



Clinical evaluation of balance in hemiparetic adults: a systematic review

Avaliação clínica do equilíbrio em adultos hemiparéticos: uma revisão sistemática

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Abstract

Introduction: Hemiparesis is a common post-stroke impairment often associated with balance deficits. Standardized instruments for balance assessment may be useful in identifying individuals at risk of falling and evaluating intervention outcomes. **Objectives:** To identify instruments with adequate psychometric properties and clinical application to assess balance in hemiparetic cases within the scope of physiotherapy and to verify tools most frequently used in studies that evaluated the effects of therapeutic interventions in order to improve the balance of hemiparetic patients. **Methods:** A search was conducted in the Medline, Lilacs, PEDro, and Web of Science databases by two independent researchers, who selected and analyzed studies that evaluated the reliability and validity of balance assessment instruments and intervention results. **Results and discussion:** The Berg Balance Scale was the most frequently used instrument in the intervention studies. Nine single-task tests (timed up and go, functional reach test, step test, four-square step test,

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side step test, supported standing balance, standing arm raise, static tandem standing, and weight shifting) and six multiple-task tests (Berg balance scale, Brunel balance assessment, Fugl-Meyer Assessment/balance section, mini balance evaluation systems test, and postural assessment scale for stroke patients) demonstrated adequate psychometric properties and clinical applications to assess balance in hemiparetic individuals. **Conclusions:** The Berg Balance Scale had the most widely studied psychometric properties and was the most frequently used scale in the intervention studies. Further studies are required to validate and adapt other instruments for the Brazilian population.

Keywords: Disability evaluation. Balance. Stroke. Rehabilitation. Systematic review.

Resumo

Introdução: A hemiparesia é um quadro comum após acidente vascular encefálico e pode levar a alterações do equilíbrio. A avaliação do equilíbrio com instrumentos padronizados pode identificar indivíduos com risco de queda e verificar resultados de intervenções. **Objetivos:** Identificar instrumentos com propriedades psicométricas adequadas e a aplicabilidade clínica para avaliação do equilíbrio do indivíduo com hemiparesia na prática fisioterápica além de verificar quais os instrumentos mais utilizados em estudos que avaliaram o efeito de exercícios terapêuticos para a melhora do equilíbrio nessa população. **Materiais e métodos:** Pesquisadores independentes realizaram busca nas bases de dados Medline, Lilacs, PEDro e Web of Science, selecionaram e analisaram estudos de confiabilidade e validade dos instrumentos e dos estudos de intervenção. **Resultados e discussão:** A Escala de Equilíbrio de Berg foi o instrumento mais utilizado nos estudos de intervenção. Foram identificados nove testes de tarefa única (Timed up & GO, Functional Reach, Step Test, Four Square Step Test, Side Step Test, Supported Standing Balance, Standing arm raise, Static Tandem Standing e weight shift) e seis instrumentos com múltiplas tarefas (Escala de Avaliação do Equilíbrio de Berg, Brunel Balance Assessment, Escala de Fugl-Meyer/seção equilíbrio, Mini Balance Evaluation Systems Test e Escala de Avaliação Postural para pacientes após Acidente vascular encefálico) com propriedades psicométricas adequadas e aplicabilidade para avaliação do equilíbrio na hemiparesia. **Considerações finais:** Destacou-se a Escala de Equilíbrio de Berg, por ter propriedades psicométricas amplamente estudadas e ter sido utilizada na maioria dos estudos de intervenção encontrados. São necessários novos estudos para adaptação dos instrumentos ainda não validados no Brasil.

Palavras-chave: Avaliação. Equilíbrio. AVE. Reabilitação. Revisão sistemática.

Introduction

Cerebral vascular accident (CVA) is the most common cause of disability in adults (1). Disabilities caused by CVA are commonly associated with motor impairment, hemiparesis, and balance disorders, which are commonly observed in hemiparetic stroke patients (2-5). These changes compromise the patients' safe gait at home and in the community, increasing the likelihood of falls (6).

