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ORIGINAL ARTICLE

# Consumer preference in ranking walking function utilizing the walking index for spinal cord injury II

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**Study design:** Blinded rank ordering.
**Objective:** To determine consumer preference in walking function utilizing the walking Index for spinal cord injury II (WISCI II) in individuals with spinal cord injury (SCI) from the Canada, the Italy and the United States of America.
**Method:** In all, 42 consumers with incomplete SCI (25 cervical, 12 thoracic, 5 lumbar) from Canada (12/42), Italy (14/42) and the United States of America (16/42) ranked the 20 levels of the WISCI II scale by their individual preference for walking. Subjects were blinded to the original ranking of the WISCI II scale by clinical scientists. Photographs of each WISCI II level used in a previous pilot study were randomly shuffled and rank ordered. Percentile, conjoint/cluster and graphic analyses were performed.
**Results:** All three analyses illustrated consumer ranking followed a bimodal distribution. Ranking for two levels with physical assistance and two levels with a walker were bimodal with a difference of five to six ranks between consumer subgroups (quartile analysis). The larger cluster ($N=20$) showed preference for walking with assistance over the smaller cluster ($N=12$), whose preference was walking without assistance and more devices. In all, 64% (27/42) of consumers ranked WISCI II level with no devices or braces and 1 person assistance higher than multiple levels of the WISCI II requiring no assistance. These results were unexpected, as the hypothesis was that consumers would rank independent walking higher than walking with assistance.
**Conclusion:** Consumer preference for walking function should be considered in addition to objective measures in designing SCI trials that use significant improvement in walking function as an outcome measure.
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**Keywords:** consumer preference; walking function after SCI; minimal clinically important difference; spinal cord injury; WISCI

## Introduction

The walking index for spinal cord injury II (WISCI II) was developed for use in clinical trials as a quantification of walking impairment. The ranking of modes of walking was created by spinal cord injury (SCI) clinical investigators and was based on walking capacity, reflecting impairment severity.[1,2] For example, level 17 on the scale (Figures 1a and b), which requires the subject to walk 10 m with no walking aids or braces but with minimal assistance of one person, was ranked higher (less impaired) than levels requiring walking aids/braces with no physical assistance (independent in walking). The reasoning was that a subject who could walk only with the minimal assistance of one person (level 17) had less impairment than a subject who required a walker and braces to walk independently. The expectation was that the WISCI II measure would be more sensitive to treatment for improving impairment (strength)[3,4] in the lower extremities than customary performance scales, which may show improvement in function from training alone.[5]

Performance scales such as the functional independence measure (FIM),[6] which measures burden of care, and the spinal cord injury measure II (SCIM II)[7,8] are commonly used in clinical rehabilitation settings; in these instruments, walking without physical assistance is ranked higher than walking with assistance, regardless of the need for walking

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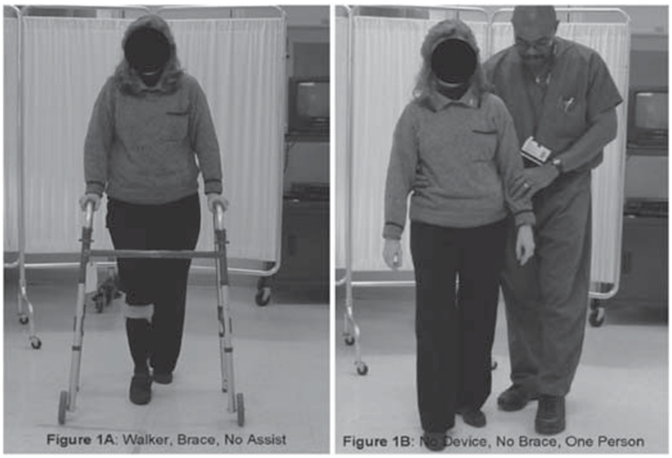
a b




*Legend*: Photograph A illustrates walking independently with walker and braces as compared to photograph B which illustrates no walker or brace but with physical assistance.

c

**WISCI II Levels**

| Level | | | | |
|---|---|---|---|---|
| 0 | | | | Unable |
| 1 | Parallel bars | Braces | 2 persons | < 10 meters |
| 2 | Parallel bars | Braces | 2 persons | 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 |

*Legend:* Definitions of the WISCI II Levels

**Figure 1** (**a**–**c**) Examples of uniformity of WISCI II pictures, definition of devices/assistance but unidentified ranking of WISCI II level.

aids and braces. The FIM, for example, collapses the use of any and all walking aids and braces into one level and fails to integrate the use of devices with the use of assistance, as the ranking is driven by the burden of care (level of physical assistance). The SCIM II walking items (items no. 12, 13, 14)[9] have some similarity to the WISCI II scale, as it ranks walking devices such as crutches, canes and braces separately, but of the 9 levels (0–8), only 5 correspond to the spread of capacity reflected by the 21 WISCI II levels. Furthermore, the use of walking aids on the SCIM II walking items are only at the independent level or with supervision and not integrated with physical assistance.[10] It has been recognized, however, that the two instruments have different purposes,[8,11,12] as the WISCI II is a capacity scale and the SCIM II is a performance scale. It is important to appreciate that the need for physical assistance and walking aids may be viewed differently based on the research question. Do we want to measure walking capacity or walking performance? Is improvement in walking function to be determined by consumers alone or by consumers together with clinicians and clinical scientists?[13,14]

The WISCI II scale, together with walking speed,[4,15] has been recommended as the best-validated outcome measures of walking function for use in clinical trials.[16–18] Recent emphasis on the need to determine clinically important differences in outcome measures[12,19] for clinical trials requires us to consider how clinically important differences may be applied to the WISCI II scale. Before designing a study to examine this relationship, we felt it was prudent to explore how consumers view the WISCI II scale's rankings of various levels of walking and if their preference for improved walking function differs from the ranking developed by clinical scientists for use in clinical trials.

Therefore, a study of the ranking of the WISCI II levels by consumers was undertaken to identify potential issues relevant to the design of a future study of minimum clinically important differences (MCIDs) of the same measure. The hypothesis was that consumers instructed to rank the WISCI II scale items on a continuum from least to most preferred walking condition would rank order the WISCI II levels in terms of independence of physical assistance in walking, irrespective of need for walking aids or braces.

## Methods

*Participants*

In all, 42 consumers with chronic, incomplete SCI from three research sites (Thomas Jefferson University Hospital, Philadelphia, PA, USA; IRCCS Fondazione S Lucia, Rome, Italy; and University of British Columbia, Canada) participated in the study. Demographic characteristics of the sample (age, gender, time since injury, WISCI level, level of injury and impairment) are listed in Table 1. Upper and lower extremity motor scores were extracted from a chart review and available data was placed in Table 1.

**Table 1** Demographics, injury characteristics and WISCI levels of patients

| | *USA* n = *16* | *Italy* n = *14* | *Canada* n = *12* |
|---|---|---|---|
| Mean age | 45.6 | 49.4 | 50 |
| Average WISCI level | 15.8 | 15.7 | 15.3 |
| *Time since injury (years)* | | | |
| ⩽1 year | 0 | 7 | 0 |
| 2–5 years | 9 | 7 | 8 |
| >5 years | 7 | 0 | 4 |
| *Gender* | | | |
| Male | 13 | 9 | 7 |
| Female | 3 | 5 | 5 |
| *Neurological level* | | | |
| Cervical | 9 | 7 | 6 |
| Thoracic | 2 | 5 | 6 |
| Lumbar | 5 | 2 | 0 |
| *ASIA impairment scale* | | | |
| B | 0 | 0 | 1 |
| C | 1 | 0 | 1 |
| D | 15 | 14 | 10 |
| *Average motor score* | | | |
| UEMS | 45 (5*) | 43.4 (7*) | 33.7 (3*) |
| LEMS | 42.8 (12) | 43.8 (13) | 37.2 (10) |

Abbreviations: ASIA, American Spinal Injury Association; LEMS, lower extremity motor score; UEMS, upper extremity motor score; WISCI, walking index for spinal cord injury.
UEMS (*N**) number represents cervical admissions with known data.
LEMS (*N*) number represents patients with known data.

