Validation of the Morse Fall Scale – Brazilian version for institutionalized older adults (MFS-B/ ILPI)

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Abstract

Objective: To validate the criterion and construct of the Morse Fall Scale - Brazilian version (MFS-B) for institutionalized older adults. *Method:* Methodological validation study nested within a longitudinal study. The research was conducted in two Homes for the Aged (ILPIs), involving 172 older individuals. Data were collected through direct assessment of the older adult and chart data. Analysis was performed using descriptive and inferential statistics including ROC curve, sensitivity, specificity, Pearson correlation, and Exploratory and Confirmatory Factor Analysis. *Results:* The best estimate for predicting falls was at the cutoff point of 45 points on the MFS-B for institutionalized older adults, with a sensitivity of 93.3% and specificity of 58.9%. When analyzing the reliability of the MFS-B with the exclusion of the item "intravenous therapy/saline or heparin flush catheter" – "IV therapy/SHFC" reliability improved ($\alpha \geq 0.700$), and this exclusion was also supported by Exploratory and Confirmatory Factor Analysis. *Conclusions:* The results indicate a good predictive ability of the MFS-B for institutionalized older adults, with improved accuracy when excluding the item "IV therapy/SHFC". These findings supported the adaptation of the MFS-B to five assessment items, referred to as MFS-B/ ILPI.

Keywords: Aged. Homes for the Aged. Accidental Falls. Patient Safety. Validation Study.

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INTRODUCTION

Falls are defined as "an event resulting in the unintentional rest of an individual on the ground or at a lower level than their initial position" and are the second leading cause of death from accidental or unintentional injury worldwide[1]. Age is one of the primary risk factors for falls, with a higher risk of death or serious injuries resulting from this incident, and the risk of falls increases proportionally with age. Approximately 20 to 30% of older adults who fall suffer moderate to severe injuries[1].

Older adults with markers of frailty have up to 53% higher chances of experiencing recurrent falls[2]. Although environmental factors are not identified as predictors of falls[2], it is worth emphasizing that the mobility of older adults can be affected by environmental obstacles, leading to falls, fractures, hospitalization, and even death.

The impact of falls increases with population aging, constituting a public health problem, with prevention being a challenge[1]. In addition to falls among older adults that occur in the community, falls in Homes for the Aged (ILPIs - Instituições de Longa Permanência para Idosos) have significant records, ranging between 27.5% and 48.5% [3,4].

Therefore, it is necessary for ILPIs teams to have knowledge about risk factors and develop interprofessional actions for fall risk assessment and prevention[3]. Early identification of fall risk is one of the strategies for preventing the incident[5,6]. However, scales for predicting fall risk applicable specifically to institutionalized older adults have not been identified.

Among the instruments used to assess fall risk, the Morse Fall Scale in the Brazilian version (MFS-B) stands out, validated for hospitalized adults[7]. A study utilized this scale to assess the risk of falls in institutionalized older adults, demonstrating the association of MFS-B risk classifications with the occurrence of falls[3]. Despite these results, the authors suggested adapting the MFS-B for this population[3]. Thus, this study addressed the hypothesis: "Does the MFS-B have accuracy in detecting the risk of falls in institutionalized older adults?" and aimed to validate the criterion and construct of the MFS-B for use in ILPIs.

METHOD

A methodological study of criterion and construct validation was conducted, aiming to assess the accuracy of the MFS-B in predicting falls in ILPIs, nested within a prospective study conducted in two ILPIs in the municipality of Porto Alegre, Rio Grande do Sul, Brazil. The study was conducted in 2019, with a follow-up period of nine months. The selection of institutions was convenience-based, as they represented the two largest ILPIs in the municipality with similar characteristics of being philanthropic institutions and of the participants, with all institutionalized older adults who agreed to participate in the research being included. Those who lacked the necessary communication capacity for the application of the sixth item of the MFS-B (mental state) were excluded.

Data collection began after the project was approved by the Research Ethics Committee of the institution, under Opinion Number 2,877,992 and CAAE Number 95243418.5.0000.5336. All included participants, or their legal guardians, signed the Informed Consent Form (ICF).

For data collection, records were assessed (age, sex, and length of institutionalization), along with direct assessment of the older adult through the administration of the MFS-B[5]. In the event of a fall, the administration of the MFS-B and the collection of data related to the incident were recorded in the ILPIs' safety incident notification book.

