _{2,26} =1.66, P=.21) or among the BMI categories (F _{3,35} =1.24, P=.31). There was no significant difference in TAI scores between men and women (t ₃₉ =.22, P=.83).	Session 1 = .85; Session 2 = .82 Part 2: Session 2 = .84 Total score: Session 1 = .85; Session 2 = .84 Intra-rater reliability (ICC): Part 1: Rater 1 = .87; Rater 2 = .77; Rater 3 = .79 Part 2: Rater 1 = .83; Rater 2 = .74; Rater 3 = .81 Total score: Rater 1 = .78; Rater 2 = .84; Rater 3 = .88	mean (SD) scores for the TAI is available in Table 2 of Tsai et al. 2013.			
	Table 1.						

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample		d f	Validity		Reliability		Res Inte	Responsiveness Interpretability	
		TAI 3.0	TAI 2.0	TAI 3.0	TAI 2.0	TAI 3.0	TAI 2.0	TAI 3.0	TAI 2.0	
		er SEM	er SEM	er SEM	er SEM	er MDC	er MDC	er MDC	er MDC	
	Part 1 score	.61	.50	.59	.45	1.68	1.38	1.64	1.25	
	Part 2 score	.71	.60	.68	.75	1.96	1.66	1.87	2.07	
	Final score	.56	.50	.55	.54	1.55	1.38	1.53	1.51	