*Procedures*

*Procedure for original WISCI ranking by professionals*. The rank order method used for the development of the WISCI II scale by clinical scientists differed from the method used to measure preference by consumers. The features (for example, devices, braces and/or physical assistance) for the WISCI II scale had been determined and validated for SCI experts by a modified Delphi technique.[1,2] The Delphi technique is a method of generating group consensus without having a prolonged face-to-face interaction. The international experts included clinical scientists, physicians and physical therapists specializing in SCI comprising eight teams/centers from five continents for a total of 24 professionals. They were asked to rank the various sets of features based on the severity of the impairment. The rank order is listed in Figure 1a–b (WISCI II scale, 2001). Convergence and predictive validity of the WISCI II scale has been demonstrated in a randomized clinical trial[4] and reliability and reproducibility shown in a chronic group of SCI subjects.[20]

*Procedure for assigning consumer rank*. Consumers, blinded to the ranking of the levels of the WISCI II scale by clinical scientists, were presented with a rank-ordering task. (The original WISCI scale published in 2000[1] was slightly modified with the addition of level 0 and level 18 in 2001.[2])

Photographs were taken (at the United States of America research site, by study personnel) depicting each defined WISCI II level (20 photos) using the same models and a similar background in order to ensure uniformity (see Figures 1a and b). The photo of WISCI II level 1 was eliminated because the only difference between the photo of WISCI II level 1 and 2 were in relation to the description of the distance walked (<10 versus >10 M). An explanation of the distance would have biased the ranking. At each site, the pictures were color laser printed on a half sheet of paper and laminated with the WISCI II level description printed at the bottom (that is, walker, brace, one person assist and so on).

Research participants met individually with the research coordinator at each research site. Participants sat at a large table and were presented with a stack of the 20 WISCI II level photos with word descriptors (see Figures 1a and b) in random order and asked to do the following: 'put these pictures in rank order by your preference for walking, from worst to best.' English to Italian translation was validated by the bilingual investigators. The coordinator noted the order of the cards once the subject was carried out ordering them, and these data were forwarded to the United States of America center for analysis.[21]

*Statistical analysis*

The ranking of preferences by consumers for walking with or without devices, braces and/or physical assistance of a person as illustrated in the 20 photographs was compared with the ranking of WISCI II levels by three separate analyses.

(1) The 25th, 50th (median) and 75th quartiles and the interquartile range of the rankings for each WISCI II category were calculated. These consumer rankings were compared to the existing ranked levels in the WISCI II scale.[1,2]
(2) *Conjoint analysis*: The rankings of the consumers were analyzed using metric conjoint analysis. Conjoint analysis is most often used to measure consumer preference in choosing a commercial product based on its attributes of cost, appearance (size, color and bulk) and practical use (time saving, energy saving). The consumer rank orders their preferences based on various combinations of the attributes (cost, appearance and practical use), which is expressed as part worth utilities (PWUs) or overall value. The higher the PWU value, the higher the weight of the consumer's preference. This application of conjoint analysis in this study attempts to explain the rankings of the subject by determining the value the subject assigns to a finite set of features (attributes) of the items being ranked—here, the use of devices, braces and assistance. Therefore, the PWU value assigned to a set of features such as walking with no devices, braces or physical assistance reflects the quantitative preference of the consumer. For a feature (device) with several categories (such as canes, crutches walkers and parallel bars), the range of the PWUs describes the overall importance given to that feature. Subjects were clustered based on their

PWUs using a $\kappa$-means clustering algorithm (SAS PROC FASTCLUS) with the number of clusters chosen to maximize the pseudo-F statistic. Blinded consumer ranking was compared with the existing ranking of WISCI II levels.[1,2]

(3) Bar graphs were created to illustrate the frequency of ranking of each of the photographs by the consumers compared with the existing ranking of the WISCI II levels.[1,2]

## Results

Overall, the ranking of the consumer of walking preference (Table 2) was very similar to the existing ranking by experts for the levels that required the least use of devices/braces/persons (levels 20 (no device/no brace/no assist), 19 (cane 1/no brace/no assist) and 18 (no device/brace/no assist)) and those requiring the greatest use of devices/braces/persons (levels 0 (wheelchair), 2 (parallel bars/brace/assist 2), 3 (parallel bars/brace/assist 1), 4 (parallel bars/no brace/assist 1) and 5 (parallel bars/brace/no assist)). However, there was a bimodal distribution of consumers for levels 17 (no device/no brace/assist 1), 14 (cane 1/no brace/assist 1), 13 (walker/no brace/no assist), 10 (cane 1/brace/assist 1) and 9 (walker/brace/no assist). Quartile, conjoint and cluster analysis revealed these bimodal differences of ranking by consumers, which ranged up to six levels and is illustrated by graphic analysis.

*Interquartile range analysis*
The analysis of rankings (Table 2) showed a disagreement in consumer ranking with an interquartile range of six ranks for level 17 (no device/no brace/assist 1) and five ranks for 14 (cane1/no brace/assist 1), 13 (walker/no brace/no assist) and 9 (walker/brace/no assist), which helps to better define the differences in the quartiles reflected in the bimodal distribution.

*Conjoint analysis*
Cluster analysis of PWUs from the conjoint analysis indicated that a five cluster solution was best. Mean PWUs by cluster are given in Table 3. The majority of the subjects, 29/42 (clusters no. 1, 2 and 3), have a preference for walking with assistance of one person with no device over walking independently with a device such as a walker. These three clusters differed on the relative weight given to individual devices. A smaller group, 12/42 (cluster no. 4), would rather walk independently regardless of the device. Cluster 5 (1/42) is an outlier giving highest preference to use of a walker.

*Photo comparison.* Estimated ranks for a particular photo, depicting a particular WISCI II level, can be calculated by summing the intercept and the PWUs for a set of features for a specific photo (Table 3). In the following two examples, we will illustrate the calculations for a comparison within and between clusters 4 and 1 for a set of features for specific photos.

*Example 1*: Comparison within and between clusters 4 and 1 for the photo depicting WISCI II level 7 (crutches 2/brace/assist 1) versus the photo depicting WISCI II level 12 (crutches 2/brace/no assist).

For cluster 4, the photo that depicts WISCI II level 7 (crutches 2/brace/assist 1) has a relative preference of 7.60 $(10.10+0.06+(-0.58)+(-1.98))$. For the photo that

**Table 2** Mean, median and 25th and 75th percentile of consumer preference rankings for each of the WISCI II categories

| *WISCI II levels expert ranking* | *20* | *19* | *18* | *17* | *16* | *15* | *14* | *13* | *12* | *11* | *10* | *9* | *8* | *7* | *6* | *5* | *4* | *3* | *2* | *0* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 20 | 17.5 | 18.6 | 15.6 | 13.4 | 16.1 | 13.8 | 11.4 | 12.1 | 9.4 | 12.7 | 10 | 7.5 | 8.2 | 6.3 | 5.5 | 4.6 | 3.4 | 2.3 | 0.3 |
| Median | 20 | 18 | 19 | 17 | 13 | 16 | 15 | 11 | 12 | 9.5 | 14 | 9 | 7 | 8 | 6 | 5 | 4 | 3 | 2 | 0 |
| 25th | 20 | 17 | 18.2 | 12 | 13 | 15.2 | 11 | 9 | 11 | 8 | 10.2 | 8 | 7 | 7 | 6 | 5 | 4 | 3 | 2 | 0 |
| 75th | 20 | 18 | 19 | 18 | 14.7 | 17 | 16 | 14 | 13 | 11 | 14 | 13 | 8 | 10 | 6 | 5 | 4.7 | 3 | 2 | 0 |
| IQR | 0 | 1 | 0.75 | 6 | 1.75 | 1.75 | 5 | 5 | 2 | 3 | 3.75 | 5 | 1 | 3 | 0 | 0 | 0.75 | 0 | 0 | 0 |

Abbreviations: IQR, interquartile range; WISCI II, walking index for spinal cord injury II.

**Table 3** Mean part worth utilities by cluster

| *Cluster* | *Intercept* | *Devices* | | | | | *Braces* | | *Persons* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *None* | *One cane/crutch* | *Two crutches* | *Walker* | *Parallel bars* | *None* | *Braces* | *0 person* | *1 person* | *2 persons* |
| 1 ($n=20$) | 10.47 | 6.52 | *4.04* | 0.03 | *−3.86* | −6.73 | 0.71 | −0.71 | *2.19* | −0.16 | −2.03 |
| 2 ($n=4$) | 10.67 | 6.55 | 4.16 | −1.71 | −6.78 | −2.22 | 0.86 | −0.86 | 2.40 | −0.81 | −1.59 |
| 3 ($n=5$) | 10.36 | 6.49 | 4.56 | −3.54 | −0.54 | −6.97 | 0.63 | −0.63 | 2.27 | −0.31 | −1.96 |
| *4 ($n=12$)* | 10.1 | 4.17 | *2.56* | 0.06 | *−0.86* | −5.92 | 0.58 | −0.58 | *4.58* | −1.98 | −2.6 |
| 5 ($n=1$) | 10.49 | 4.10 | 0.40 | −3.85 | 6.15 | −6.80 | 0.97 | −0.97 | 1.53 | 0.19 | −1.72 |
| Expert Ranking | 10.59 | 5.61 | 3.03 | 0.03 | −2.47 | −6.21 | 1.64 | −1.64 | 3.01 | −1.26 | −1.75 |

Abbreviation: WISCI II, walking index for spinal cord injury II.
Values in italics represent the differences between clusters 1 and 4 for devices (one cane and walker) and no assistance (0 persons). Expert ranking refers to the original ranking of the WISCI[1,2] by clinical scientists. Estimated ranks for a particular picture can be calculated by summing the intercept and the part worth utilities for features of that picture.

illustrates WISCI II level 12 (crutches 2/brace/no assist) the relative preference is 14.16 (10.10 + 0.06 + (−0.58) + 4.58). The change in the one feature from assistance of one person to no assistance for this set of features increases the relative preference from 7.60 to 14.16 within cluster 4. The calculation for the same photos for cluster 1 shows an increase of relative preference for the photo depicting WISCI II level 7 (crutches 2/brace/assist) from 9.63 (10.47 + 0.03 + (−0.71) + (−0.16)) to 11.98 (10.47 + 0.03 + (−0.71) + 2.19) for the photo depicting WISCI II level 12 (crutches 2/brace/no assist). The range of relative preference for cluster 4 of 6.56 (14.16–7.60) is greater than for cluster 1, which is 2.35 (11.98–9.63), for the same set of features for a specific photo. This range disparity is the same when manipulating only the feature 'no person assist and one person assistance' for all levels that include 1 or 0 persons.

*Example 2*: Comparison within and between clusters 4 and 1 for the photo depicting WISCI II level 8 (walker/no brace/assist 1) versus the photo depicting WISCI II level 17 (no device/no brace/assist 1).

For cluster 4, the photo that depicts WISCI II level 8 (walker/no brace/assist 1) has a relative preference of 7.84 (10.10 + (−0.86) + 0.58 + (−1.98)). For the photo that illustrates WISCI II level 17 (no device/no brace/assist 1), the relative preference is 12.87 (10.10 + 4.17 + 0.58 + (−1.98)). This change in one feature from use of a walker to no device for this set of features increases the relative preference from 7.84 to 12.87 within cluster 4. The calculation for the same photos for cluster 1 shows an increase of relative preference for the photo depicting WISCI II level 8 (walker/no brace/assist 1) from 7.16 (10.47 + (−3.86) + 0.71 + (−0.16)) to 17.54 (10.47 + 6.52 + 0.71 + (−0.16)) for the photo depicting WISCI II level 17 (no device/no brace/assist 1). The range of relative preference for cluster 1 of 10.38 (17.54–7.16) is greater than for cluster 4 of 5.03 (12.87–7.84) for the same set of features for a specific photo.

**Table 4** Rank order of pictures for clusters 1 and 4 compared with expert ranking

| | *Physical assistance* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Expert ranking | 20 | 19 | 18 | 17 | 16 | 15 | 14 | | 12 | 11 | 10 | | 8 |
| Cluster 1 | 20 | 18 | 17 | 19 | 15 | 14 | 10 | 16 | 12 | 11 | 7 | | |
| Cluster 4 | 20 | 18 | 19 | 15 | 16 | | 12 | 9 | 17 | 14 | 10 | 11 | 5 |

Abbreviation: WISCI II, walking index for spinal cord injury II.
The shading is used to illustrate how cluster 1 and 4 differed from each other and the experts in ranking the WISCI II levels requiring physical assistance. Cluster 1 shifts levels up and cluster 4 shifts levels down compared with expert ranking. Expert Ranking refers to the original ranking of the WISCI[1,2] by clinical scientists.