Each older adult included in the study was assessed once and reassessed in the event of a fall, with the administration of the MFS-B at these two distinct moments. Following this initial assessment, researchers and ILPIs teams-maintained surveillance regarding the occurrence of falls during the study follow-up period. Older adults who experienced a fall were attended to according to each institution's routine. Data were organized through independent double data entry and correction of inconsistencies.

For the purpose of accuracy analysis, the MFS-B values from the day of the fall were considered for older adults who fell, and the MFS-B values from the initial assessment were considered for older adults who did not fall.

For descriptive analysis, measures of central tendency, variability, and assessment of symmetry (Kolmogorov-Smirnov test) were used for continuous numerical variables. When skewness was identified, median and interquartile range or range were utilized. Categorical variables were analyzed using absolute and relative frequencies. For inferential analysis, aiming to assess the association and correlation between exposure and outcome, association tests (chi-square or Fisher's exact test) and Pearson correlation test were performed, with significance levels set at 5%. For predictive validation of falls by the MFS-B, the Receiver Operating Characteristic (ROC) curve and the cutoff point evaluated by sensitivity, specificity, and Youden's Index were used.

The reliability of the MFS-B was analyzed by internal consistency through the correlation between two halves using Guttman's Split-Half method, and correlations were assessed using the Spearman-Brown formula.

In the Construct Validation, to identify the original structure of the items in the MFS-B, Exploratory Factor Analysis (EFA) was employed, respecting sample adequacy [Kaiser-Meyer-Olkin (KMO)] with factor extraction through the decomposition of the polychoric correlation matrix using the Principal Factors method. For retention, Kaiser's method (eigenvalues >1), Bartlett's test of sphericity, and scree plot analysis were utilized. The Varimax oblique rotation method was selected for rotation.

In order to validate the factorial structure identified in the EFA, Confirmatory Factor Analysis (CFA) was employed using the AMOS GRAFICS 21.0 module of SPSS. The quality of model fit was evaluated, in addition to the chi-square test (acceptable values between 1 and 3) to verify the fit of the theoretical model to the data, based on the following indices: a) Tucker-Lewis Index (TLI), b) Goodness of Fit Index (GFI), c) Adjusted Goodness of Fit Index (AGFI), d) Comparative Fit Index (CFI), e) Standarized Root Mean Square Residual (SRMR), and f) Root Mean Square Error of Approximation (RMSEA). Indices "a", "b", "c", and "d" evaluate model fit, with values between 0.90 and 0.95 considered acceptable, and values above 0.95 indicating a good fit [8]. Indices "e" and "f" are indicators of residual and error; values between 0.05 and 0.08 are considered indicative of good fit for SRMR and RMSEA, respectively [9]. The Maximum Likelihood Estimation (MLE) method was used in this study. Finally, the adequacy of the model was tested by comparing the fit indices of the data in alternative models: MFS-B Model with five items and MFS-B with six items.

DATA AVAILABILITY

The data set is not publicly available as it contains information that compromises the privacy of the research participants.

RESULTS

Of the 225 institutionalized older adults in ILPIs during the study period, 34 were not included due to meeting the exclusion criteria, and 19 declined to participate in the research. Therefore, 172 institutionalized older adults participated in the study.

Among the participants, females predominated (n=111; 64.5%) with ages ranging from 61 to 99 years [median=80 (1st-3rd quartile: 73 – 85)]. The median length of institutionalization was 4 years (minimum <1 year and maximum of 29 years).

The incidence of falls was 35% (n=60). In the initial assessment of fall risk using the MFS-B, a median score of 55 points (range from zero to 105 points) was achieved. Considering the risk estimate among older adults who experienced falls [(Median (1st-3rd): 65 (55-90)] and those who did not experience falls [(Median (1st-3rd): 40 (25-65)], there was a statistically significant difference ($p<0.001$), indicating a higher fall risk score by the MFS-B among older adults who experienced falls.

When assessing the classification of fall risk based on MFS-B scores, high risk predominated (n=102; 59.3%) followed by moderate risk (n=50; 29.1%), with low risk being least common (n=20; 11.6%). In the assessment of older adults who experienced falls (n=60), MFS-B scores on the day of the fall were predominantly in the high-risk category (n=56; 93.3%), followed by moderate risk (n=4; 6.7%). No older adult classified as low risk by the MFS-B experienced a fall.

Thus, a statistically significant association was evident between falls and the classification of high risk, and between no falls and low and moderate risk ($p<0.001$).