Falls are considered the most important complication of stroke (7, 8), with an incidence rate of 73% within the first six months after the vascular event (8, 9). Post-stroke falls may result in soft tissue injuries, hip fractures, radius fractures, and traumatic brain injuries, which can lead to hospitalization

(10, 11). Another possible consequence is the reduction of physical activities due to fear of falling (12). In the study of Bugdayci et al. (13), 88% of patients hospitalized for rehabilitation during the subacute post-stroke phase reported having fear of falling (13). Schmid and Rittman (14), through a qualitative analysis of a sample of 132 subjects with 1- or 6-month old history of stroke, indicated the following three important aspects related to the consequences of falls after a stroke: limitation of activities of daily living and participation, increased dependence, and a growing fear of falling.

Balance restoration is considered crucial in post-stroke rehabilitation (1). Several studies have shown that balance is an essential precursor to the restoration of independence in daily living, functional

mobility activities, and fall prevention (1, 15, 16). Assessment of balance disorders can help identify individuals at risk of falling (17) and evaluate the outcomes of rehabilitation interventions (18), with the use of standardized assessment tools in clinical practice (19). These tools guide health professionals in the assessment of patients' level of disability, in addition to their functional, sensory, and motor capabilities (20). When selecting the appropriate instrument to use in clinical practice, the physiotherapist should consider the validity, reliability, and feasibility of the instrument (21). Although posturographic evaluation provides an accurate measure of postural stability in hemiparetic individuals (22), this resource is usually not available in the daily clinical practice of physiotherapists.

Considering the large number of balance assessment tools available and the inherent variability of these instruments, we aimed to conduct a systematic review of the literature to identify which instruments have adequate psychometric properties and clinical application to assess balance in individuals with hemiparesis as a sequela of stroke in physiotherapy practice. As a secondary objective, we aimed to conduct a survey of assessment tools to identify the tool used most often in intervention studies that evaluated the effect of therapeutic exercise programs on the balance of hemiparetic individuals.

Methods

A systematic review of the literature was performed, following the guidelines indicated in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (23). The terms "clinical assessment," "clinical tests," and "clinical evaluation" were combined with the terms "balance," "stroke" (cerebrovascular accident), and "rehabilitation" and used as search terms in the Medline, Lilacs, PEDro, and Web of Science databases. Initially, studies were selected by reading the title and abstract, with consideration of the following inclusion criteria: written in English, Spanish, and Portuguese and published in the databases for the past 10 years until May 2012; used clinical balance assessment tools in adults with hemiparesis due to stroke, regardless of whether patients were in the acute or chronic phase; and evaluated the results of intervention programs that had balance as one of the main outcome measures. Studies

that used the force platform as the main instrument for balance evaluation were excluded (unless such evaluation was associated with some type of clinical assessment), as well as those that investigated trunk balance with the individual in a sitting position.

In the next step, the full texts were read. In all the selected studies, references that were not found through the electronic search were manually searched using the same criteria and procedures. All the steps were independently conducted by the two researchers. After each step, we sought consensus regarding the results. A third researcher participated in the process by providing guidance on the procedures and clarification of doubts. In the absence of a consensus among the researchers, their opinion was requested.

In the data extraction phase, the researchers allocated the selected studies into two groups for further analysis as follows: 1) In the group of exploratory studies, which investigated the psychometric properties of assessment tools and intervention studies that used instruments for clinical balance assessment, the instruments identified were analyzed based on the quality criteria proposed by Terwee and colleagues (24); 2) in the group of intervention studies, a quantitative analysis was performed to identify the instruments used most often used to evaluate the effect of therapeutic exercise programs on balance of hemiparetic individuals.

Results

In our search in the Medline database, 142 studies were found, of which 29 were selected. In the searches made in the Lilacs and Web of Science databases, using the same search strategies mentioned earlier, four studies were identified, none of which met the inclusion criteria. In the PEDro database, 19 studies not yet identified in the previous searches were found, two of which were selected. After reading the articles, an experimental study was excluded for having used posturography to assess results, and another study was excluded because it assessed mobility as the main outcome, with no use of a specific balance assessment instrument. Three other studies were excluded because of failure to access the full contents of the articles. In total, five studies were excluded at this stage. Then, based on the references of the selected articles, studies were manually searched,

and six additional studies were included, for a total of 32 studies evaluated. Of these studies, 22 had the instrument as the main focus of the analysis (20 observational or methodological studies and 2 systematic reviews) and 10 intervention studies were identified. The processes of identification and selection of the studies for the systematic review are shown in Figure 1.

In the analysis of the studies that evaluated the psychometric properties of the instruments (1, 3, 4, 17-21, 25-38), single-task tests (timed up-and-go [TUG] test, functional reach test, step test, four-square step test, side step test, supported standing balance, standing arm raise, static tandem standing, and weight shifting) and multiple-task tests were identified (Berg balance scale [BBS; validated in Brazil], Brunel balance assessment [BBA], postural assessment scale [validated in Brazil as a postural assessment scale for patients after a stroke (PASS)], Fugl-Meyer assessment of motor recovery, and mini balance evaluation systems test [Mini-BESTest]) were identified. The instruments showed high reliability (1, 3, 17, 18, 20, 21, 25-27, 29-38), as reviewed in the studies using the intraclass correlation coefficient

(ICC) (25, 26, 29-32, 34, 38) and/or kappa coefficient (18, 26). All the instruments showed an ICC > 0.80 (high reliability) and kappa coefficient values > 0.75 (high agreement) (32). Table 1 provides an overview of the analysis of the psychometric properties of the instruments, considering the content validity, internal consistency, construct validity, reliability, responsiveness, floor and ceiling effects, and interpretability of their results. The characteristics of the studies analyzed are summarized in Tables 2 and 3. The BBS was the most cited instrument, with high reliability and validity for measuring balance in stroke patients (3, 17, 19-21, 29-32, 36, 37).

In the group of intervention studies (39-48), we observed that most (80%) of the studies used the BBS as an outcome measurement tool of balance improvement. Of these studies, some used the BBS with running tests or measures of mobility (75%) and others used the BBS along with other balance assessment tools (25%). The other instruments used were the PASS (40), activities-specific balance confidence scale (43), sensory organization balance test (42), Tinetti and Romberg balance tests, and four-square step test (47).