*Feature comparison*. The weight given to each specific feature (devices/braces/persons) can also be compared within clusters and between clusters by looking at the PWU.

*Example 1*: For cluster 1, the weight of the preference for no devices is 6.52 compared with the most negatively weighted device, parallel bars, which is −6.73 for a range of 13.25 (6.52–(−6.73)). This is a comparison within a cluster. Cluster 1, however, is more negative regarding use of a walker (−3.86) than cluster 4 (−0.86). This is a comparison between clusters.

Table 4 shows a comparison of predicted rankings based on PWU for clusters compared with expert ranking. The two largest clusters, cluster 1 ($N=20$) and cluster 4 ($N=12$), show a difference of six ranks for level 17 (18–12; no device/no brace/assist 1) and level 13 (9–15; walker/no brace/no assist). This disparity of ranks is similar in range seen above for level 17 (no device/no brace/assist 1) and 13 (walker/no brace/no assist) in the quartile analysis. Level 17 (walking with assistance) is shifted six ranks lower by cluster 4, whereas level 13 (walking independently with a walker) is shifted six ranks higher.

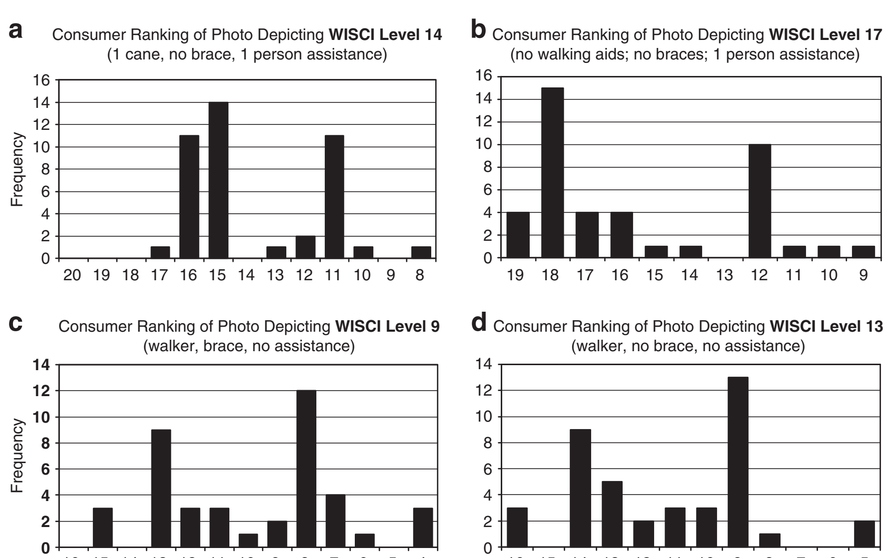



**Figure 2** (**a**–**d**) Graphic analysis of the consumer ranking of WISCI levels 14 and 17 and levels 9 and 13 among the 20 WISCI II levels.

*Bar graph analysis*
The bar graph analysis (Figures 2a–d) illustrates the bimodal distribution of consumer preference when the photo depicting WISCI II level 17 (no device/no brace/assist 1) and WISCI II level 14 (cane 1/no brace/assist 1) are ranked among the photos that depict the levels of the original WISCI scale ranked by clinical experts (2000). For the photo depicting WISCI II level 17 (no device/no brace/assist 1), 28 of 42 (67%) consumers ranked this photo within two ranks to the original ranking of WISCI II level 17 by the clinical experts (2000). In all, 14 out of 22 (33%) shifted the rank of this photo by an average of five ranks lower than the clinical scientists. For the photo depicting WISCI II level 14 (cane1/no brace/assist 1), 22 (61%) of consumers shifted it one to three ranks higher and 16 (38%) of consumers shifted it lower than the clinical scientists.

The bar graph analysis (Figures 2a and d) illustrates the bimodal distribution of consumer preference when the photo depicting WISCI II level 9 (walker/brace/no assist) and WISCI level 13 (walker/no brace/no assist) are ranked among the photos that depict the levels of the original WISCI scale ranked by clinical experts (2000). Again, the bimodal distribution is clearly illustrated.

## Discussion

The hypothesis that consumers would rank those WISCI levels requiring physical assistance lower than those levels not requiring physical assistance was not supported in this study. This finding was unexpected because typically the goal of rehabilitation as set by rehabilitation professionals is to achieve the highest level of independent walking at the time of discharge using performance measures, such as the FIM[6] and SCIM, which emphasize lack of physical assistance in differentiating levels of walking.[7] It had been expected that consumer preference for walking function would more likely conform to clinicians' goals, but not to clinical ranking of the scientists.

Consumer preference for the photos depicting the WISCI II levels showed little disparity for most of the levels (0–6, 8, 12, 15, 16, 18–20; Table 2). However, the consumer preference illustrated by quartile, conjoint and graphic analysis was bimodal for certain levels. They showed a difference of interquartile range of five to six levels (Table 2) for photos depicting levels 17 (no device/no brace/assist 1), 14 (cane 1/no brace/assist 1), 13 (walker/no brace/no assist) and 9 (walker/brace/no assist). Photos depicting levels 17 and 14 illustrate walking with one person assistance, which is one area of disparity and levels 13 and 9 illustrate walking with a walker and no physical assistance, the second area of disparity (Table 2). Conjoint analysis by part worth utilities helps to identify the two groups of consumers (clusters 1 and 4) that differ and a method to quantify their relative preferences. The larger group of consumers, cluster 1 ($N=20$) shows a relative preference to cluster 4 ($N=12$) for photos depicting all levels of walking with assistance regardless of devices (Table 3). These two clusters also differ in regard to use of walkers with cluster 1 showing a far more negative preference of a walker (−3.86) compared with cluster 4 (−0.86). This disparity of preference (range of 4–6 levels) between cluster 1 and 4 is also shown in photos depicting walking with assistance (levels 17, 14 and 7) and those that use a walker (levels 13 and 9; Table 4). Finally, graphic analysis (Figures 2a and d) of ranking by consumer preference for several photos depicting walking with assistance (levels 17 and 14) and use of a walker (levels 13 and 9) further illustrates the bimodal distribution. This disparity of consumer preference for walking with assistance and use of a walker warrants further consideration for examining the benefit gained by an intervention based on consumer preference alone.

Although the ranking of level 17 (no device/no brace/assist 1) by the majority of consumers in all three analyses was similar to the clinical scientists' original ranking of this WISCI level,[1,2] this was probably based on a different rationale than ordering the levels from most to least impairment (weakness in the legs). Those consumers (cluster 1) who expressed a relative preference for physical assistance over equipment in ranking the desirability of walking levels also ranked level 13 (walker/no brace/no assist) as much as five to six ranks lower than the clinical scientists original ranking based on inter quartile ranges and cluster analysis. Obviously the larger cluster ($N=20$) preferred the assistance of one person over the use of a walking device independently.

What may be the explanation for these differences in preference by consumers? Age, severity of impairment, and/or WISCI level may have played a role, but the sample was too small for analysis of such factors. The majority of subjects were ASIA D with an average WISCI level of 15, which is typical of chronic subjects who are ambulatory.[20,22,23] We did not inquire as to the number of persons living at home or other environmental factors that could have influenced the availability of personal assistance. This might have shown a relationship with preference for walking with physical assistance, and this question needs to be examined in the future using structured interviews or other methods. Some researchers have reported that consumers' expression of preference for walking with physical assistance compared with independent walking varies based on country of origin[24] or more efficient planning of daily activities.[25] Independence in dressing in consumers with tetraplegia achieved in a rehabilitation environment may be replaced by assistance of others for greater time efficiency.[26] The rejection of assistive devices by consumers, when use of a device may permit a higher level of function, may be based on multiple factors of age, fear of the use of a defective device or cosmetic concerns.[27] Thus, the preference for use of assistance/devices by consumers may differ from the performance scales used by clinicians to rank improvement in rehabilitation settings, because of the complex network of issues surrounding walking.[14,28]

Stineman *et al.*[29] reported that rehabilitation clinicians may rank recovery preference pathways (developed by recovery preference exploration) for physical independence activities different than do consumers for rehabilitation outcomes. In examining specifically preferences for walking recovery in SCI, we found that acute rehabilitation professionals differed from consumers and from professionals in other phases of rehabilitation. The difference expressed by acute rehabilitation professionals was based on reimbursement pressure to discharge patients home, reflecting a cultural influence in the United States of America.[30] Cultural influence of differences for preference for walking recovery in SCI were also seen between North Americans (Canada/USA) and Europeans (Italy).[31] In addition to cultural influences, clinicians may view the pattern of recovery from a disability based more on objective reasoning rather than from a subjective or consumer perspective.[32,33]

As the determination of significant improvement in an outcome measure by patients is central to Jaeschke's[34] definition of the MCID, it seems prudent to examine potential differences in ranking by consumers, clinical scientists and clinicians. Although the MCID is defined as 'the smallest difference in score… which patients perceive as beneficial', there is a wide variation in methods used to analyze meaningful difference[35] with several recent reviews and criticisms.[36–38] Most often an objective measure of function (FIM or modified Rankin) is compared with the subjective perception of significant improvement (Likert scale).[39–41]

The unexpected findings of this study, however, raise some very important issues in the design of a future study of walking function and the need to consider both consumers' and clinicians' assessment of clinically important differences. Clinicians and consumers may show agreement when a global scale such as the modified Rankin or the FIM ranks independence in all activities higher than dependence in all activities. However, the use of such a global measure for walking may present problems with sensitivity and specificity as suggested by others,[41] because of the multi-factorial nature of functional ambulation. Walking preference by consumers or ranking of improvement by clinical scientists may not show a simple dichotomy between independent and dependent to determine the MCID. When the research question involves a more precise assessment of minimal significant improvement in walking function with or without devices, clinicians, clinical scientists and consumers may differ in their opinions as to what is 'better', and by how much.

Furthermore, the perception of improvement in function certainly can be influenced by preference of independent function, but this is not always the same as performing an activity without physical assistance.[24,26] A recent report[28] suggested that subjective impressions of change in motor performance such as walking function by patients and clinicians may be more sensitive in reflecting treatment effectiveness in clinical trials than objective measures. This suggests that subjective measures of preference/perception may need to be integrated with objective measures in a clinical trial.

Finally, walking aids and devices for patients recovering from SCI may include different walkers, bilateral crutches and braces,[3] and likely differ from the aids used by patients recovering from a stroke who require at most a unilateral walking device and/or a brace.[42] As a result, walking measures that assess only speed, as used in stroke studies,[41] and do not consider devices, may not apply to SCI. As the use of different devices may change the speed of walking for persons with the same severity of impairment following a SCI,[43,44] this variation of speed with the use of different devices should be considered in the design of a trial, which examines speed, devices and minimal significant improvement.

The sample size of this study is a limitation. Also, one criticism[45] of the WISCI II scale is that levels such as 17 (no device/no brace/assist 1) and 14 (cane 1/no brace/assist 1) plus others are rarely used, which might raise the issue of relevancy in our study. This opinion was based on a retrospective study[11] and 981 subjects[45] in which progression of self-selected (SS) to maximum WISCI was not possible[11] or not clearly indicated.[45] When the maximum WISCI test is properly assessed[20,22,23] in chronic subjects or those discharged from the hospital, the progression from SS to maximum may increase three to six levels and this requires testing the continuum of levels each step at a time. If the WISCI II levels are determined correctly by progressing patients from SS to maximal (maximun) levels, levels 14 and 17 are used quite frequently (80%) either at SS, through the progression or at maximum.[20]

Across the three different countries/cultures, we found consistent findings of consumer preference for walking with human assistance and this warrants further consideration. The question posed to consumers differed from the one posed to clinicians in the development of the WISCI scale. The clinical scientists were asked to rank levels to reflect impairment that is the 'objective' view. Consumers were asked to rank the same levels in terms of preference. That is the subjective view. Both are important, and need to be taken into account when the WISCII is used as an outcome measure in trials, or rehab outcomes. Capacity for walking may be the better construct to assess MCID for impairment than the preference for walking, because a higher maximum WISCI level gives more options to the patients as they could presumably walk at all lower levels as well.[43] A future study will need to use a more adequate sample size and compare consumer, clinician and clinical scientists' assessments of significant improvement.

## Conclusion

Consumers with chronic SCI, who were all ambulatory, showed a preference for walking with human assistance over walking independently with devices. This result was unexpected. Because consumer preferences may differ from clinical scientists' and clinicians' rankings, consideration of these differences is essential in the design of a study examining MCID of locomotion in persons with SCI.

## Conflict of interest

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