In individual analysis, options in five items that score risk in the MFS-B were associated ($p<0.0001$) with falls (history of falls, secondary diagnosis, assistance with ambulation, gait, and mental status). The item "intravenous therapy/saline or heparin flush catheter" (IV therapy/SHFC) was associated ($p=0.012$), but only with one of the three older adults who used IV therapy/SHFC in the ILPIs. This indicated the need for investigation of this item in the MFS-B and the ability of the MFS-B to detect fall risk with this item missing.

The results presented in Table 1 indicated acceptable reliability (αS-H=0.682), considering the joint assessment of the six items of the scale. However, an improvement in reliability was identified with the deletion of the item "IV therapy/SHFC", where the coefficient became 0.772 (αS-H), meaning that the reliability changed from acceptable to satisfactory (αS-H $\geq$0.700).

In order to identify the unidimensionality characteristic of the scale across the six items, Exploratory Factor Analysis (EFA) was employed. The dataset yielded an estimate of 0.87 for KMO (Kaiser-Meyer-Olkin measure of sampling adequacy), and a significant chi-square value: [χ^2 (15)=183.084; $p<0.001$)], indicating the feasibility of proceeding with EFA. Using the Kaiser criterion (eigenvalues >1), two factors were extracted, achieving an explained variance of 72.19% [Factor 1–61.6%; Eigenvalue=2.356/Factor 2–10.6%; Eigenvalue=1.002]; and a significant result for the Bartlett test ($p<0.001$).

In the composition of the factors, Factor 1 encompassed the items "History of Falls", "Secondary Diagnosis", "Assistance with Ambulation", "Gait", and "Mental State". In contrast, Factor 2 consisted of the item "IV therapy/SHFC", with a factor loading below 0.300 and a communal variance of 0.176, indicating that this item is not representative in explaining the variability of the scale. This finding was further confirmed by the scree plot analysis graph, suggesting the relevance of a single factor that significantly contributes to the explained variance of the scale.

Thus, as observed from the description of item content, factor loadings, and communalities indices, the most appropriate factorial model comprises a single factor composed of five items, which does not reflect the original structure of the MFS scale. Factor loadings associated with Factor 1 ranged from 0.426 (Assistance with Ambulation) to 0.972 (Secondary Diagnosis), indicating a good ability of the items to consistently explain the construct. In contrast, the only item forming Factor 2 was IV therapy/SHFC, with a non-representative factor loading (0.216) considering the sample size, suggesting that this item did not prove to be relevant compared to the other scale items and in accordance with the Factor Loadings Matrix for the items of MFS-B (Table 2).

Table 1. Descriptive measures and reliability estimate for the items of the MFS-B (n=172). Porto Alegre, RS, Brazil, 2019.

MFS-B Itens	Descriptive statistics			Reliability Statistics		
	Mean	Sd	Median	Corrected Total Item Correlation	Guttman Reliability (S-H)*	Split Half if Item Excluded
History of Falls	12.5	12.5	12.5	0.316	0.682	0.440
Secondary Diagnosis	14.3	3.2	15.0	0.117		0.577
Assistance with Ambulation	5.8	8.2	0.0	0.450		0.318
Intravenous Therapy	0.1	1.5	0.0	0.006		0.772
Gait	10.8	8.1	10.0	0.403		0.444
Mental state	9.6	7.2	15.0	0.441		0.433

MFS-B: Morse Fall Scale - Brazilian version; *Guttman's Split-half coefficient for two halves. Source: Authors, 2023.

Table 2. Factor loading matrix for the items of MFS-B (N=172). Porto Alegre, RS, Brazil, 2019.

MFS-B Itens	Communality (Extraction)	Factor Loadings	
		Factor 1	Factor 2
History of Falls	0.641	**0.557**	0.128
Secondary Diagnosis	0.457	**0.972**	-0.234
Assistance with Ambulation	0.810	**0.426**	0.061
Intravenous Therapy/Saline or Heparinized Intravenous Device	0.176	-0.015	**0.216**
Gait	0.839	**0.612**	0.204
Mental state	0.604	**0.418**	0.190

MFS-B: Morse Fall Scale - Brazilian Version. Source: Authors, 2023.

From the model with five items, the Confirmatory Factor Analysis (CFA) procedure was employed to assess the fit of this new unifactorial structure. Using Maximum Likelihood estimation, the fit of the theoretical model to the dataset was initially assessed through the adjusted chi-square test for degrees of freedom, which indicated a good fit. Based on this result, using an estimate less sensitive to sample size, there is evidence that the structural model reached an estimate that did not significantly differ from the analyzed real dataset.