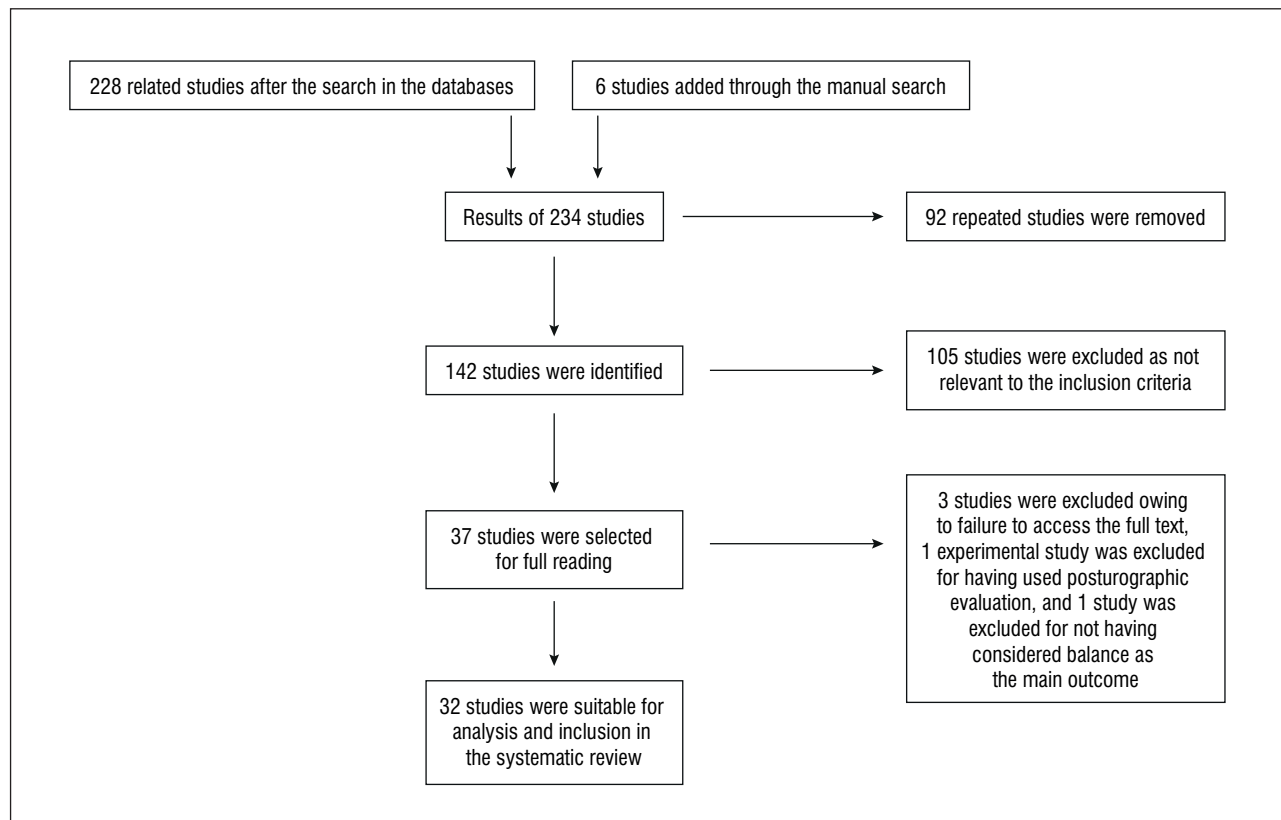


Figure 1 - Identification and selection of the studies for systematic review

Table 1 - Psychometric properties of the instruments for clinical assessment of balance in hemiparesis

Instrument	Content validity	Internal consistency	Construct validity	Interpretability	Reliability	Responsiveness	Ceiling or floor effect
BBS	?	+	+	?	+	+	0
BBA	+	+	+	?	+	?	?
FM-B	?	+	+	?	+	+	0
FSST	?	?	?	?	+ ↓	+	?
<i>Functional Reach</i>	?	?	?	?	+ ↓	?	?
Mini BESTest	+	?	+	?	+	?	+
PASS	?	+	+	?	+	+	no
<i>Standing arm raise</i>	?	?	?	?	+ ↓	?	?
STS	?	?	?	?	+ ↓	?	?
<i>Side Step Test</i>	?	?	?	?	+ ↓	?	?
<i>Step Test</i>	?	?	?	?	+ ↓	+	?
TUG	?	?	+	?	+ ↓	?	?
<i>Weight shift</i>	?	?	?	?	+ ↓	?	?

Note: Classification: + = positive; - = poor; ? = insufficient information or unidentified; ↓ = sample < 50 subjects; 0 = observed; no = not observed. BBA = Brunel Balance Assessment; BBS = Berg Balance Scale; FM-B = Fugl-Meyer Assessment (balance section); FSST = Four Square Step Test; Mini BESTest = Mini Balance Evaluation Systems Test; PASS = Postural Assessment Scale; STS = Static Tandem Standing; TUG = Timed UP & G.

Table 2 - Studies of construct and concurrent validity

(To be continued)

Reference and test	Objectives	Subjects	Psychometric properties/ applicability
Mao et al.(32) BBS, PASS and FMA = balance section	Compare the psychometric properties of the instruments (reliability, concurrent validity, convergent and predictive).	123 hemiparetic patients in the acute phase followed until 180 days after stroke	Acceptable levels of concurrent validity, convergent ($r \geq 0.86$, $p < 0.0001$) and predictive ($r \geq 0.8$, $p < 0.0001$). Responsiveness, measured by the effect size (ES) was high before 90 days (≥ 0.63) and low 90 to 180 days ($0.31 \leq ES \leq 0.4$). Psychometric characteristics of the PASS were considered better than the other scales.

Table 2 - Studies of construct and concurrent validity

(To be continued)

