



RELATIONSHIP BETWEEN WALKING INDEX FOR SPINAL CORD INJURY (WISCI) LEVEL AND NEUROLOGICAL STATUS AND WALKING SPEED IN SCI

Ralph J. Marino MD, Anthony S. Burns MD, Chip Coward MD, John F. Ditunno Jr MD

Department of Rehabilitation Medicine, Jefferson Medical College of Thomas Jefferson University, and The Regional Spinal Cord Injury Center of Delaware Valley

ABSTRACT

Objective:

Examine the relationship between Walking Index for Spinal Cord Injury (WISCI) level and both neurological status and walking speed in chronic spinal cord injury (SCI).

Design:

Convenience sample.

Participants/Methods:

Twenty-five ambulatory individuals with traumatic motor incomplete SCI of at least 12 months duration were enrolled. Neurological examination was performed according to the International Standards for Classification of SCI. Subjects ambulated 100 meters or if unable, as far as possible, in a supervised setting at the level utilized in the community. Ambulation velocity (m/min) and continuous heart rate (HR) were measured.

Results:

Subjects were predominantly male (23/25), tetraplegic (20/25) and AIS grade D (23/25). Mean age was 37 years (range 20-71 years), and mean duration of injury was 5.7 years. WISCI levels ranged from 9 – 20, with a median of 13. Subjects were grouped by WISCI: G1= levels 9-11 (n=4), G2= 12-14 (n=9), G3=15-17 (n=5), and G4=18-20 (n=7). Ambulatory velocity increased with better WISCI group, except for groups 3 and 4. Mean velocities in m/min (SD) for G1-G4 were: 13.3 (5.8); 20.9 (10.8); 47.5 (13.6); and 46.4 (9.3). Mean total motor score differed between groups: G1-4 motor scores 63, 79.1, 88.6, and 87.6 (ANOVA, p<.01). In post-hoc comparisons, only G1 differed significantly from G3 and G4.

Conclusions:

Although numbers are small, these findings support the construct validity of the WISCI. Higher WISCI levels are associated with faster walking speeds and better neurological status. Further study with a wider range of injury severity is needed.

INTRODUCTION

The Walking Index for Spinal Cord Injury (WISCI) is a functional capacity measure of ambulation, developed to more precisely define walking ability in individuals after spinal cord injury (SCI). (1) The scale rank orders the impairment to walking based on use of devices, braces, and physical assistance. Originally described with 19 levels, the WISCI scale was revised and expanded in 2001 to include 21 levels of function (scored from 0-20). (2) (Appendix) The objective of this study is to examine construct validity of the Walking Index for Spinal Cord Injury (WISCI), by exploring the relationship between WISCI level and both neurological status and walking speed in chronic spinal cord injury (SCI).

TABLE 1: Subject Characteristics

CHARACTERISTIC	NUMBER	PERCENT (%)	
SEX	Male	22	88
	Female	3	12
LEVEL	Tetraplegia	20	80
	Paraplegia	5	20
ASIA IMPAIRMENT	C	2	8
	D	23	92
WISCI GROUP	G1 (9-11)	4	16
	G2 (12-14)	9	36
	G3 (15-17)	5	20
	G4 (18-20)	7	28

DESIGN

Convenience sample of ambulatory outpatients with chronic stable SCI.

SUBJECTS AND METHODS

Twenty-five ambulatory individuals with traumatic motor incomplete SCI of at least 12 months duration were enrolled. Neurological examination was performed according to the International Standards for Classification of SCI. (3) Subjects ambulated 100 meters or if unable, as far as possible, in a supervised setting at the level utilized in the community. Ambulation velocity (m/min) and continuous heart rate (HR) were measured. Because of low numbers of subjects, WISCI levels were collapsed into 4 groups for analyses. Analysis of variance (ANOVA) was used to determine if groups differed in American Spinal Injury Association (ASIA) motor score, ambulatory velocity, and physiologic cost index (PCI = Δ heart rate/velocity), a measure of energy expenditure. For positive findings, post-hoc Scheffe comparisons were made to determine which groups differed.

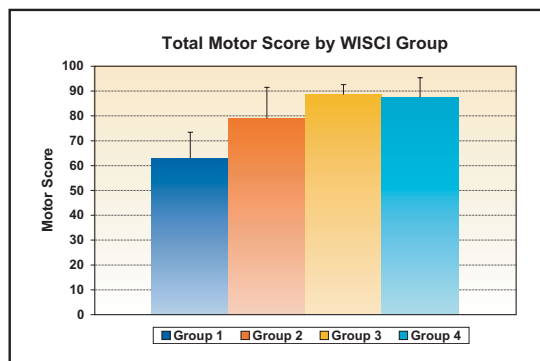
RESULTS

Subjects were predominantly male (22/25), tetraplegic (20/25) and AIS grade D (23/25). (Table 1) Mean age was 37 years (range 20-71 years), and mean duration of injury was 5.7 years. WISCI levels ranged from

TABLE 2: ASIA Motor Scores by WISCI Group

WISCI Group	TOTAL MOTOR SCORE		SIGNIFICANCE
	Mean	SD	
1	63.00	10.42	p<.01 A
2	79.11	12.36	A B
3	88.60	3.97	B
4	87.57	7.74	B
WISCI Group	LOWER EXT MOTOR SCORE		SIGNIFICANCE
	Mean	SD	
1	22.50	4.44	p<.001 A
2	36.56	2.80	B
3	40.20	1.56	B
4	43.71	1.25	B

FIGURE 1: Total Motor Score by WISCI Group



9 – 20, with a median of 13. Subjects were grouped by WISCI: G1= levels 9-11 (n=4), G2= 12-14 (n=9), G3=15-17 (n=5), and G4=18-20 (n=7).