In the factorial model with the exclusion of the "IV therapy/SHFC" item, the results were as follows: a) the estimate for the Standardized Root Mean Square Residual (SRMR) was 0.058, indicating good fit, meaning that the differences between the estimated model and the actual data were not significant; b) the Root-Mean-Square Error of Approximation (RMSEA) demonstrated an acceptable measure of fit for the factorial model, not only over the sample but also for the population (0.074 (90% CI = 0.019 - 0.169; $p < 0.05$)); c) the Goodness-of-Fit Index (GFI) showed an estimate of 0.938, indicating that the factorial model had high explanatory power and precision over the actual sample data; d) when this same index was adjusted for Adjusted Goodness of Fit Index (AGFI), the estimate again proved satisfactory, with a value of 0.909; e) the convergent validity of the proposed model for MFS-B with five items, through incremental fit measures by the Comparative Fit Index (CFI), achieved an index of 0.965, indicative of significant adjustment; f) corroborating this result, the Tucker-Lewis Index (TLI) was estimated at 0.912, demonstrating robustness and satisfactory adequacy of the tested model. Thus, all results were superior when compared to the factorial model with the original composition of MFS-B with six items

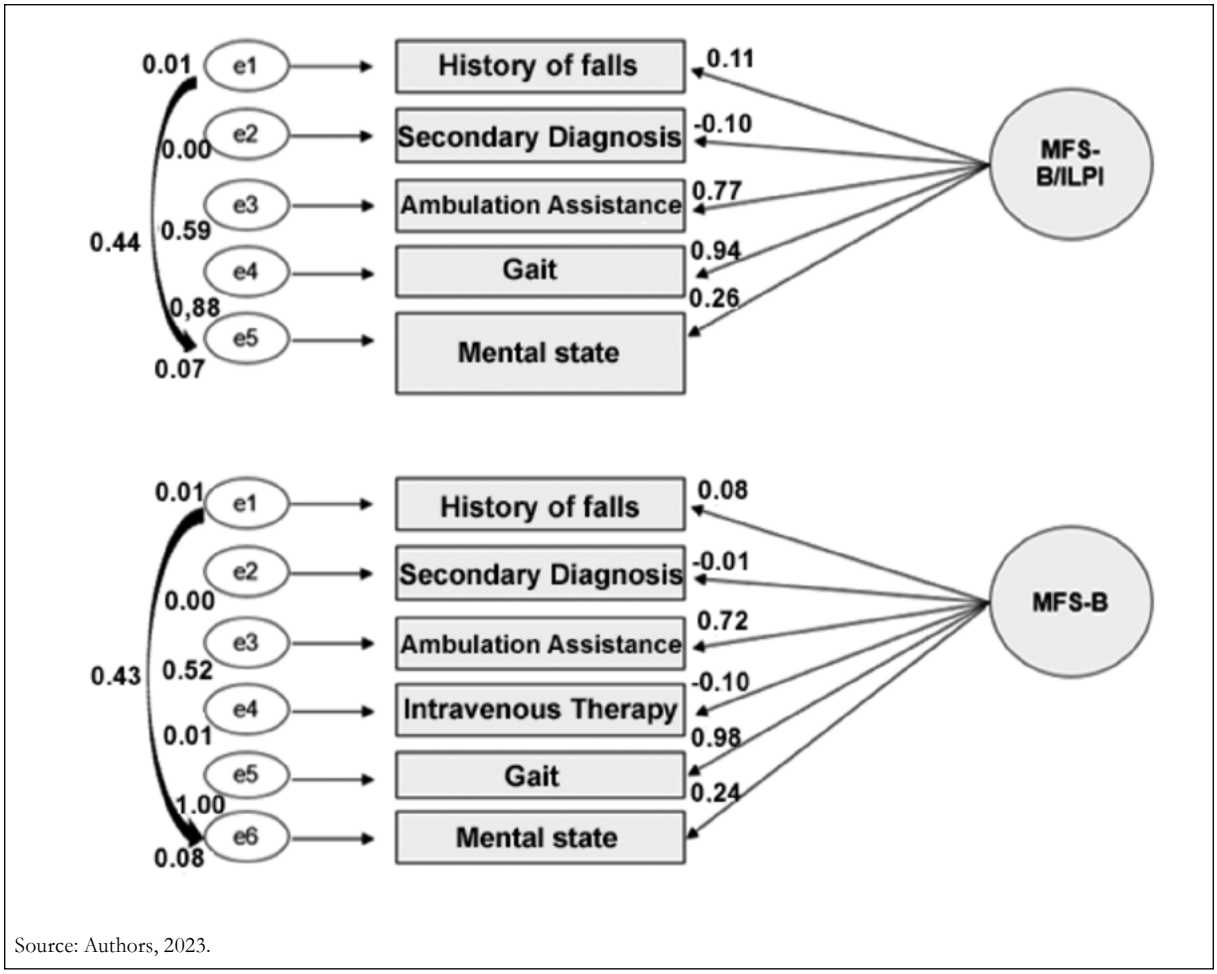
(AGFI=0.874; GFI=0.922; RMSEA=0.153 [0.110–0.199]; TLI=0.650; SRMR=0.101).