Reference and test	Objectives	Subjects	Psychometric properties/ applicability
Wang et al. (31) BBS and PASS	Compare the psychometric properties of the short form of the instruments (BBS-3P, PASS-3P) with the original (BBS and PASS) versions.	77 hemiparetic subjects in the first part of the study and 226 in the second part	High concurrent validity between the instruments ICC = 0.99 (BBS and BBS-3P), ICC = 0.97 (PASS and PASS-3P). The lower limb subscale of the FMA had a positive correlation with BBS ($r = 0.65$, $p = 0.002$) and the balance section of FMA ($r = 0.499$, $p = 0.047$). The scales were correlated.
Smith PS et al. (21) BBS and Functional Reach	Assess the best instrument for measuring balance in individuals post stroke.	75 hemiparetic patients	The performance of individuals in BBS was associated with performance on Functional Reach, $r = 0.78$ for the whole sample. The authors emphasized that the Functional Reach requires a shorter time for application.
Chou et al. (30) BBS	Develop a reduced version of the BBS.	226 hemiparetic subjects in the acute phase	Both scales showed significant improvement in dynamic balance during the four weeks (ICC ≥ 0.96 BBS original with the reduced version). Concurrent validity ($r \geq 0.97$) scores of the shortened version were high. Convergent validity of the scores on the short version with the scores of the Barthel Index ($r = 0.84-0.86$). The short version with seven items of the BBS-3P showed similar psychometric properties to the original scale.
Oliveira et al. (20) BBS	Correlate the performance of FMA, BBS and the Barthel index.	20 chronic hemiparetic subjects	The scales were moderately correlated. Barthel and Motor section of FMA ($r = 0.58$, $p = 0.005$) and lower extremities of the FMA ($r = 0.49$, $p = 0.007$) section.
Frykberg et al. (36) BBS	Correlate the clinical assessment of balance with posturography.	20 chronic hemiparetic subjects	The displacement speed of the center of pressure anteriorly showed moderate negative correlation with BBS ($r = -0.50$, $p = 0.05$).

Table 2 - Studies of construct and concurrent validity

(To be continued)

Reference and test	Objectives	Subjects	Psychometric properties/ applicability
Tyson and De Souza (18) BBA	Evaluate the reliability, construct validity and concurrent validity of the scale.	92 hemiparetic patients (not specified whether acute or chronic)	Correlation with BBS was significant (0.97, $p < 0.01$).
Blennerhassett and Jayalath (27) FSST and ST	Assess whether the FSST is feasible, valid, and sensitive to change during rehabilitation of individuals post stroke.	37 hemiparetic patients	Strong agreement of scores on FSST and ST in the same session. Moderate to strong inverse relationship between ST and FSST scores at each evaluation ($r = -.73$ to $-.86$).
Franchignoni et al. (35) Mini BESTest	Develop a reduced version of the BESTest using classical psychometric techniques and Rasch model.	115 patients with various neurological diagnoses (among them, 22 subjects with hemiparesis, unspecified as acute or chronic)	The Mini BESTest is a screening instrument that showed adequate construct validity. Rasch analysis on all 14 items showed good values of <i>InFit</i> and <i>outfit MnSq</i> . The variance explained by the estimated measure of the Rasch model was 58.8%.
Fujisawa and Takeda (25) Side Step Test	Assess the test-retest reliability and investigate the concurrent validity with other tests such as the ability to stand on one leg and gait measures.	28 acute and subacute hemiparetic subjects after hospital discharge	High correlation between the measurement of the maximum length of lateral step (in Side-step test) and maximum gait speed and step length ($r = 0.84$ to 0.89). Significant correlation between the duration measure of the leg support and the "side-step" test, maximal gait speed and step length.
Faria et al. (33) TUG	Compare the TUG between individuals with and without hemiparesis, considering the direction toward which they turned during the test, and determine the potential clinical variables that could explain possible observed differences.	22 hemiparetic subjects (acute and chronic) and 22 controls.	Stroke subjects were slower than the control group in the TUG; similar performances were observed when turning toward the paretic and nonparetic/matched sides. Fear of falling was responsible for 44% of the variance observed. Significant correlation between gait speed, balance and fear of falling ($-0.69 < r < -0.52$, $p < 0.13$).
Ng and Hui-Chan (34) TUG	Assess test-retest reliability, and discriminatory capacity of the instrument.	10 healthy elderly subjects and 11 subjects with chronic stroke.	The test was able to differentiate individuals with stroke from healthy individuals.

Table 2 - Studies of construct and concurrent validity

(Conclusion)

Reference and test	Objectives	Subjects	Psychometric properties/ applicability
Tyson and De Souza (26) Supported Standing Balance, Standing Arm Raise, Standing Forward Reach, Static Tandem Standing, weight shift, timed 5-m walk with and without an aid, and Tap and Step-up tests	Evaluate the reliability and validity of various functional tests to assess balance after stroke.	48 subjects (acute and chronic stroke)	The tests Supported Standing Balance, Standing Arm Raise, Standing Forward Reach, Static Tandem Standing showed a significant correlation with the BBS ($r = 0.33$ to 0.7). The Tap test also showed significant correlation ($r = 0.74$) but the correlations between BBS and Step-up test and Weight shift test were not significant (0.19 and 0.26 , respectively).
Yoneyama et al. (38) PASS	Validation of the Brazilian version of the PASS.	19 subjects (chronic stroke)	Showed high correlation with FMA ($r = 0.79$) and adequate internal consistency (0.83).

Note: BBS = Berg Balance Scale; PASS = Postural Assessment Scale; TUG = Timed UP & Go; FSST = Four Square Step Test; ST = Step Test; BBA = Brunel Balance Assessment; FMA = Fugl Meyer Assessment; Mini-BESTest = Mini Balance Evaluation Systems Test; ICC = intraclass correlation coefficient.

Table 3 - Studies of predictive criterion validity

(To be continued)

Reference and test	Objectives	Subjects	Psychometric characteristics
Garland et al. (3) BBS	Investigate whether the recovery of functional balance is accompanied by changes in measures of postural control.	27 hemiparetic subjects in the acute phase	Improved measurement of BBS 14 ± 7.1 among a period of one month ($p < 0.001$).
Mackintosh et al. (6) BBS and ST	Evaluate the predictive validity of the instruments.	55 hemiparetic subjects in the acute phase	History of falls during hospitalization and/or rehabilitation associated with a score lower than 49 on the BBS and less than 07 in ST, were predictors of two or more falls during the period of six months.
Persson et al. (17) BBS, TUG, Swedish Postural Assessment Scale	Evaluate the ability of clinical tests conducted during the first week after stroke, to identify the risk of falling during the following year.	96 hemiparetic subjects in the acute phase	All tests were associated with the risk of falling. The cutoff points for predicting risk of falling were: score ≤ 42 for the BBS and ≥ 15 seconds for the TUG. The positive predictive value observed for the BBS was 64%.

Table 3 - Studies of predictive criterion validity

(Conclusion)

Reference and test	Objectives	Subjects	Psychometric characteristics
Tyson et al. (1) BBA	Evaluate the predictive validity of the instrument by assessing the influence of the deficiency balance in function and recovery of function after stroke.	102 hemiparetic subjects in the acute phase	The deficiency of the initial balance was strong predictor of function and recovery after stroke. This result demonstrated the predictive validity of the BBA.
Blennerhasset et al. (28) FSST and ST	Investigate if the clinical tests predict falls or limited mobility in the community.	30 hemiparetic subjects in the chronic phase	Significant improvements occurred for the ST (MD = 1.8 steps, 95% CI = 0.3-3, p = .03) and FSST (MD = 4.3s, 95% CI -10.3-1.6, p = 0.05). 40% of participants reported a fall. The cutoffs were < 10 in ST and unable or ≥ 15 seconds to complete the FSST.

Note: BBS = Berg Balance Scale; PASS = Postural Assessment Scale; TUG = Timed UP & Go; FSST = Four Square Step Test; ST = Step Test; BBA = Brunel Balance Assessment.

Discussion

The results of this systematic review revealed nine tests with a single task and six instruments with multiple viable tasks for balance assessment of individuals with hemiparesis. The following were the single-task tests: TUG test, functional reach test, step test, four-square step test, side step test, supported standing balance, standing arm raise, static tandem standing, and weight shifting. The multiple-task instruments were the BBS, BBA, Fugl-Meyer scale section of balance assessment, Mini-BESTest, and PASS. The most widely used instrument for balance assessment in hemiparetic individuals in the intervention studies was the BBS (39, 41, 43-48). The BBS was sensitive to changes in the evaluation results of the intervention programs performed in that it observed significant differences in pre- and post-intervention scores in all the studies.

