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A systematic review of validity and reliability assessment of measuring Spasticity Evaluation Tool and Wheelchair Skills Tests at the level of international classification of functioning, disability and health (ICF) in people with spinal cord injury

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Abstract

Background: Assessment of spasticity and wheelchair skills performance is important in both clinical practice and research.

Aim: The present study aimed to systematically review the psychometric properties (reliability and validity) of outcome measures used to assess spasticity and wheelchair skill tests in people with spinal cord injury.

Materials and Methods: A search was conducted using terms through PubMed, Embase, Scopus, and Web of Science databases. Related articles included measures of spinal cord injury patients published in English from 2010 to 2021.To determine the publication quality of studies COSMIN checklist was used.

Results: A total of 2150 potentially eligible studies were retrieved from four databases. The remaining 20 full-text studies were retrieved for complete review. Finally, 12 studies involving a total of 658 participants were included in the systematic review.

Conclusion: Ethical, safety, and psychological issues were considered during the test for people with disabilities. According to previous studies, the Spasticity Evaluation Tool has been suggested as a reliable tool for assessing spasticity in SCI subjects. However, due to the variety of tests and the elimination of selected tools, wheelchair skills tests cannot be recommended.

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1. Introduction

Damage to the spinal cord causes neurological disorders that affect motor, sensory, and autosomal function, whereas injury to the chest, back, and spinal cord propulsion can result in paraplegia and injury to the cervical area and can affect the upper limb and lead to tetraplegia [1].

In epidemiological studies, two studies reported the prevalence of spinal cord injury from 490 to 526 million (2018) among developed countries [2].

Spinal cord injury results in complete or partial loss of physical, sensory, and autonomous functions under the injury surface. In patients with spinal cord injury, there is a high risk for secondary complications, such as shoulder pain, urinary tract infections, skin pressure ulcers, osteoporosis, chronic pain, spasticity problems, depression, cardiovascular disease, obesity, and type 2 diabetes [3].

Wheelchairs are an important tool for the rehabilitation of individuals with major mobility restrictions and for improving functional independence [4, 5]. Having a suitable wheelchair may improve the quality of life for these people, giving them the independence they need and the desire to live more freely [6]. The majority of spinal cord injuries (roughly 80%) rely on a wheelchair for mobility for the rest of their lives. Users of manual wheelchairs must have various independent functions to cope with physical barriers in different life environments [7].

Incomplete spinal injury usually causes a change in motor control and spasticity and appears as signs and symptoms such as decreasing intensity or decreasing or increasing motor efficiency [8]. Spasticity is a type of motor disorder characterized by a rapid increase in tunic tensile reflexes with the exaggerated tendon impulses due to excessive excitability of tensile reflexes as one of the components of the upper motor neuron syndrome [9]. In conclusion, spasticity is a well-known consequence of the upper motor neuron damage which can be debilitating for a person with spinal cord injury [4].

The biopsychosocial model, including the international classification of functioning, disability, and health (ICF), provides a unified, international, and standardized language to describe and classify ICF with all health conditions, including SCI. This model is accepted all over the world [10].

The selection tool for the evaluation of spinal cord injury at the clinical level and research areas should preferably be based on descriptive and appraisal goals [11]. Measurement results are designed to measure strengths and limitations of clients, provide measurements of functions, predict future results, and direct interventions for patient care programs over time [12]. Most people with spinal cord injuries require rehabilitation and physiotherapy to maximize their potential and learn to live as wheelchair users. To enable this process, evaluating manual wheelchair skills is of high importance [13].

According to the available literature reviews, clinical tests evaluating the performance of individuals with SCI use physiotherapy and occupational therapy. Studies have determined the subject's ability after the acute period of the lesion or to what extent occupational therapy and physiotherapy exercises have increased the performance of the SCI subjects. After the medical team completes its work, an adapted physical educator is provided for a patient to improve their quality of life, longevity, and participation in physical activity. Adapted physical education, as defined by the National Consortium for Physical Education and Recreation for Individuals with Disabilities (NCPERID), is physical education that may be adapted to meet the specific needs of children who may have delays in gross motor development.

