

Assessment Tools for Balance Confidence in Individuals with Spinal Disorders: A Scoping Review

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ABSTRACT

Introduction: Spinal disorders commonly lead to impairments in balance, mobility and participation in daily activities. Beyond physical deficits, reduced balance confidence is a critical yet underassessed factor contributing to fear of falling, activity restriction and poor rehabilitation outcomes. Despite its clinical relevance, there is variability in the instruments used to evaluate balance confidence in individuals with spinal disorders.

Aim: To identify and summarise the assessment tools used to evaluate balance confidence in individuals with spinal disorders and to report their psychometric properties across different spinal conditions.

Materials and Methods: This scoping review was conducted at the Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India, using the five-stage Arksey H and O'Malley L framework and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines. A systematic search was performed in PubMed, Scopus, Physiotherapy Evidence Database (PEDro) and the Cochrane Library to identify relevant studies published between January 2015 and November 2025. Eligible studies were screened, selected and data were systematically charted and synthesised

to summarise the assessment tools and their psychometric properties.

Results: Eight studies met the eligibility criteria for inclusion, with most focusing on individuals with Spinal Cord Injury (SCI). The Activities-specific Balance Confidence (ABC) scale was the most commonly used self-reported measure and demonstrated strong reliability and validity, particularly in incomplete SCI populations. Fear of falling was primarily assessed using the Falls Efficacy Scale-International (FES-I) and Spinal Cord Injury Fall Concern Scale (SCI-FCS). Performance-based measures, including the Mini-Balance Evaluation Systems Test (Mini-BESTest), Brief-BESTest, Berg Balance Scale (BBS) and Functional Reach Test (FRT), showed favourable psychometric utility for assessing balance and fall risk. Evidence for non SCI spinal disorders was limited, highlighting a gap in the current literature.

Conclusion: Assessment of balance confidence in individuals with spinal disorders requires a multidimensional approach that integrates both self-reported and performance-based measures. The ABC Scale appears to be the most consistently supported tool for evaluating balance confidence, particularly in SCI populations. However, evidence remains limited for other spinal conditions, underscoring the need for further validation of balance confidence measures across broader spinal disorder populations.

Keywords: Fear of falling, Psychometric, Spinal cord injuries, Spinal disease, Treatment outcome

INTRODUCTION

Spinal disorders include a broad collection of diseases affecting the vertebrae, intervertebral disc, facet joints, nerve roots, muscles and spinal cord [1]. Spinal disorders, such as SCI, cervical spine disorders and other degenerative or structural disorders of the spine, are leading causes of functional impairment and reduced quality of life [2]. Spinal disorders frequently result in impairments in postural stability, gait performance and functional mobility due to disruptions in neuromuscular control, proprioceptive feedback and biomechanical alignment. Individuals with SCI and degenerative spinal conditions often demonstrate reduced balance control, impaired coordination and increased susceptibility to falls, which can significantly restrict daily activities and participation in rehabilitation programs [3,4]. In addition to objective balance deficits, altered sensory integration and motor control further compromise dynamic postural adjustments required for safe ambulation and functional independence [5].

Biomechanically, SCI can impair balance control through disturbances in proprioceptive input, central processing and neuromuscular responses, leading to compromised postural stability during standing and walking. These impairments can reduce functional mobility and increase fall risk in affected individuals [6].

Balance is a multidimensional construct that requires the integration of sensory, motor and cognitive systems. While performance-based balance assessments provide a quantification of physical balance capacity, they do not fully capture the balance ability in real-world activities [7]. Balance confidence, which refers to a person's self-perception of their ability to maintain balance and carry out activities without falling and has become an important factor influencing mobility behaviour and participation [8].

Among ambulatory individuals with Motor Incomplete Spinal Cord Injury (motor-incomplete SCI), balance confidence is closely associated with walking capacity, functional ambulation and fear of falling. Lower levels of balance confidence often lead to activity avoidance and reduced walking exposure, even in people with relatively preserved objective balance performance [9]. Spinal disorder and adult spinal deformity are associated with reduced postural stability, altered sensory integration and delayed response to disturbance, which correlate with falls and reduced daily activities of life [10]. Falls often result in injuries and are substantially more common than in healthy older adults, leading to mobility restrictions and reduced activity, identifying balance and fall risk in the spinal population as targets for both evaluation and intervention [11].

To promote neuroplasticity and functional recovery following incomplete spinal damage, modern locomotor therapy places a strong emphasis on rigorous, task-specific stepping exercises at higher cardiovascular intensities. The idea that specific practice of the walking task is crucial for locomotor outcome is supported by randomised crossover data showing that high intensity, variable task-specific stepping produces greater gain in overground and treadmill walking speeds and balance confidence than impairment-based non stepping program [12]. Backward walking training has been demonstrated to enhance BBS scores, sensory organisation test performance, gait speed, Timed Up and Go (TUG) and ABC Scale score in chronic (iSCI) when administered with partial weight support and overground practice. This suggests that backward walking training can be a challenging, balance-oriented locomotor strategy [13].

Across spinal conditions, patient-reported outcomes are central to evaluating treatment effectiveness, yet traditional instruments have focused more on pain and disability than on perceived balance and fear of falling. Given the high fall burden, the demonstrated link between balance performance, balance confidence and participation and the emerging efficacy of task-specific gait intervention, there is a clear need to better characterise and measure balance confidence as a distinct construct in people with spinal cord-related disorders [13]. A more precise understanding of balance ability, fear of falling and their correlation with objective locomotor performance is required to guide assessment and rehabilitation strategies [12].

Spinal disorders frequently result in loss of balance and mobility and can lead to a higher risk of falls, thereby limiting the person's participation in activities and reduce balance confidence. A variety of assessment instruments have been employed to assess balance confidence, fear of falling and related balance functions in this population, but the evidence is fragmented across a number of different spinal conditions and assessment instruments. A scoping review is therefore needed to identify the tools available for assessing balance confidence, fear of falling and related balance constructs, to summarise their use and identify gaps in the existing literature.

The focus of this scoping review was to identify and examine the existing literature on assessment instruments used to measure balance confidence in individuals with spinal disorders. Relevant studies were systematically identified, screened and synthesised in the present review.

MATERIALS AND METHODS

This scoping review was conducted at the Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India, using a systematic approach, from the identification of relevant articles to the analysis and reporting of the findings. The review was prospectively registered with the Open Science Framework (OSF) (Doi: 10.17605/OSF.IO/6MX8U). The review process adhered to the five-stage methodological framework proposed by Arksey H and O'Malley L [14]. Furthermore, the review was conducted and reported in accordance with the PRISMA-ScR guidelines [15] to ensure methodological transparency, consistency and adherence to established reporting standards.

Inclusion criteria:

- Studies involving individuals with spinal disorders;
- Studies assessing balance confidence, fear of falling, or related balance assessment tools;
- Observational, cohort, validation, or experimental studies;
- Full-text articles published in English.

Exclusion criteria:

- Review articles, conference abstracts, case reports, editorials and study protocols;

- Studies not involving spinal disorders
- Studies not assessing balance-related measures;
- Non English studies or articles without full-text availability.

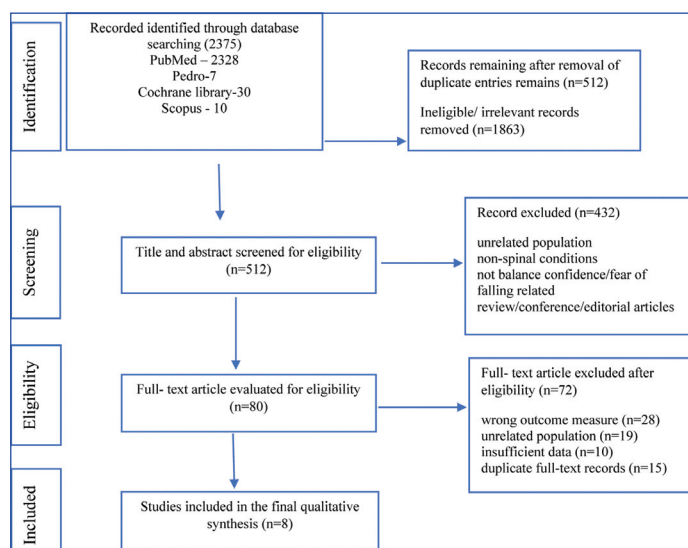
Identifying the research question: The Population, Concept, and Context (PCC) framework was used to formulate the research question [16]. The population of interest included individuals with spinal disorders, such as SCI, cervical spondylotic myelopathy, and other related spinal conditions. The concept focused on assessment tools used to evaluate balance confidence, fear of falling, and related balance constructs. The context included clinical, rehabilitation, and community-based settings where these assessment tools were applied. systematic database search was conducted on PubMed, Scopus, PEDro and the Cochrane Library for studies published from January 2015 to November 2025 [Table/Fig-1].

Databases	Keywords	Number
PubMed	("Spinal disease" OR "Spinal disorder" OR "Spinal cord injury" OR "SCI" OR "Spine tumour" OR "Spine infection" OR "Spine deformities") AND ("Balance confidence" OR "Postural control" OR "Fear of falling" OR "Fall risk" OR "Balance assessment" OR "Balance" OR "Confidence" OR "Confidence assessment" OR "Confidence in balance" OR "Balance control" OR "Postural balance")	2328
PEDro	("Balance confidence, fear of falling, ABC scale, FES-I") AND ("spinal cord injury, spinal disorder")	7
Cochrane library	"Spinal cord injury AND balance confidence"	30
Scopus	"Assessment scale AND balance confidence OR fear of fall AND Spinal disease"	10

[Table/Fig-1]: Search keywords for different databases.

Study selection: The database search across PubMed, Scopus, PEDro and the Cochrane Library yielded a total of 2375 records. Following the removal of duplicate entries, 512 studies remained and 512 were screened based on titles and abstracts; 432 records were excluded for failing to meet the inclusion criteria. Subsequently, 80 full-text articles were reviewed for eligibility and 72 articles were excluded due to irrelevance to balance confidence assessment, non spinal populations, use of non standardised outcome measures, or insufficient methodological details. Finally, eight studies met the eligibility criteria and were included in the final qualitative synthesis of this scoping review.

The primary author conducted the initial screening of titles and abstracts identified through the database search, while full-text eligibility assessment was independently performed by two authors. A visual depiction of the flow of studies from the review process has been created using the PRISMA flow diagram [Table/Fig-2].



[Table/Fig-2]: PRISMA flowchart for identification and selection of article.

Charting the data: Data were charted using a standardised extraction form developed in line with the review objectives. Extracted information included author and year of publication, study design, participant characteristics, type of spinal disorder, balance confidence assessment tools used, reported psychometric properties and key findings. Following data extraction, the compiled tables were reviewed by the authors to ensure accuracy and consistency.

Compiling, summarising and presenting the results: An analytical framework was created during this stage in order to fully understand the content of current literature. The qualitative analysis is organised in a table, followed by a qualitative synthesis of the findings.

RESULTS

A total of 2375 records were identified through database searching. After removal of duplicate and ineligible records, 512 studies remained for title and abstract screening. Of these, 432 records were excluded, leaving 80 full-text articles for eligibility assessment. Following full-text review, 72 articles were excluded and eight studies were included in the final review [Table/Fig-2], a variety of balance assessment tools were employed to assess balance constructs including balance confidence and fear of falling in persons with spinal disorders.

The present scoping review included a total of eight studies [Table/Fig-3] [4,5,8,17-21]. The studies included were cross-sectional

studies (n=4), prospective cohort studies (n=2), observational studies (n=1) and validation studies (n=1). Studies were mainly conducted with people with SCI, mainly incomplete and ambulatory populations and with people with cervical spondylotic myelopathy. The number of participants in the studies included varied from 15 to 83. The age of participants ranged from 18 to 88 years and there were both men and women. Most studies included here studied ambulatory or chronic incomplete SCI and the available evidence thus far has a heavy emphasis on assessing balance for SCI. Balance confidence was the most evaluated construct, mostly with the use of the ABC Scale. Other self-reported measures were the FES-I and SCI-FCS to assess fear of falling and fall-related concern. Some performance-based outcome measures that were commonly used along with self-reported measurements included the BBS, Mini-BESTest, Brief-BESTest, Timed Up and Go (TUG) and 10-Meter Walk Test (10MWT) [Table /Fig-3].

Psychometric Properties of Outcome Measures

The studies included reported good to excellent psychometric characteristics for several of the assessment tools. The ABC Scale had good test-retest reliability and validity for use in spinal populations. The Mini-BESTest, Brief-BESTest and FRT were also found to be good psychometrically useful performance-based measures for balance and fall risk prediction. Also, FES-I and SCI-FCS were determined to be useful for evaluation of fear of falling and fall-related concern in SCI population.