The BBS consists of 14 items that assess static and dynamic balance in a functional context, that is, during activities such as going from sitting to standing and picking up an object on the ground. Owing to the extensive evaluation of its psychometric properties and its widespread use in research and clinical practice, the scale has been used as a reference tool to establish construct validity in studies that used new

balance assessment tools for hemiparetic patients (18, 26, 36). A cutoff score of 42 was suggested by Persson and colleagues to predict falls in patients during the first year after stroke (17). However, Mackintosh and colleagues reported that a score of 49 on the scale was predictive of recurrent falls within 6 months after rehabilitation, with a sensitivity and specificity higher than 80% (37). The BBS, despite being the most frequently used and studied assessment tool for hemiparetic individuals, showed a ceiling effect, which is probably associated with the lack of tasks for balance assessment while walking, suggesting that the scale cannot detect changes when used in individuals with mild impairment (36). The scale was translated and validated for Brazilian Portuguese by Miyamoto and colleagues in 2004, in their study among the elderly (49).

The PASS is a range of easy and fast applications to evaluate static and dynamic balance, as well as balance skills, during postural transfers in the acute and chronic post-stroke phases (47). The original version was created by Benaim et al. in 1999 (50) and was based on three main aspects as follows: the postural control depends on two domains that can be assessed (ability to maintain posture and balance with position change); a scale that can be used in all patients, including those with large postural defects; and a

sensitive scale that contains tasks with increasing levels of difficulty. The PASS was validated in Brazil by Yoneyama et al. in 2008, showing construct validity, internal consistency, and interobserver and intraobserver reliabilities, which makes it suitable for use in clinical practice (38).

The Fugl-Meyer assessment is a quantitative tool for measuring sensorimotor recovery after stroke. The scale has a section for balance assessment, which can be used separately and in which a ceiling effect (36) was identified. The Brazilian version of the scale was developed by Maki and colleagues in 2006 (51).

The BBA has the advantage of being a hierarchical scale, which combines a series of functional tests, forming an ordinal scale (18). The scale consists of 14 items that are assessed from a sitting position, with support for balance while standing. The scale demonstrated adequate content validity, construct, internal consistency, and reliability. No information about the responsiveness of the scale was found.

The Mini-BESTest is the only instrument that combines gait in a cognitive task, an important aspect of postural control and balance. Moreover, it was analyzed using the Rasch model, which enables assessment of the relevance or contribution of an item for measuring a certain construct, possible redundancy in relation to other items in the scale, and appropriateness in the response categories (35). The Mini-BESTest (35) was developed from the BESTest, an instrument created by Horak and colleagues in 2009 (52) with the aim of aiding in the identification of postural control systems that may be responsible for altering functional balance. The Mini-BESTest is a screening instrument formed by 14 items that measure the “dynamic equilibrium” construct and that requires 10–15 minutes to administer (35). The Mini-BESTest has not been studied specifically in a stroke population but has been studied in a sample of individuals with different neurological conditions, including hemiparesis. Although the instrument is potentially useful, it is new and still in the process of validation in Brazil.

Among the single-task tests, the step test, side step test, four-square step test, functional reach test, and TUG test are highlighted in this review. The step test was developed to assess dynamic balance during an activity that requires weight bearing and movement while maintaining one-leg support (44). The measure is scored by the number of times an individual can climb a 7.5-cm-high stair step in 15

seconds. The test proved to be reliable for hemiparetic people (37; 41-44). The side step test evaluates weight-bearing characteristics in the frontal plane that are often related to difficulties in maintaining standing balance in hemiparetic individuals. The test is performed with no support both on the paretic and nonparetic sides. Five repetitions of side steps are performed as widely as possible over a 10-m line. The test is scored according to the total distance moved, divided by the number of steps. It also showed good reliability (25). The four-square step test measures the ability of an individual to pass over obstacles and change direction during gait (27). The test consists of walking to four points marked by sticks placed on the ground in a cross shape. The score is given by measuring the time taken to complete the task of walking clockwise and counterclockwise. Reliability was not reported for hemiparetic individuals, but the authors reported good reliability for the elderly (27). The test was sensitive enough to detect changes during rehabilitation in hemiparetic individuals (27). The functional reach test assesses the anterior stability limits. The test is defined as the maximum distance that the individual can reach forward, beyond the length of the upper limb, while maintaining a fixed base of support in the standing position. In a study that correlated the performance of individuals in the functional reach test with that in the BBS, a positive association was found between the instruments (21). Except for the TUG test, no specific information regarding the construct validity of single-task trials was identified.

The TUG test assesses changes in dynamic balance while performing the task of getting up from a chair, walking 3 m, turning 180°, returning to the chair, and sitting (33). The method of scoring is by measuring the time taken to complete the task. The test has excellent reliability and is useful for differentiating subjects with hemiparesis from healthy individuals (40). The direction of return, either to the paretic or nonparetic side, did not seem to influence the test results (33). The TUG test, despite being considered as a single-task test, assesses various components often involved in falls, such as standing, walking, and turning. The measure, however, is given by the time spent performing the task, not providing specific information on which features may have contributed more to the balance deficit (39, 40). A measure ≥ 15 seconds was predictive of the risk of falls in patients during the first year after stroke (17).

The choice of an instrument based on evidence should take into account its specific application, for example, if the instruments will be used for screening, to measure progression, or to guide intervention programs. Instruments to measure progression should provide good responsiveness, whereas instruments for screening do not need to be responsive to change. Single-task tests have the advantage of a shorter time for implementation, making it useful for screening procedures, although it provides little information about the possible deficits presented by patients. Meanwhile, multiple-task instruments can help to identify more specific deficits in postural control, including items that assess balance in different contexts and while performing functional activities. Some multiple-task instruments incorporate single-task tests as one of the items of the scale, often with minor adaptations, as in the case of the Mini-BESTest, in which the TUG test is included with a cognitive task (35), and the BBA, which includes the weight shifting (18). This is an advantage as it allows associating information from single-task tests within a broader context.

Another issue to be considered is whether the instruments have been already translated and validated for the Brazilian population. Validation of a test that has not been developed in the country where it will be used is important to avoid threats to the validity of the instrument. In this study, the Brazilian versions of the following scales were identified: the BBS (45), PASS (47), and FSM (48).

It is noteworthy that all the instruments analyzed do not require specialized equipment or formal training to implement and can be used in the clinical practice of physiotherapists. Such instruments are important tools, and as their application is not time-intensive, they may be used in combination, with consideration of the strengths and weaknesses of each.

Tyson and Connel, in a systematic review (19), analyzed studies that evaluated the reliability, validity, and clinical utility of measures of balance in adults with different neurological conditions. The authors conducted a review considering the time required to administer the test, cost, need for specialized equipment and training, and portability. After the analysis, the authors identified a total of ten psychometrically robust and accessible tests for use in clinical practice, including the BBS and BBA. This review, however, did not examine specifically

instruments used in hemiparetic individuals, who have different characteristics from those with other neurological conditions. In another systematic review identified in our search, Pollock et al. (53) aimed to identify measures for balance assessment during gait in post-stroke patients. Despite balance changes in gait being major post-stroke disabilities (3), some multiple-task instruments do not include items related to gait, such as the BBS, PASS, and FSM.

This review was limited by the analysis of studies published over the last ten years in English, Spanish, and Portuguese, and the fact that three studies were excluded because of failure to access their full texts. Moreover, in a systematic review, the quality of the review relies on the studies identified. We observed that some studies had small samples and many do not adequately characterize the sample, not specifying the severity and phase of the stroke. Only few psychometric properties have been thoroughly investigated. Only one study evaluated the “minimal real change,” and no study has assessed the clinically significant minimal change.

Final considerations

The scientific literature in neurological rehabilitation has published several research studies on balance assessment tools. Multiple-task instruments provide a more detailed balance assessment, whereas single-task instruments may be useful as screening tools for balance disorders.

Although recommending a single instrument for balance assessment in hemiparesis is not reasonable, the BBS stands out in that its psychometric properties have been widely studied, having been used in most intervention studies and validated for the Brazilian population. However, the presence of ceiling and ground effects has been emphasized, suggesting that the use of the instrument be limited to patients with moderate dysfunction.

Some psychometric properties of the instruments remain unexplored, thus requiring further studies to better discriminate the ideal instrument for each clinical situation. As not all instruments have been validated for the Brazilian population, further studies are also needed for translation and adaptation of the instruments in Brazil.

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