Mean total motor score differed between groups: G1-4 motor scores 63, 79.1, 88.6, and 87.6 (ANOVA, p<.01). (Table 2, Figure 1) In post-hoc comparisons, the only positive finding was that G1 differed significantly from G3 and G4 (but not G2). Findings for lower extremity motor score were similar, except that G1 differed from the other 3 groups.

Mean ambulatory velocities in m/min (sd) for G1-G4 were: 13.3 (5.8); 20.9 (10.8); 47.5 (13.6); and 46.4 (9.3). There was a difference in velocity by WISCI group (p<.001). Post hoc comparisons indicated that ambulatory velocity between G1 and G2 differed from G3 and G4, but not with each other. (Table 3, Figure 2). There also was a difference in PCI by WISCI group (p<.01). In post hoc comparisons, G1 differed from G3 and G4. The velocity of ambulation increased with increasing WISCI level, as shown in Figure 3 (p<.001).

TABLE 3: Ambulatory Velocity and PCI by WISCI Group

WISCI Group	VELOCITY		SIGNIFICANCE
	Mean	SD	
1	13.3	5.82	p<.001 A
2	20.93	10.81	A
3	47.54	13.61	B
4	46.43	9.29	B
WISCI Group	PCI		SIGNIFICANCE
	Mean	SD	
1	6.56	5.10	p<.01 A
2	2.95	2.78	A B
3	0.71	0.37	B
4	0.82	0.49	B

FIGURE 2: Ambulatory Velocity by WISCI Group

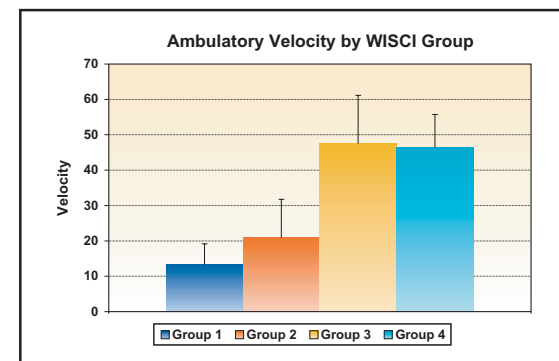
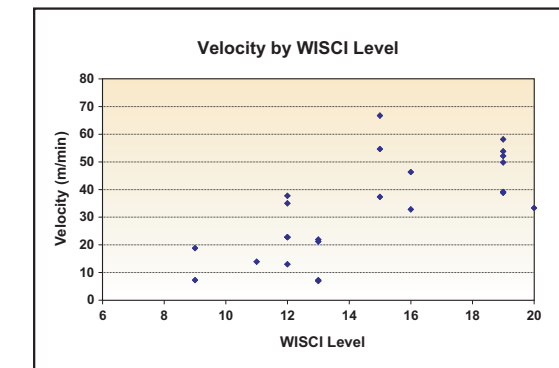


FIGURE 3: Velocity by WISCI Level



CONCLUSIONS

Although numbers are small, these findings support the construct validity of the WISCI. Higher WISCI levels are associated with faster walking speeds and better neurological status. Further study with a wider range of injury severity is needed.

REFERENCES

1. Ditunno JF Jr, Ditunno PL, Graziani V, et al.: Walking index for spinal cord injury (WISCI): an international multicenter validity and reliability study. Spinal Cord 38:234-43, 2000.
2. Ditunno PL, Ditunno JF Jr: Walking index for spinal cord injury (WISCI II): scale revision. Spinal Cord 39: 654-6, 2001.
3. American Spinal Injury Association: International Standards for Neurological Classification of Spinal Cord Injury, Revised 2002; Chicago, IL, American Spinal Injury Association; 2002.

APPENDIX: Scoring Sheet (Walking Index for Spinal Cord Injury II)

Check descriptors which apply to current walking performance, then assign the highest level of walking performance. (In scoring a level, one should choose the level at which the patient is safe as judged by the observer, with patient's consent level described. If neither other than stated in the standardized definitions are used, they should be documented as descriptors. If there is a discrepancy between two observers, the higher level should be chosen.)

Level assigned _____

LEVEL	DEVICES	BRACES	ASSISTANCE	DISTANCE
0				Unable
1	Parallel bars	Braces	2 persons	< 10 meters
2	Parallel bars	Braces	1 person	10 meters
3	Parallel bars	Braces	1 person	10 meters
4	Parallel bars	No braces	1 person	10 meters
5	Parallel bars	Braces	No assistance	10 meters
6	Walker	Braces	1 person	10 meters
7	Two crutches	Braces	1 person	10 meters
8	Walker	No braces	1 person	10 meters
9	Walker	Braces	No assistance	10 meters
10	One cane/crutch	Braces	1 person	10 meters
11	Two crutches	No braces	1 person	10 meters
12	Two crutches	Braces	No assistance	10 meters
13	Walker	No braces	No assistance	10 meters
14	One cane/crutch	No braces	1 person	10 meters
15	One cane/crutch	Braces	No assistance	10 meters
16	Two crutches	No braces	No assistance	10 meters
17	No devices	No braces	1 person	10 meters
18	No devices	Braces	No assistance	10 meters
19	One cane/crutch	No braces	No assistance	10 meters
20	No devices	No braces	No assistance	10 meters