Authors/Year	Study Design	Spinal disorder	Population (N) age (years), Gender (F/M)	Aim	Outcomes	Results
Jorgensen V et al., [4] (2017)	Cross-sectional validation study	Ambulatory SCI	N=68 Age (55±15) years F/M-23/45	To validate and compare psychometric performances of the BBS and Mini-BESTest in individuals with chronic SCI.	BBS, 10MWT, FES-I, LEMS	Fear of falling was prevalent in ambulatory individual with SCI and was significantly associated with previous fall and reduced activity participation. Cronbach's $\alpha=0.96$. OR=1.07 (95% CI 1.00-1.14); injurious falls OR=1.07 (95% CI 1.00-1.15)
Chiu AY and Pang MY [5] (2017)	Cross-sectional	Cervical spondylotic myelopathy	N=72 Age (63.9±10.9) years F/M - 28/44	To examine psychometric properties of balance performance	ABC scale, BBS scale, mini-BESTest	The balance and confidence performance measures showed acceptable reliability and validity. Test-retest reliability: ICC=0.85; Internal consistency: Cronbach's $\alpha=0.94$.
Shah G et al., [8] (2017)	Cross-sectional study	Incomplete Spinal Cord Injury (SCI)	N=26 Age (59.7+18.9) years F/M - 6/20	To assess the reliability and validity of the ABC scale in individuals with incomplete SCI	ABC, Mini-BESTest, 10MWT, MMT	The ABC is trustworthy tool to measure balance confidence in people with chronic iSCI. ICC=0.93, Convergent validity: $\rho=0.60-0.80$; Discriminative validity: AUC=0.95
Morooka Y et al., (2025) [17]	Prospective cohort study	Incomplete cervical Spinal Cord Injury (SCI)	N=50 Age (68.3±13.4) years (Mean) F/M- 13/37	To determine responsiveness and minimal important change of Mini-BESTest and Brief-BESTest	Mini-BESTest, Brief-BESTest, BBS, GRC	Mini-BESTest and Brief-BESTest demonstrated moderate responsiveness in detecting balance changes, with MIC values of 3.7 and 2.2, respectively. MDC: Mini-BESTest = 4.8; Brief-BESTest=3.2.
Jørgensen V et al., (2017) [18]	Cross-sectional validation study	Ambulatory Spinal Cord Injury (SCI)	N=46 Age (55±17) years F/M- 11/35	To compare the Mini-BESTest and Berg Balance Scale (BBS) for balance assessment in SCI	Mini-BESTest, Berg Balance Scale (BBS)	Mini-BESTest showed superior detection of dynamic balance deficit. BBS vs Mini-BESTest $rs = 0.90$, TUG $rs > -0.70$, SCIM $rs > 0.80$, 10MWT $rs > 0.80$, FES-I $rs = -0.62$, (Cronbach's $\alpha=0.94$).
Srisim K et al., 2015 [19]	Prospective cohort study	Chronic spinal cord injury (ambulatory SCI)	N=83 Age (52.68±11.21 (Non-multiple fallers), 44.21±10.72 (Multiple fallers)) years F/M-15/69	To compare functional assessments for predicting the risk of multiple falls in ambulatory SCI patients	BBS, TUG, 10MWT, FRT, Step Test, FTSST	FRT was the best clinical predictor of multiple falls in ambulatory SCI, but overall predictive accuracy was moderate. ICC=1.000, SEM=0.19. Sensitivity=73%, Specificity=55%, AUC=0.64, adjusted OR=3.18 (95% CI: 1.01-10.03) for multiple fall risk
Chan K et al., (2019) [20]	Cross-sectional study	Chronic incomplete SCI	N=21 Age (56.8±14.0) years F/M- 14/7	To evaluate test-retest reliability, concurrent validity and convergent validity of the Mini-BESTest in chronic iSCI	Mini-BESTest, LE muscle strength	Mini-BESTest showed excellent reliability, strong correlation with lower extremity strength ($r=0.73$) and good validity, supporting its use as a comprehensive balance assessment tool in chronic iSCI. ICC=0.94-0.98. EO COP velocity correlations $r=-0.54$ to -0.71 ; Convergent validity: lower extremity strength $r=0.73$ ($p<0.001$)
Ponti A et al., [21] (2020)	Observational study	SCI (Tetraplegia or paraplegia)	N=15 Age (36±13.38) years F/M- 4/11	To assess quality of life, fear of falling and satisfaction with sit-ski use in individual with SCI	SCI- FCS	Participants reported reduced Fear of falling and improved perceived safety during sit-ski use: balance confidence was indirectly reflected through reduced fall concern. Cronbach's $\alpha=0.827$; Inter-rater ICC=0.972; Intra-rater ICC=0.973

[Table/Fig-3]: Characteristics of included studies [4,5,8,17-21].

Abbreviations- ABC: Activities-specific balance confidence scale; Mini-BESTest: Mini balance evaluation systems test; SCI-FCS: Spinal cord injury fall concern scale; FES-I: Falls efficacy scale international; FRT: Functional reach test; TUG: Timed up and go test; 10 MWT: 10-meter walk test; 6MWT: 6-minute walk test; SCI-FAP: Spinal cord injury functional ambulation profile; BBS: Berg balance scale; FES: Functional electrical stimulation; iSCI: Incomplete spinal cord Injury; FTSST: Five times sit to stand test

DISCUSSION

The present scoping review aimed to chart the existing assessment tools to evaluate balance confidence and balance constructs in people with spinal disorders. The results show that in SCI populations, assessment of balance confidence has been mainly investigated, whereas there is less evidence for other spinal disorders. Within the identified tools, the most popular and psychometrically sound self-reported tools were the ABC Scale; and the performance-based tools were the Mini-BESTest, Brief-BESTest, BBS and FRT were commonly used as complementary assessments [8,20].

Balance confidence has been identified in recent years as a psychological construct playing a vital role in mobility, participation and fall-related behaviour during neurological rehabilitation. Self-reported balance confidence is a measure of an individual's self-assessment of their ability to maintain equilibrium during activities they engage in during the day that can significantly affect the likelihood of participating in activities, apart from their physical balance capacity [22,23]. This distinction is important in SCI patients, where there is fear of falling and loss of confidence which can result in activity restriction, decreased community ambulation and decreased quality of life, while functional mobility is maintained [4].

The present review reflected the strong evidence base on falls and balance problems in people with SCI, probably because these problems are so prevalent in this population. It has been reported that persons with ambulatory SCI have a higher likelihood of falling, with physical injury, psychological distress and decreased involvement in daily living activities occurring with these falls [3]. This is in line with the current results: tools like the FES-I and SCI-FCS were found to be useful tools for capturing fear of falling and fall-related concern. These measures can be useful in addition to objective measures of balance, as physical measures of balance may not be a complete representation of an individual's confidence or behavioural adaptations to fall risk.

The ABC Scale is relevant for ambulatory SCI populations and that it has strong reliability and validity in these groups. Comparable results are found in more general neurological populations like stroke and Parkinson's disease, in which balance confidence is shown to be strongly correlated with mobility performance and participation [24-26]. This new research confirms the clinical usefulness of the ABC Scale as a readily available patient-reported outcome in rehabilitation. Other assessment tools that were commonly reported were performance-based assessments (Mini-BESTest, Brief-BESTest and BBS). These tools evaluate objective balance performance, encompassing anticipatory postural control, reactive balance and dynamic gait function. Use of performance-based measures as well as self-reports is frequent, indicating a multidimensional approach to the assessment of balance. There is some evidence suggesting that objective balance performance and perceived balance confidence are distinct constructs: balance performance should be assessed and measured in clinical practice in addition to balance confidence [27].

Limitation(s)

Several limitations exist in the present scoping review that should be noted when evaluating the results. The number of included studies was relatively small, with a disproportionate focus on ambulatory individuals with SCI. Consequently, the findings may not be generalisable to other spinal disorders, such as cervical spondylotic myelopathy, lumbar spinal stenosis and other degenerative spinal conditions. Psychometric evidence for balance confidence tools in non SCI populations was limited and inconsistently reported, making it difficult to determine their applicability across degenerative and progressive spinal conditions, is limited. Future research should prioritise the validation and responsiveness testing of balance in spinal disorders.

CONCLUSION(S)

The scoping review revealed a variety of assessments to evaluate balance confidence, fear of falling, or balance constructs in people with spinal disorders. Performance-based instruments like the Mini-BESTest, Brief-BESTest, BBS and FRT offer valuable complementary assessments of objective balance performance. The available evidence on this topic, however, is largely in the context of SCI and little research has been conducted on other spinal disorders, like cervical and lumbar degenerative conditions. The results of the present study emphasise the need to use a multidimensional assessment strategy that combines patient-reported and performance-based assessments to better capture balance-related impairments. Future research should focus on verifying balance confidence assessments across a wide range of spinal conditions to aid in comprehensive evaluation, enhance fall risk diagnosis and improve rehabilitation outcomes.

Authors' contribution: MJ: Conceptualised the scoping review, developed the research question, designed the methodology, conducted the literature search, performed study selection and data charting, synthesised the findings and drafted the original manuscript; RS: Supervised the study, contributed to the methodological framework, guided the review process, critically reviewed; NV: Assisted with literature screening, data extraction, verification of findings and contributed to manuscript revision; BS: Contribute to data extraction, organised the study characteristics; MS: Support in screening process and data charting. All the author read and approved the final manuscript.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Feb 11, 2026
- Manual Googling: May 21, 2026
- iThenticate Software: May 23, 2026 (5%)

ETYMOLOGY: Author Origin**EMENDATIONS:** 8**AUTHOR DECLARATION:**

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? No
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Feb 09, 2026**
Date of Peer Review: **Feb 20, 2026**
Date of Acceptance: **May 25, 2026**
Date of Publishing: **Jul 01, 2026**