Regarding the factor loadings (λ) observed in the model for each of the five items, they revealed factorial validity ($p < 0.05$). Figure 1 presents the final confirmatory factorial structure, with saturations (factor loadings, λ) statistically different from zero, including solutions for the original MFS-B model with six items, as well as for the MFS-B with five items (excluding "IV therapy/SHFC").

In the analysis for predictive validity, aiming to assess the accuracy of MFS-B in predicting the outcome of falls, Receiver Operating Characteristic (ROC) curve analysis was utilized (Figure 2). In the analysis of the relationship between cases that presented falls and the total score of the scale, the best estimate obtained in the area under the ROC curve was 0.807 (95% CI: 0.745–0.870) for MFS-B with its original six items. In the same evaluation, excluding the "IV therapy/SHFC" item, the best estimate obtained in the area under the ROC curve was 0.811 (95% CI: 0.749–0.873). Thus, it was named MFS-B/ILPI with a sensitivity of 0.933 (93.3%) and specificity of 0.589 (58.9%) at the cutoff point of 45 points, validated by the Youden index equal to 52.2.

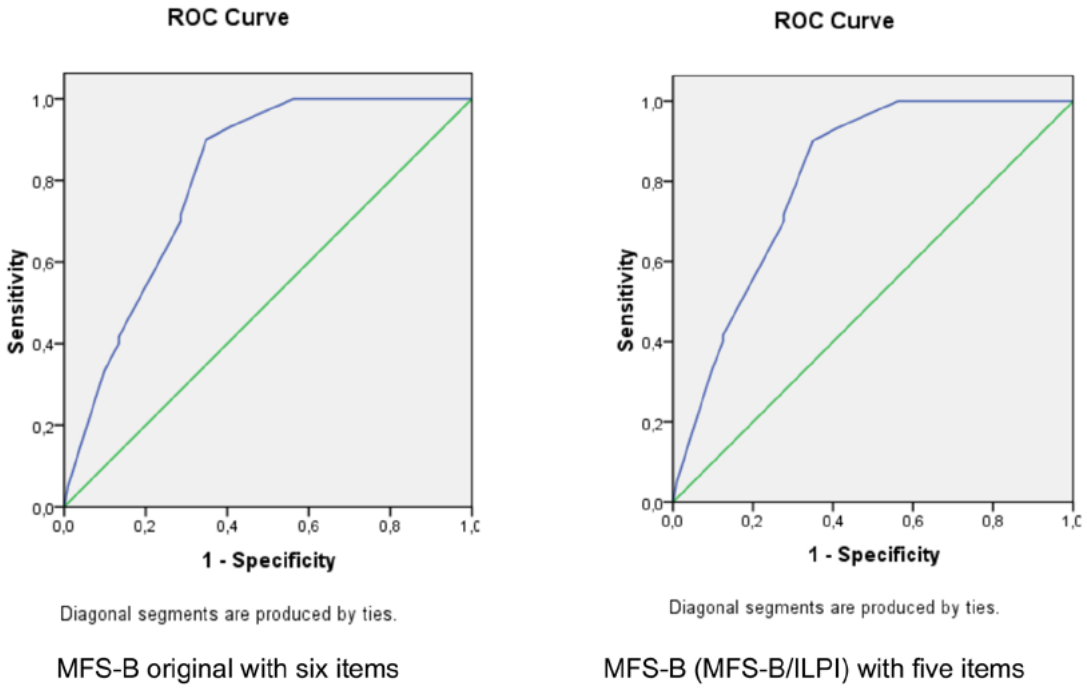
In the correlation analysis between MFS-B with the six items of the scale and falls, a high correlation was obtained (r=0.508). However, for MFS-B/ILPI with five items, there was a slightly higher correlation (r=0.512), demonstrating a slight increase in the magnitude of association compared to MFS-B.

Thus, