Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Patient–Clinician Agreement on Safe Ambulation After Incomplete Spinal Cord Injury and Its Association with Falls and Functional Outcomes

Meriç Şipal

mericselim@hotmail.com

Yozgat Bozok University https://orcid.org/0000-0002-5500-0206

Sinem YILDIRIM

Ankara City Hospital

Zuhal Yiğit

Ankara Physical Medicine and Rehabilitation Training and Research Hospital

Elif Yalcin

Ankara Physical Medicine Rehabilitation Training and Research Hospital

Article

Keywords: Spinal Cord Injuries, Walking, Rehabilitation, Self Report, Perception

Posted Date: May 18th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9327618/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: There is no duality of interest

Abstract

Study Design: Cross-sectional observational study.

Objectives: To examine associations among observed walking status, patient-perceived and clinician-recommended safe ambulation, clinical outcomes, and self-reported falls after incomplete spinal cord injury (iSCI).

Setting: Physical Medicine and Rehabilitation Center, XXX Hospital, XXX, XXX.

Methods: Adults aged ≥18 years with iSCI at neurological level T3 or below and American Spinal Injury Association Impairment Scale grade C or D were included. Walking status was assessed using the Walking Index for Spinal Cord Injury II (WISCI II). Patient-perceived safe ambulation (P13) and clinician-recommended safe ambulation (T5) were recorded using WISCI II-anchored items. Additional outcomes were lower extremity motor score, gait speed, Timed Up and Go, Berg Balance Scale, Spinal Cord Independence Measure III, and selected patient-reported measures. Falls were recorded. The Ambulation Safety Gap (ASG) was defined as WISCI II-Observed minus T5. Correlation analyses were performed.

Results: Of 50 screened individuals, 43 were included (mean age 43.6 ± 13.5 years; 21 women). WISCI II-Observed showed a moderate association with lower extremity motor score and strong associations with gait speed, balance, and functional independence, with an inverse association with functional mobility (all $p < 0.001$). P13 and T5 were strongly associated with WISCI II-Observed (both $p < 0.001$). ASG was not associated with falls ($r = 0.047$, $p = 0.767$).

Conclusions: Observed walking status was associated with mobility and functional independence after iSCI. Patient-perceived and clinician-recommended safe ambulation were also strongly associated with observed walking status. ASG showed limited variability and was not associated with falls.

Sponsorship: None

INTRODUCTION

Balance is maintaining the body's center of mass within the base of support via postural control for stability and orientation with respect to gravity (1). Balance is commonly classified as static (fixed surface) or dynamic (during movement or on an unstable base of support) (2).

In individuals with incomplete spinal cord injury (iSCI), falls are prevalent and most often occur during walking or postural transitions in daily-life settings, with loss of balance commonly reported as a contributing factor (3). The role of balance becomes salient when ambulation relies on assistive devices or orthoses. Many activities impose dynamic balance demands that may approach or exceed an individual's functional capacity. However, these demands may not correspond to the support provided by a device: equipment sufficient for static stability or short-distance, controlled ambulation (e.g., within parallel bars) may be assumed adequate for demanding activities such as overground walking, turning,

or stair negotiation. Conversely, psychological and social influences (e.g., maintaining a “normal” identity) may lead ambulatory individuals with iSCI to accept fall risk and choose less-stable orthoses or walking aids despite safety concerns (4). In such situations, a strong desire to walk may increase exposure to falls and fall-related injuries, which can reduce mobility/participation and, in some cases, require medical care or hospital readmission (3–5).

Despite its clinical relevance, it remains insufficiently clear to what extent patient-perceived functional walking level and recovery expectations align with clinician-defined safe ambulation, and how these perceptions relate to observed walking performance and fall risk in iSCI (6). Therefore, the primary aim of this cross-sectional observational study was to compare patient-perceived functional level and recovery expectations with the clinician perspective (physiatrist or physiotherapist), to examine their correspondence with observed/actual walking status, and to investigate their associations with walking parameters and self-reported falls.

METHODS

Study type and participants

This single-center, cross-sectional observational study examined observed walking status, patient-perceived safe ambulation, clinician-recommended safe ambulation, and their associations with clinical outcomes in adults with iSCI. The study was conducted between February 2023 and February 2025 at the specialized SCI XXXX (XXXX), where individuals in the chronic phase are routinely admitted for clinical monitoring. The study is reported in accordance with the STROBE statement for cross-sectional studies. Participants were recruited consecutively from eligible admissions during the study period.

All participants provided written informed consent prior to participation. The study was approved by the local Ethics Committee of XXXX (approval number: XXXX) and was registered at ClinicalTrials.gov (XXXX). The study was conducted in accordance with the Declaration of Helsinki (2013 revision).

Adults (≥18 years) with iSCI at neurological level T3 or below were eligible. Participants were required to have an American Spinal Injury Association Impairment Scale (AIS) grade of C or D. ICD-10 codes used for eligibility screening were S24.72–S24.77 (T3–T12) and S34.70–S34.77. Participants with communication impairments that precluded obtaining reliable self-reported information were excluded.

Evaluations

Diagnostic assessments and AIS grading were performed by physiatrists, while functional evaluations were conducted by physical therapists experienced in spinal cord injury rehabilitation. Demographic data (age, sex, body mass index [BMI], and time since injury) were recorded together with all study outcomes. Participants were evaluated using their usual assistive devices and support equipment as needed.

Primary outcome measure

Walking status was evaluated using the Walking Index for Spinal Cord Injury II (WISCI II), which grades 10-meter ambulation (0–20) based on the amount of physical assistance, braces, and walking aids required (7). In this study, WISCI II was operationalized in three complementary forms: (i) WISCI II–Observed, reflecting the walking level the participant typically performs under routine conditions using their usual devices; (ii) WISCI II–Clinician Safe (T5), reflecting the clinician-recommended WISCI II level considered appropriate for safe daily ambulation; and (iii) WISCI II–Patient Safe (P13), reflecting the participant's own judgment of a safe walking level.

To quantify a potentially safety-relevant mismatch between performed ambulation and a clinician-defined safety boundary, we calculated the Ambulation Safety Gap (ASG) for each participant as ASG = WISCI II–Observed − WISCI II–Clinician Safe (T5). With this definition, a positive ASG indicates that the participant's routine/performed ambulation exceeded the clinician-recommended safe level, whereas ASG = 0 indicates alignment between performed and recommended safe ambulation.

Secondary outcome measures

Muscle strength was assessed using the AIS lower extremity motor score (LEMS), scored bilaterally across L2–S1 on a 0–5 scale (total 0–50). Walking performance was evaluated using time-based measures, including the Ten-Meter Walking Test (10MWT) and the Timed Up and Go (TUG) Test.

In the 10MWT, participants started walking 3 meters before and continued 3 meters after the 10-meter track to eliminate acceleration and deceleration, maintaining a self-selected speed. Overground gait speed (m/s) was derived from the 10MWT by dividing the 10-meter distance by the recorded time, and was calculated accordingly. Additionally, participants whose overground gait speed met or exceeded the 0.44 m/s threshold—an indicator of readiness for community ambulation—were identified and reported (8).

TUG was used to assess functional mobility. Participants stood up from a chair, walked 3 meters at a self-selected safe speed, turned, returned, and sat down, using their usual assistive device if needed. Total time was recorded in seconds.

The Turkish version of the Berg Balance Scale (BBS) was utilized for balance assessment (9). BBS measures both dynamic and static balance. A score of 0-4 was assigned for each activity, with the highest possible total score being 56 (9, 10). Additionally, participants who had a score of more than 47 points (an indicator of readiness for community walking without aids) were reported (11).

The Turkish version of the Spinal Cord Independence Measure III (SCIM III) was employed to assess functionality and independence (12). This scale is scored in 3 subscales, Self Care (0–20), Respiration and Sphincter Management (0–40), and Mobility (0–40), with a maximum of 100 points (13).

The Quebec User Evaluation of Satisfaction with Assistive Technology 2.0 (QUEST 2.0) comprises 12 items rated on a 5-point Likert-type scale (1 = not satisfied at all, 5 = very satisfied). It is divided into eight

assistive device items and four service items (14). In this study, only the assistive device subscale of the validated Turkish version was used (15).

The Readiness for Hospital Discharge Scale/Short Form (RHDS/SF) assesses patient–perceived readiness for hospital discharge and their ability to manage care needs at home using an 8-item, 0–10 scale (16). The validated Turkish version was used in this study (17).

The Acceptance and Action Questionnaire–II (AAQ-II) comprises seven statements representing various facets of experiential avoidance (e.g., "I am afraid of my feelings," "Emotions cause problems in my life"). Respondents rate each statement from 1 (never true) to 7 (always true); higher scores indicate greater psychological inflexibility (total 7–49) (18). For the study, the Turkish validated version of the scale was employed (19).

The Spinal Cord Lesion–Related Coping Strategies Questionnaire (SCL-CSQ) is a self-report measure for individuals with spinal cord injury/lesion that assesses coping across three domains—Acceptance, Social Reliance, and Fighting Spirit—using 12 items. Items are rated on a 4-point scale and summarized as domain and overall means (20). The Turkish version of the SCL-CSQ was used in this study (21).

Additionally, the World Health Organization Quality of Life–BREF (WHOQOL-BREF), which evaluates physical, psychological, social, and environmental well-being, comprises 26 items rated on a 5-point Likert scale (22). The Turkish version used in this study included a national 27th item, which was excluded from scoring (23).

Patient- and clinician–perceived items

In addition to the standardized outcome measures, study-specific patient- and clinician-reported items were collected using a visual analog scale (VAS) or self-reported event counts (Appendix 1). For each VAS item, participants marked their response on an unmarked 10-cm horizontal line anchored by "very little" on the left and "very much" on the right. Patient items captured perceived status and orthosis/assistive device-related experiences, whereas clinician items reflected the clinician's view of the patient's current condition. Falls and near-falls in therapy and non-therapy settings over the past year were recorded as self-reported counts. These items were used to provide complementary clinical context and were analyzed as exploratory variables.

Statistical Analyses

Normality was assessed using the Shapiro-Wilk test. Continuous variables are presented as mean ± standard deviation or median (interquartile range), as appropriate.

Correlation analyses were performed using Pearson's correlation coefficient for approximately normally distributed continuous variables and Spearman's rank correlation coefficient for non-normally distributed, ordinal, or count-based variables. Correlation strength was interpreted as weak ($0.10 \leq |r| < 0.30$), low-moderate ($0.30 \leq |r| < 0.40$), moderate ($0.40 \leq |r| < 0.60$), moderate-strong ($0.60 \leq |r| < 0.70$),

strong (0.70 ≤ |r| < 0.90), and very strong (|r| ≥ 0.90). Statistical significance was set at α = 0.05 (two-tailed), and all analyses were conducted using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA).

Primary analyses examined associations of WISCI II-Observed with core mobility and functional outcomes, P13, and T5, and of ASG with therapy-setting falls (P16). Additional correlations were exploratory.

RESULTS

Fifty individuals were screened and 43 were enrolled; seven declined participation due to the intensity of their ongoing rehabilitation program (n=7). Participant demographics and injury characteristics are presented in Table 1. Baseline clinical and patient-reported outcomes are summarized in Table 2; overall, participants demonstrated slow overground gait speed (0.31 ± 0.25 m/s), prolonged functional mobility times (TUG: 67.73 ± 61.69 s), and low balance scores (BBS: 17.54 ± 16.74).

Walking status (WISCI II) (primary)

WISCI II–Observed showed a moderate association with lower-extremity strength (LEMS; r=0.570, p<0.001) and strong associations with overground gait speed (r=0.770, p<0.001), balance (BBS; r=0.770, p<0.001), and functional independence (SCIM III total; r=0.735, p<0.001). It was also moderately–strongly related to SCIM III Mobility (r=0.664, p<0.001) and inversely related to functional mobility (TUG; r=−0.693, p<0.001). In contrast, WISCI II–Observed was not significantly associated with HRQoL (WHOQOL-BREF) or psychosocial measures (QUEST 2.0, RHDS/SF, AAQ-II, SCLCSQ) (all p>0.05) (Table 3).

Perceived safe ambulation levels were highly consistent with observed walking status. WISCI II–Patient Safe (P13) showed a very strong correlation with WISCI II–Observed (r=0.942, p<0.001), whereas WISCI II–Clinician Safe (T5) showed a strong correlation (r=0.801, p<0.001). Planned post-discharge indoor (P14) and outdoor (P15) ambulation levels also correlated strongly with WISCI II–Observed (r=0.919 and r=0.748, respectively; both p<0.001).

Ambulation Safety Gap (ASG)

ASG was defined as the discrepancy between performed ambulation and the clinician-recommended safe ambulation boundary (ASG = WISCI II–Observed − T5). ASG had a median of 0.0 (IQR 0.0–0.0) and was not significantly associated with self-reported falls in therapy settings over the past year (P16) (Spearman r=0.047, p=0.767).

Strength, timed mobility, balance, and functional independence

LEMS showed moderate relationships with gait speed (r=0.482, p=0.001) and TUG (r=−0.488, p=0.001), and a strong relationship with balance (BBS; r=0.721, p<0.001) (Table 3). Overground gait speed and TUG

were very strongly inversely correlated (r=−0.964, p<0.001), and both measures showed strong relationships with balance and functional independence (Table 3). At the time of assessment, 12 participants (27.9%) met or exceeded the gait-speed threshold of 0.44 m/s, and four (9.3%) exceeded the BBS threshold (>47).

HRQoL and other patient-reported outcomes

WHOQOL-BREF total score correlated strongly with the Physical Health domain (r=0.832, p<0.001) and showed moderate associations with psychological inflexibility (AAQ-II; inverse) and coping (SCLCSQ), with smaller associations with discharge readiness (RHDS/SF) (Table 3). QUEST 2.0 showed small-to-moderate associations with Physical Health and SCIM III total score, and a moderate association with RHDS/SF, but no significant relationships with observed walking status or balance outcomes (Table 3). AAQ-II and SCLCSQ were not significantly associated with objective mobility measures (Table 3).

Patient- and clinician-perceived items

Among patient-perceived items, upright activity and aid-use items (P8–P10) aligned with observed walking status and objective mobility/balance in expected directions (Table 3). Fall-related items showed coherent relationships across contexts and event types: therapy falls (P16) correlated with outside-therapy falls (P17) and near-falls in therapy (P18), and outside-therapy falls (P17) correlated with outside-therapy near-falls (P19). Notably, outside-therapy near-falls (P19) were moderately associated with WISCI II–Observed and LEMS (Table 3).

Among clinician-perceived items, T3 showed a low–moderate association with LEMS, whereas its correlations with SCIM III Mobility and BBS did not reach significance (Table 3). Clinician recommendations for post-discharge indoor and outdoor ambulation (T6 and T7) were strongly related to observed walking status and objective mobility and balance (Table 3).

DISCUSSION

This cross-sectional observational study examined the relationships among walking status, mobility, functional independence, and HRQoL in individuals with iSCI. Observed walking status showed clinically coherent links with core mobility constructs—particularly gait speed, balance, and functional mobility—whereas patient-perceived health and psychosocial adjustment did not necessarily parallel objective walking performance. At the time of assessment, participants generally showed slow overground gait speed, prolonged functional mobility times, and low balance scores, suggesting performance below levels commonly associated with confident community ambulation.

Walking status was assessed using the WISCI II to capture participants' usual walking performance. For interpretability, WISCI II was considered in three complementary forms: (i) WISCI II–Observed, reflecting the walking level typically demonstrated; (ii) clinician-recommended safe WISCI II (T5), representing the level the clinician judged appropriate for safe ambulation; and (iii) patient-perceived safe WISCI II (P13),

representing the patient's own judgment of safe walking. This approach separates what is performed from what is recommended and what is perceived as safe, thereby allowing potential safety-relevant mismatches to be identified. In this sample, patient-perceived safe ambulation closely matched observed walking status, whereas clinician recommendations tended to be more conservative; similarly, planned indoor ambulation tracked observed status more closely than planned outdoor ambulation, consistent with the higher demands of outdoor walking. When WISCI II–Observed exceeds T5, this may indicate ambulation beyond a clinician-defined safety boundary and warrants evaluation in relation to fall-related outcomes.

A distinctive contribution of this study was the inclusion of perceived safe ambulation levels alongside WISCI II–Observed. Patient-perceived safe WISCI II (P13) closely matched WISCI II–Observed, whereas clinician-recommended safe WISCI II (T5) was also strongly related but generally more conservative. A similar gradient was observed in post-discharge plans: planned indoor ambulation (P14) tracked WISCI II–Observed more closely than planned outdoor ambulation (P15), consistent with the greater complexity and unpredictability of outdoor walking. Importantly, when WISCI II–Observed exceeds the clinician-recommended safe level (T5), this may indicate ambulation beyond a clinician-defined safety boundary in daily life and warrants evaluation in relation to fall-related outcomes.

In this sample, WISCI II–Observed correlated moderately with lower extremity muscle strength (LEMS) and strongly with overground gait speed (10MWT), balance (BBS), and functional independence (SCIM III), while showing a moderate–strong inverse association with functional mobility (TUG). Gait speed and TUG were very strongly inversely related, supporting a shared mobility construct; however, TUG additionally captures transitions and turning central to everyday mobility. Given the strong associations among WISCI II–Observed, 10MWT, TUG, and BBS, these measures should be interpreted together rather than in isolation (10, 24-27). Although BBS was closely tied to walking status and timed mobility, only a small proportion of participants exceeded commonly used thresholds (gait speed ≥0.44 m/s in 27.9%; BBS >47 in 9.3%), suggesting that most remained below levels typically associated with confident, adaptable community ambulation. These findings align with the view that upright postural control and dynamic weight shifting during stepping are central determinants of functional ambulation after SCI (28).

Lower extremity strength was associated with mobility performance, but the overall pattern suggests that strength represents one component within a broader functional profile. LEMS related to gait speed and TUG and showed a strong association with balance, consistent with the integrated demands of stance control and dynamic stability. At the same time, the lack of consistent relationships with broader patient-reported outcomes underscores that gains in physical capacity may not automatically translate into perceived health or psychosocial adjustment.

Beyond performance metrics, these findings reflect a recurrent clinical dilemma: when continued intensive rehabilitation remains beneficial versus when it risks becoming prolonged and misaligned with real-life priorities. Intensive rehabilitation may continue beyond a point of diminishing returns due to well-

intentioned persistence by both patients and caregivers, increasing resource use and associated costs for payers (29). This highlights the need for an explicit, shared decision process that includes the multidisciplinary team and—most importantly—the patient, and for interval-based monitoring when further gains plateau. Without such an aligned process, some individuals may seek care across multiple institutions, repeatedly entering similar rehabilitation cycles and delaying long-term goals such as participation in life roles and community living.

From this perspective, it is useful to distinguish a patient's therapeutic ambulation level (achievable within structured therapy) from the safe functional ambulation level that can be sustained in daily life. The gap between these levels should be made explicit, and atypical patterns (e.g., routinely performing above a clinician-defined safety boundary) should prompt closer review. This distinction is clinically important because functional ambulation capacity (e.g., gait speed) is closely linked to independent community ambulation in individuals with SCI (30).

Although ASG was not associated with therapy-setting falls in this study, this finding should be interpreted cautiously because falls were self-reported and limited to therapy settings. Future studies should evaluate ASG using prospective, objective fall monitoring across contexts and should consider that WISCI II primarily reflects short-distance ambulation; therefore, it is important to assess whether the assistive device use implied by a given WISCI level is maintained during longer-distance walking and real-world mobility demands.

These considerations also highlight why mobility assessment should not rely on a single measure. WISCI II and similar tools primarily assess short, structured walking tasks; complementary measures are needed to capture broader real-life mobility demands. In this context, SCIM III—especially its mobility subscale—adds value by reflecting longer-distance mobility. Changes in walking independence may also influence the overall SCIM III score because certain self-care tasks (e.g., maintaining balance during toileting) are closely linked to mobility capacity (31).

Mobility and functional independence are critical for supporting patients' autonomy and social participation after SCI (32). In our data, functional independence (SCIM III total and SCIM Mobility) tracked closely with walking status and timed mobility, supporting the practical value of combining performance-based walking measures with activity-level outcomes. The moderate association between SCIM III total score and RHDS/SF suggests that perceived preparedness for discharge may be partly grounded in tangible functional ability rather than psychosocial factors alone.

HRQoL, in contrast, appeared more closely related to psychological and contextual factors than to objective walking performance. WHOQOL-BREF total score correlated strongly with its Physical Health domain and showed meaningful relationships with AAQ-II (inverse) and SCLCSQ. Associations between WHOQOL-BREF domains and RHDS/SF further suggest that perceived health status and readiness may evolve together through confidence, support, and adaptation processes not captured by gait metrics alone. Consistent with this pattern, QUEST 2.0 related to Physical Health, SCIM III total score, and RHDS/SF, suggesting that assistive technology satisfaction may reflect usability and daily-life fit even

when it does not map directly onto gait speed or balance. AAQ-II and SCLCSQ were primarily linked to HRQoL-related domains rather than objective mobility, consistent with the role of acceptance and coping in well-being.

The RNLI could have been considered; however, although RNLI has been validated in SCI (Hitzig et al.), the available Turkish version was adapted for prosthesis users (Demirdel et al.) and follows a different scoring approach than the SCI-validated format (33, 34). Because a Turkish translation aligned with the SCI-validated RNLI format and scoring was not available, RNLI was not included.

Beyond the cross-sectional findings, this study highlights the need for SCI-specific psychometric validation of commonly used measures and for establishing MDC and MCID values in iSCI populations. It also provides a practical step toward a VAS-based multidimensional framework integrating observed walking performance with perceived safety, satisfaction, and real-world consequences (e.g., falls/near-falls).

Limitations and recommendations for future studies

The cross-sectional design precludes causal inference, the sample size was modest, and time since injury was heterogeneous. Falls/near-falls were self-reported and may be subject to recall bias; moreover, the fall indicator analyzed in relation to ASG was limited to therapy-setting falls (P16), which may not fully reflect real-world exposure. Future studies should use larger, multicenter, longitudinal designs with objective/prospective fall monitoring and should evaluate whether WISCI II–implied device use is sustained during longer-distance and real-world mobility demands. Further work is also needed to establish SCI-specific psychometric properties and MDC/MCID values and to support development of a VAS-based multidimensional outcome framework.

This study showed that observed/actual WISCI II is closely related to gait speed (10MWT), functional mobility (TUG), balance (BBS), and functional independence (SCIM III) in iSCI, whereas HRQoL (WHOQOL-BREF) and several psychosocial measures were not aligned with objective walking metrics. Considering observed walking status together with clinician-recommended and patient-perceived safe ambulation may help identify safety-relevant mismatches in everyday mobility. In this sample, ASG was not significantly associated with therapy-setting falls over the past year (P16) (r_s=0.047, p=0.767). Future studies should examine these discrepancies longitudinally with prospective fall monitoring and evaluate whether assistive device requirements implied by WISCI II are maintained during longer-distance walking and real-world mobility demands.

Declarations

Acknowledgments: The authors thank all participants and clinical staff who supported data collection.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest: The authors declare no conflicts of interest.

Data Availability Statement: De-identified data are available from the corresponding author upon reasonable request.

References

1. Yu HX, Wang ZX, Liu CB, Dai P, Lan Y, Xu GQ. Effect of Cognitive Function on Balance and Posture Control after Stroke. Neural Plast. 2021;2021:6636999.
2. Zhang J, Liu J, Mi J, Liu R. Integrative neuromuscular training on static and dynamic balance in team sport athletes: a systematic review and meta-analysis. BMC Sports Science, Medicine and Rehabilitation. 2026;18(1):102.
3. Musselman KE, Arnold C, Pujol C, Lynd K, Oosman S. Falls, mobility, and physical activity after spinal cord injury: an exploratory study using photo-elicitation interviewing. Spinal Cord Ser Cases. 2018;4:39.
4. Jørgensen V, Roaldsen KS. Negotiating identity and self-image: perceptions of falls in ambulatory individuals with spinal cord injury - a qualitative study. Clin Rehabil. 2017;31(4):544–54.
5. Singh H, Shibi Rosen A, Bostick G, Kaiser A, Musselman KE. Exploring the causes and impacts of falls among ambulators with spinal cord injury using photovoice: a mixed-methods study. BMJ Open. 2020;10(8):e039763.
6. Chan K, Cheung L, Taylor C, Wong C, Inglis G, Walden K, et al. Communicating Standing and Walking Data after Spinal Cord Injury: A Patient-Engaged, Qualitative Study. Top Spinal Cord Inj Rehabil. 2023;29(Suppl):1–14.
7. Ditunno JF, Jr., Ditunno PL, Scivoletto G, Patrick M, Dijkers M, Barbeau H, et al. The Walking Index for Spinal Cord Injury (WISCI/WISCI II): nature, metric properties, use and misuse. Spinal Cord. 2013;51(5):346–55.
8. van Hedel HJ. Gait speed in relation to categories of functional ambulation after spinal cord injury. Neurorehabil Neural Repair. 2009;23(4):343–50.
9. Sahin F, Yilmaz F, Ozmaden A, Kotevolu N, Sahin T, Kuran B. Reliability and validity of the Turkish version of the Berg Balance Scale. J Geriatr Phys Ther. 2008;31(1):32–7.
10. Wirz M, Müller R, Bastiaenen C. Falls in persons with spinal cord injury: validity and reliability of the Berg Balance Scale. Neurorehabil Neural Repair. 2010;24(1):70–7.
11. Jørgensen V, Opheim A, Halvarsson A, Franzén E, Roaldsen KS. Comparison of the Berg Balance Scale and the Mini-BESTest for Assessing Balance in Ambulatory People With Spinal Cord Injury: Validation Study. Physical Therapy. 2017;97(6):677–87.
12. Unalan H, Misirlioglu TO, Erhan B, Akyuz M, Gunduz B, Irgi E, et al. Validity and reliability study of the Turkish version of Spinal Cord Independence Measure-III. Spinal Cord. 2015;53(6):455–60.
13. Itzkovich M, Gelernter I, Biering-Sorensen F, Weeks C, Laramee MT, Craven BC, et al. The Spinal Cord Independence Measure (SCIM) version III: reliability and validity in a multi-center international study.

Disabil Rehabil. 2007;29(24):1926–33.
14. Berardi A, Grieco G, Panuccio F, D'Angelo M, Auxiliadora Marquez M, Tofani M. Measuring Assistive Devices Management in Spinal Cord Injury. Measuring Spinal Cord Injury. 2021:131–46.
15. Yakut Y, Yurt Y, Yagci G, Simşek I. Turkish adaptation of the Quebec User Evaluation of Satisfaction with Assistive Technology 2.0 with Users of Prosthetics and Orthotics. J Exerc Ther Rehabil. 2021;7(3):284–95.
16. Weiss ME, Costa LL, Yakusheva O, Bobay KL. Validation of patient and nurse short forms of the Readiness for Hospital Discharge Scale and their relationship to return to the hospital. Health Serv Res. 2014;49(1):304–17.
17. Kaya S, Sain Guven G, Teleş M, Korku C, Aydan S, Kar A, et al. Validity and reliability of the Turkish version of the readiness for hospital discharge scale/short form. J Nurs Manag. 2018;26(3):295–301.
18. Bond FW, Hayes SC, Baer RA, Carpenter KM, Guenole N, Orcutt HK, et al. Preliminary psychometric properties of the Acceptance and Action Questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. Behavior therapy. 2011;42(4):676–88.
19. Yavuz F, Ulusoy S, Iskin M, Esen FB, Burhan HS, Karadere ME, et al. Turkish version of Acceptance and Action Questionnaire-II (AAQ-II): A reliability and validity analysis in clinical and non-clinical samples. Klinik Psikofarmakoloji Bülteni-Bulletin of Clinical Psychopharmacology. 2016;26(4):397–408.
20. Elfström ML, Kennedy P, Lude P, Taylor N. Condition-related coping strategies in persons with spinal cord lesion: a cross-national validation of the Spinal Cord Lesion-related Coping Strategies Questionnaire in four community samples. Spinal Cord. 2007;45(6):420–8.
21. Paker N, Bugdayci D, Kesiktas N, Sahin M, Elfström M. Reliability and validity of the Turkish version of spinal cord lesion-related coping strategies. Spinal cord. 2014;52(5):383–7.
22. The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. Psychol Med. 1998;28(3):551–8.
23. Eser E, Fidaner H, Fidaner C, Eser SY, Elbi H, Göker E. WHOQOL-100 ve WHOQOL-BREF'in psikometrik özellikleri. Psikiyatri Psikoloji Psikofarmakoloji (3P) Dergisi. 1999;7(Suppl 2):23–40.
24. van Hedel HJ, Wirz M, Dietz V. Assessing walking ability in subjects with spinal cord injury: validity and reliability of 3 walking tests. Arch Phys Med Rehabil. 2005;86(2):190–6.
25. Aguirre-Güemez AV, Pérez-Sanpablo AI, Quinzaños-Fresnedo J, Pérez-Zavala R, Barrera-Ortiz A. Walking speed is not the best outcome to evaluate the effect of robotic assisted gait training in people with motor incomplete Spinal Cord Injury: A Systematic Review with meta-analysis. J Spinal Cord Med. 2019;42(2):142–54.
26. Bolliger M, Blight AR, Field-Fote EC, Musselman K, Rossignol S, Barthélemy D, et al. Lower extremity outcome measures: considerations for clinical trials in spinal cord injury. Spinal Cord. 2018;56(7):628–42.

27. Lemay JF, Nadeau S. Standing balance assessment in ASIA D paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. Spinal Cord. 2010;48(3):245–50.
28. Yang F-A, Chen S-C, Chiu J-F, Shih Y-C, Liou T-H, Escorpizo R, et al. Body weight-supported gait training for patients with spinal cord injury: a network meta-analysis of randomised controlled trials. Scientific Reports. 2022;12(1):19262.
29. Truchon C, Fallah N, Santos A, Vachon J, Noonan VK, Cheng CL. Impact of Therapy on Recovery during Rehabilitation in Patients with Traumatic Spinal Cord Injury. J Neurotrauma. 2017;34(20):2901–9.
30. van Silfhout L, Hosman AJF, Bartels R, Edwards MJR, Abel R, Curt A, et al. Ten Meters Walking Speed in Spinal Cord-Injured Patients: Does Speed Predict Who Walks and Who Rolls? Neurorehabil Neural Repair. 2017;31(9):842–50.
31. Baunsgaard CB, Nissen UV, Brust AK, Frotzler A, Ribeill C, Kalke YB, et al. Exoskeleton gait training after spinal cord injury: An exploratory study on secondary health conditions. J Rehabil Med. 2018;50(9):806–13.
32. Lili L, Sunnerhagen KS, Rekand T, Alt Murphy M. Participation and autonomy, independence in activities of daily living and upper extremity functioning in individuals with spinal cord injury. Scientific Reports. 2024;14(1):9120.
33. Hitzig SL, Escobar EMR, Noreau L, Craven BC. Validation of the Reintegration to Normal Living Index for community-dwelling persons with chronic spinal cord injury. Archives of Physical Medicine and Rehabilitation. 2012;93(1):108–14.
34. Demi̇rdel S, Bayramlar K. Amputasyondan sonra normal yaşama yeniden katilim sürecinin yaşam kalitesi ve fonksiyonel düzey ile ilişkisinin incelenmesi. Türk Fizyoterapi ve Rehabilitasyon Dergisi/Turkish Journal of Physiotherapy and Rehabilitation. 2014;25:1–7.

Tables

Table 1 to 3 are available in the Supplementary Files section.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1.docx
- Table2.docx
- Table3.docx
- Appendix1.docx