Evaluation helps to achieve the goals and actions of a program's growth. You can write down your strengths and weaknesses through the assessment. Weaknesses become targets and specific activities are used to achieve goals and objectives [14]. Recognizing the strengths and weaknesses of the disabled person, an adaptive physical education coach strengthens their strengths and improves their quality of life by increasing their participation in activities. In addition, the problems and secondary complications in spinal cord injury compared with other disabilities groups; Considering the prevalence of this injury, which was reported in previous wards, further research on disabled persons is of great importance.

To determine the functional status of SCI and develop an appropriate exercise program, it is necessary to evaluate the required factors such as spasticity and wheelchair skills. Therefore, evaluating the performance of the patient using the mentioned tools results in the collection of the required information, which can effectively help physical educators. It also makes it easier for researchers to identify tools by arranging the measurement results in the ICF model.

In addition, studies have aimed to identify a tool with good validity and reliability to assess Spasticity Evaluation Tool and Wheelchair Skills Tests of SCI. Confirming the validity of the tests associated with each section and assessing the instructors accurately and comprehensively lead to an appropriate training program and ultimately offer exercise designs for individuals suffering from SCI.

Therefore, it was necessary to conduct a systematic review in the field of health and the assessment tools in this group with the following objectives: 1. Assess the validity and reliability of evaluation tests for people with SCI; 2. Recommend valid and reliable tests in spasticity and wheelchair skills sections to use in upcoming research and assessments of SCI.

The present study reviewed assessments commonly used for measuring spasticity and wheelchair skills in individuals with SCI.

2. Materials and Methods

2. 1. Criteria for selecting articles

The results of the measurements were identified using a keyword search of electronic databases (PubMed, Scopus, EMBASE and Web of Science) from 2010 to 2021. The following keywords were used in the search: "spinal cord injury", "tetraplegia", "paraplegia", "reliability", "validity" and the name of the instrument. The search strategy used in the PubMed database is attached. The search strategy was performed in four databases. Then, the identified articles were entered into Endnote software, and they were screened such that duplicate articles were first removed, and then, based on the originality of second-hand sources which included systematic reviews and meta-analyses, irrelevant studies were excluded. In the next step, the articles that were written in a language other than English were excluded.

Table 1. Inclusion criteria according to PEO

Population	Complete and incomplete spinal cord injury
Exposure	Questionnaires and tests
Outcome	Reliability and validity

2. 2. Eligibility criteria

Inclusion criteria included publications with research-related test validity or reliability, studies comparing multiple tests simultaneously, cross-sectional, prospective, and experimental studies published in English. Studies not performed on people with spinal cord injury, not evaluating a person with spinal cord injury, and not evaluating the validity and reliability of the test were excluded.

2. 3. Data extraction

Reliability is the degree to which the measurement is free from measurement error, and by extension, it refers to the extent to which scores for patients who have not changed are the same for repeated measurement under several conditions. Validity is the degree to which a health-related patient reported outcomes (HR-PRO) instrument measures the construct(s) it purports to measure. In this study, the effect of spasticity on clinical and paraclinical studies was evaluated. In addition to using self-reported measurements, individuals with spinal cord injuries gain more accurate physical experience. The Penn Spasm Frequency Scale (PSFS) allows the participant to evaluate spam replication on a rating scale of 0 to 4, "0" non-spasm indicator, and "4" indicates spasm more than 10 times per hour [15, 16]. The Ashworth scale and modified Ashworth scale are often clinical scales used to evaluate spasticity [17]. The modified Ashworth scale is a 6-point ranking scale used to measure muscle tone [18]. As an aid tool to conform to the evaluation of spasticity, Spasticity Evaluation Tool (SCI-SET) can be used in clinical and research environments, especially as a tool to facilitate the role of a person with spinal cord injury as an active participant in the management of medical decision-making [19]. SCI-SET is a 35-bit tool and self-report tool, and measures interpretations of how it affects everyday life [19].

Most people with spinal cord injuries are wheelchair-dependent and may affect overall performance at the level of activities and engagement. To maintain independence, wheelchair skills (e.g., driving a wheelchair, alongside ramps or mounting on the platform) and wheelchair capacity (maximum power and oxygen consumption) for persons with spinal cord injuries are important [20]. The Wheelchair Skill Test version 2.4 for handheld wheelchair users evaluates people’s capacity to perform specific skills in their own wheelchairs as a standard. The survey includes 32 individual skills.

Researchers have reported that wheelchair users suffer from chronic degenerative lesions in soft tissues, such as impingement syndrome, rotator cuff rupture, strain, sterin and vascular necrosis, as well as evidence of radiological alterations of neck joint lesions [21]. The Wheelchair People Shoulder Pain Index (WUSPI) is a self-report consisting of 15 materials that measure shoulder pain during mobility, mobility, self-care, and public activities [21]. The Obstacle Course Assessment of Wheelchair User Performance (OCAWUP) test aims to evaluate and document the mobility performance of motory and manual wheelchair users under potentially difficult environmental conditions. Obstacles limit environmental conditions and social participation [22]. The Wheelchair Circuit Psychological Movement Test of the Wheelchair includes nine standard items related to daily activities [23].

2. 4. Quality of evidence

The present study used the COSMIN tool

(Consensus-based Standards for the selection of health status Measurement Instruments) to evaluate the quality level of imported articles based on the inclusion criteria. The COSMIN checklist focuses on evaluating the methodological quality of studies on measurement properties of HR-PROs. Because of their complexity, HR-PROs were evaluated in the current study. These instruments measure constructs that are both multidimensional and not directly measurable. The checklist contains 12 boxes, ten of which can be used to assess whether a study meets the standard for good methodological quality. Nine of these boxes contain standards for the included measurement properties (internal consistency, reliability, measurement error, content validity, structural validity, hypotheses testing, cross-cultural validity, criterion validity, and responsiveness), and one box contains standards for studies on interpretability [24]. Each item is scored on a 4-point rating scale (poor, fair, good, or excellent), and an overall score for the methodological quality of a study is determined separately for each measurement property by taking the lowest rating of any of the items in a box. Using the COSMIN checklist allows the critically appraisal of the quality of studies about a single measurement instrument and the comparison of measurement instruments [25].

A third alternative method that was considered less optimal was to calculate a ‘‘mean score’’ per box. With this method, each response option is scored (e.g., poor= 0, fair= 1, good= 2, and excellent= 3), and a total score is calculated by summarizing the scores of the completed items and dividing it by the number of completed items. An advantage of this method is that the total score is not dependent on the number of items in the box [26].

2. 5. Evaluation of reliability of tests

In health measurement scales, the intraclass correlation coefficient [27] has been integrated into the Consensus-based Standards for the selection of the health status measurement instruments (COSMIN) checklist, which was developed to assess the methodological quality of studies based on measurement attributes. One of the major boxes on the COSMIN checklist is reliability, in which it is recommended that the ICC be used as a measurement of inter-rater reliability. One of the driving factors of the use of the ICC in many fields is its ease of interpretation. The ICC is a value between 0 and 1; values below 0.5 indicate poor reliability; values between 0.5 and 0.75 demonstrate moderate reliability; values between 0.75 and 0.9 represent good reliability; and values above 0.9 indicate excellent reliability [28].

2. 6. Evaluation of validity of tests

Pearson correlation coefficient was used to evaluate the validity of the tests. Pearson’s correlation is commonly used to verify the intensity of the existing linear association between variables and to measures the linear association between quantitative variables. This coefficient is a number between −1 and 1. A negative value indicates that one variable decreases as the other increases, while a positive value indicates that one variable increases as the other increases. R values are defined as follows: r= 0–0.25, very low correlation; r= 0.26–0.49, low correlation; r= 0.5–0.69, moderate correlation; r= 0.7–0.89, high or strong correlation; r= 0.9–1.0, very high or very strong correlation. Pearson’s correlation was employed in this study, because the instrument presents a linear association between the criteria presented [29].

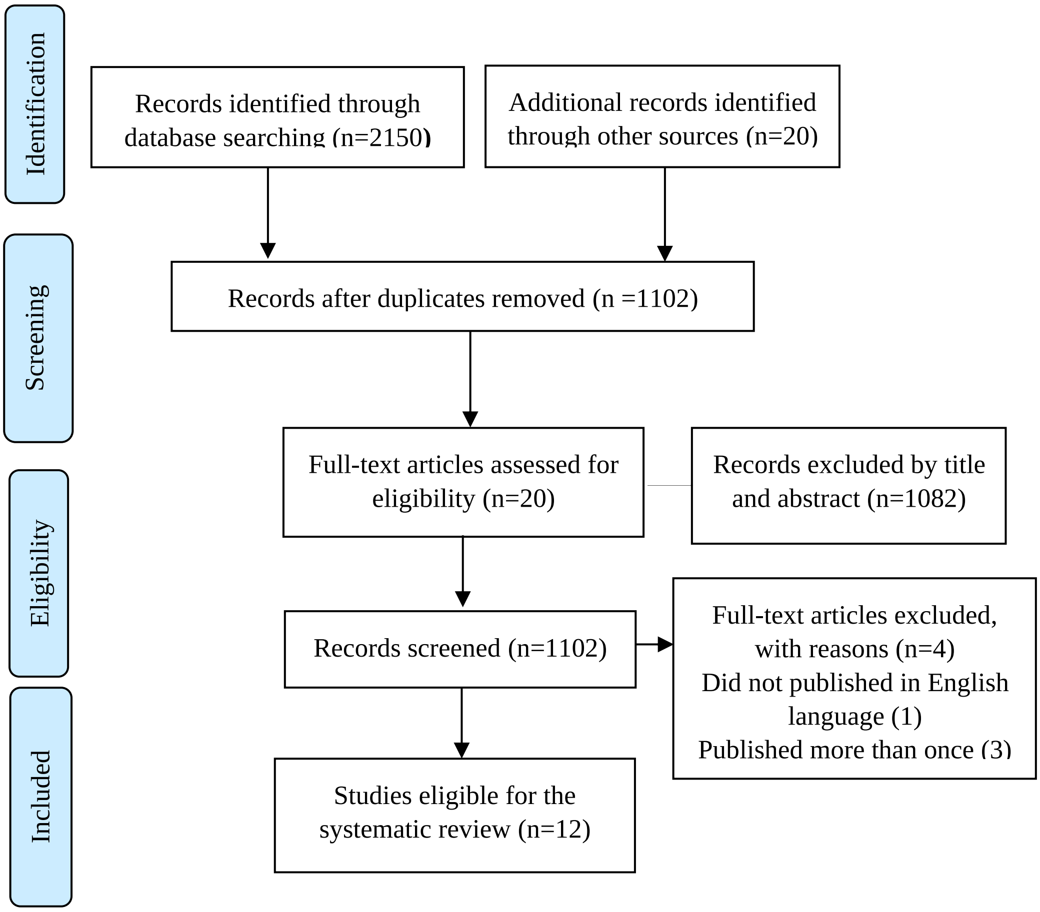

Figure 1. Flow diagram of systematic literature search [27]

3. Results

A total of 2150 potentially eligible studies were retrieved from four databases. Moreover, 20 additional records were identified through the screening of reference lists using the ancestry method. A total of 1068 duplicate studies were excluded, and the remaining 1102 potentially relevant titles and abstracts were screened, from which an additional 1082 abstracts were excluded after the screen title and abstract. The remaining 20 full-text studies were retrieved for complete review. Another eight studies were excluded because they did not meet the eligibility criteria. Finally, twelve studies involving a total of 658 participants were included in the systematic review.

3. 1. Results of spasticity tests

In the evaluation of studies in the field of spasticity, seven studies were included in the study, and their demographic information is reported in Table 2. Four studies examined the inter-examiner reliability of the Ashworth scale, two studies examined the SCI-SET scale, and only one study examined the Penn Spasm scale. Table 3 shows the ranking of the cognitive quality of the tools related to spasticity. In the evaluation of these studies, three studies were placed at the "excellent" level and four studies were evaluated at the "good" level by Cosmin; also, the average scores of each study are included. The intra- and inter-rater reliability of the Spasticity instruments (SCI-SET, Penn Spasm Frequency Scale, Modified Ashworth scale) of the SCI-SET is better. Table 3 provides details on the available data supporting the validity of each instrument. Because there is no ‘gold standard’ of an ambulation outcome measure for SCI, construct validity was assessed. Relationship between spasticity severity and self-reported instruments were (r=0.47) in SCI-SET tool.

3. 2. Results of wheelchair skill tests

According to Table 2, five studies reported the reliability evaluation of tools related to wheelchairs, among which three studies examined the wheelchair circuit test in the form of comparative and original versions, and two studies were related to the wheelchair skill test. In Table 4, the quality methodology of the studies related to the skills of working with a wheelchair has been reported, and the average scores obtained from each table have been reported. Among these, three studies have been classified as "good", and two studies have been classified as "excellent". The retest and reliability between the two assessors had a high correlation coefficient. Table 5 includes data supporting the reliability of each instrument. The reliability of most of the measures that assess wheelchair skill dependence was relatively poor, with only the wheelchair skills test (4.2 version) and the Adapted Wheelchair Circuit providing better reliability.

4. Discussion

This review evaluated the reliability and validity properties of available measures for assessing spasticity and wheelchair skill in the SCI population. Twelve articles were found to have examined the two mentioned variables, seven of which were related to spasticity, and five were related to wheelchair skill. SCI was assessed and ranked at the "activity", "body function", and other levels of the International Classification of Function, Disability, and Health (ICF); four tool was placed at the "activity" level, and the rest of the "Body function" tools were placed according to the background literature.

Our selected studies reported only the validity and reliability of the instruments and did not examine the interpretability and responsiveness. The study samples were at different levels according to the ASIA classification (A, B, C, and D).

In the current study, three instruments (SCI-SET, Modified Ashworth scale, and Penn spasm frequency scale) were investigated to evaluate the spasticity of SCIs, their validity, and their reliability. Seven studies examined these instruments. On the other hand, four instruments, namely wheelchair circuit, adapted wheelchair circuit, wheelchair skills test (4.2 version), and wheelchair skill test (3.2 version) were selected to evaluate the wheelchair skill of SCI patients. The validity and reliability of the instruments were reported.

In this section, four psychological instruments of wheelchair movement, WST, OCAWUP, and the shoulder pain index tool of wheelchair users, were selected to evaluate the skills of working with wheelchairs in spinal cord injury. The authors had not checked the validity and reliability of these two, so they were excluded from the research. As a result, five studies examined the reliability of the remaining tests, two of which examined wheelchair skills (WST) and one related to the validity test of wheelchair movement, and two studies examined the reliability of adaptive WC tests, which were included in our research.

Table 2. Characterization of eligible studies

Reference	Instrument	Country	Sample size	Study design	Gender	Age (year/ average)	Chronic/ acute/ subacute	Type of SCI	Injury level/AIS
Bobak et al. (2018) [30]	Adapted wheelchair circuit	United States	50	Reliability study	42 men 8 women	46	Chronic incomplete and complete	Tetraplegia and paraplegia	A-D
de Barros et al. (2020) [31]	Adapted wheelchair circuit	Brazil	66	Cross-sectional study	66 men	38.3-24	Incomplete and complete	Tetraplegia and paraplegia	A-B
Akpinar et al. (2017) [20]	Wheelchair circuit	Holland	105	A prospective study	74 men 31 women	18-65	Incomplete and complete	Tetraplegia and paraplegia	A-D
Ribeiro Neto et al. (2019) [32]	Wheelchair skills test (4.2 version)	Argentina	11	Cross-sectional study	10 men 1 women	29.81	Incomplete and complete	Tetraplegia and paraplegia	A_3 B_3 C_3 D_2
Kilkens et al. (2003) [13]	Wheelchair skill test (3.2version)	-	40	Reliability study	30 men 10 women	36.9	Incomplete and complete	Tetraplegia and paraplegia	-
Passuni et al. (2019) [33]	Modified Ashworth scale	-	38	Cross-sectional study	32 men 6 women	31.94	Incomplete and complete	-	A-10 B-9 C-10 D-9
Mishra & Ganesh (2014) [34]	Modified Ashworth scale	Denmark	31	Intra- and inter-rater reliability	20 men 11 women	20.2+48.3	Incomplete and complete		A, B, C_18 D_13
Baunsgaard et al. (2017) [35]	Modified Ashworth scale	Canada	20	Observational study	Men	38.9	Incomplete and complete	Tetraplegia and paraplegia	A_6 B_D 14

Reference	Instrument	Country	Sample size	Study design	Gender	Age (year/ average)	Chronic/ acute/ subacute	Type of SCI	Injury level/AIS
Lam et al. (2008) [17]	Modified Ashworth scale		65	Psychometrics study	37 men 21 women	44±14	Incomplete and complete		A_13 B_8 C_16 D_21
Akpinar et al. (2017) [36]	SCI-SET	Turkiye	66		40 men 26 women	18-88	Incomplete and complete	21 Tetraplegia and 45 paraplegia	A _13 B _10 C _19 D _24
Ansari et al. (2017) [37]	SCI-SET	Iran	100	Cross-sectional	58 men 42 women	39±11	Incomplete and complete		A_49 B_18 C_25 D_8
Christopher et al. (2021) [15]	Penn spasm frequency scale (PSFS)	Columbia	66	Psychometric study	49 men 17 women	44.1±12.3	Incomplete and complete		A, B, C_54 D_12

Table 3. Validity

Reference	Instrument	ICF domain	Validity: convergent/ construct/ concurrent/ criterion
Akpinar et al. (2017) [20]	SCI-SET	Body function	Cultural validity Relationship between spasticity severity and the tool R=0.41 Relationship between spasticity severity and self-reported instruments R=0.47
Ansari et al. (2017) [37]	SCI-SET	Body function	-
Ribeiro Neto et al. (2019) [32]	Adapted wheelchair circuit	Activity	The construct validity of the Brazilian version of the psychological test of adaptive wheelchair movement and age was 0.18, time after injury was 0.12, body mass index was 0.09, and the spinal independence measurement scale was 0.74.

Table 4. Methodological quality of validation studies based on COSMIN

Reference	Instrument	Assessed psychometric property	Methodological quality rating	Average scores in the table
Ribeiro Neto et al. (2019) [32]	Adapted wheelchair circuit	Construct and cultural validity	Good	1.84
Cowan et al. (2011) [6]	Adapted wheelchair circuit	Test-retest reliability	Good	2.25
de.Groot et al. (2010) [23]	Wheelchair circuit	Test-retest reliability	Excellent	2.77
Passuni et al. (2019) [33]	Wheelchair skills test (4.2 version)	Inter-rater reliability	Excellent	2.66
Pradon et al. (2012) [16]	Wheelchair skill test (3.2 version)	Test-retest reliability Inter-rater reliability	Good	2.16
Mishra & Ganesh (2014) [34]	Modified Ashworth scale	Inter-rater reliability	Good	2.58
Baunsgaard et al. (2017) [35]	Modified Ashworth scale and Penn spasm frequency scale	Inter-rater reliability Intra-rater reliability	Excellent	2.75
Craven & Morris (2010) [38]	Modified Ashworth scale	Inter-rater reliability Intra-rater reliability	Excellent	2.75
Akpinar et al. (2017) [20]	Modified Ashworth scale	Inter-rater reliability Intra-rater reliability	Excellent	2.81
Akpinar et al. (2017) [20]	SCI-SET	Cultural validity	Good	2.32
Ansari et al. (2017) [37]	SCI-SET	Cultural validity	Good	2.38
Mills et al. (2018) [18]	Penn spasm frequency scale	Inter-rater reliability Intra-rater reliability	Good	2.58

Table 5. Reliability

Reference	Instrument	ICF domain	Reliability: internal consistency/ Test-retest/ Inter-rater reliability/ Intra-rater reliabilities/ Measurement error intraclass correlation coefficient "ICC"/ Kappa coefficient (K)
Ribeiro Neto et al. (2019) [32]	Adapted wheelchair circuit	Activity	Test-retest ICC=0.94 – 0.84 Intra_rater reliabilities ICC=0.92 – 0.95
Rachel Cowan et al. (2011) [6]	Adapted wheelchair circuit	Activity	Test-retest ICC=0.98
de.Groot et al. (2010) [23]	Wheelchair circuit	Activity	Test-retest ICC=0.70 – 0.85
Passuni et al. (2019) [33]	Wheelchair skills test (4.2 version)	Activity	Intra_rater reliabilities ICC=0.99

Reference	Instrument	ICF domain	Reliability: internal consistency/ Test-retest/ Inter-rater reliability/ Intra-rater reliabilities/ Measurement error intraclass correlation coefficient "ICC"/ Kappa coefficient (K)
Pradon et al. (2012) [16]	Wheelchair skill test (3.2 version)	Activity	Test-retest ICC=0.94 Intra_rater reliabilities ICC=0.92
Mishra & Ganesh 2014) [34]	Modified Modified Ashworth scale	Body function	Inter-rater reliability Gastrocnemius muscle K=0.71 Soleus muscle K=0.75
Baunsgaard et al. (2017) [35]	Modified Ashworth scale	Body function	Intra_rater reliabilities K=0.94 – 0.93 Plantar flexors K=0.25
Baunsgaard et al. (2017) [35]	Penn spasm frequency scale	Body function	Intra- and inter-rater reliability K=0.94-0.80 K=0.74-0.93
Craven & Morris (2010) [38]	Modified Ashworth scale	Body function	Inter-rater reliability of the plantar flexor ankle K=0.32-0.45 Intra-rater reliability of the plantar flexor ankle K=0.32 – 0.48 Kappa range =0.63 – 0.71
Akpinar et al. (2017) [20]	Modified Ashworth scale	Body function	Inter-rater reliability of the plantar flexor ankle K=0.77 Test-retest of the plantar flexor ankle K=0.68
Akpinar et al. (2017) [20]	SCI-SET	Body function	Reliability ICC=0.80
Ansari et al. (2017) [37]	SCI-SET	Body function	Reliability ICC=0.84
Mills et al. (2018) [18]	Penn spasm frequency scale	Body function	Inter-rater reliability K<0.2 Intra- rater reliability K > 0.6

According to the value of correlation coefficient reported from the study of psychological test of wheelchair movement, it had less reliability than the modified version, and four other studies had good reliability. Considering that there are limitations in this section, there is much equipment used for these tests, and there are many items; they also evaluate different skills.

Therefore, we do not use any of these tests to assess the skills of working with recommend wheelchairs. In addition, Fliess-Douer et al. (2010), after reviewing 13 tools in this field, they concluded that there is no accepted wheelchair skills test that can compare study results, and this systematic review found many inconsistencies [10]. Among the tests and skills, they demonstrated in the wheelchair. This makes it difficult to compare the study results and create norms and standards for wheelchair skill performance [7].

Baunsgaard et al. (2017) examined the difference between the tester and inter-examiner reliability of the PSFS tools and the modified Ashworth scale. Examining these two tools, the Ashworth scale has acceptable reliability if partial agreement (weighted kappa) is considered, assuming the scale is normal, with exact agreement (simple kappa) there is weak inter-examiner and inter-examiner reliability. The Ashworth scale and PSFS are weakly correlated with each other, indicating that they assess different aspects of spasticity, and the reliability of the PSFS was confirmed. After examining the intra-examiner and inter-examiner reliability of PSFS, they stated that PSFS is probably a reliable self-report measure for the assessment of spasticity after chronic traumatic spinal cord injury. The inter-examiner was not reliable for all raters and showed weak and moderate inter-session reliability, and the Ashworth scale did not have sufficient intra-examiner reliability to identify lower limb spasticity [35].

Assessing spasticity of the lower limbs in spinal cord injury [17]. Akpinar et al. (2017) stated that the test– retest reliability for the SCI-SET was good. The intraclass correlation coefficient was 0.80 with an endurance interval of 95, and there was no significant correlation between SCI-SET scores and PSFS scores [20]. Ansari et al. (2017) reported the validity and reliability of the SCI-SET to assess the impact of spasticity on the daily life of patients with spinal cord injury [37]. MMAS is reliable for evaluating plantar flexor muscle spasms in spinal cord injury [33].

According to the studies conducted in this field, and the reports indicating the articles, the reliability of the Ashworth scale has not been confirmed in three studies, and in one study, the PSFS tool has been confirmed, and in another study, it has been known to be a suitable tool, which in we do not recommend this tool here because the reliability of the Ashworth tool is not accepted. The PSFS tool can be a better tool than the Ashworth comparison, but considering the reliability and validity of the SCI-SET questionnaire in the two studies, this tool can be considered more effective than other tools in identifying spasticity in the spinal cord injury population. Spasticity tools and their impact on the quality of life of people with spinal cord injury in 2019, SCI-SET was among the recommended tools in this study [38].

5. Limitations

The present study had some limitations. First, only the validity and reliability of studies were evaluated. Most of the studies evaluated the reliability related to the instrument. A smaller number discussed the validity, considering that the COSMIN checklist could review studies related to responsiveness. Out of twelve studies, only five were of excellent quality. Differences in the level of lesion (chronic or acute), sample size, and age of subjects may have affected the study results, and more research is needed to confirm this study.

6. Conclusions

This review study has contributed to current knowledge by comprehensively examining motor tools for use in people with SCI. Ethical, safety, and psychological issues were considered during the test for people with disabilities. One of the considerations for testing people with disabilities is to observe the reliability and validity of the instrument, which was addressed in this study in various fields. In the current study, seven tools for assessing SCI were discussed, and it was found that the PSFS tool can be a better tool than the Ashworth comparison. However, considering the reliability and validity of the SCI-SET questionnaire in the two studies, this tool can be considered more effective than other tools in identifying spasticity in the spinal cord injury population. According to previous studies, the SCI-SET questionnaire tool has been suggested as a reliable tool for assessing spasticity in SCI subjects. Future research should compare the reliability of these tools with those of other groups with disabilities such as cerebral palsy.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical Consideration

The author has completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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This research received no external funding.

Appendix

TITLE-ABS-KEY: ("spinal cord injury" OR "spinal cord disease" OR "spinal cord lesion" OR "spinal cord injuries" OR "spinal cord injured" OR "spinal cord trauma" OR "tetraplegia" OR "paraplegia" OR "quadriplegia" OR "paralysis")

AND

TITLE-ABS-KEY: ("Ashworth scale" OR "Ashworth" OR "modified Ashworth scale" OR "ashworth scale" OR "ashworth scale assessment" OR "ashworth scale" OR "MAS")

AND

TITLE-ABS-KEY: ("validity" OR "valid" OR "validation" OR "reliability" OR "reliable" OR "reliabilities")

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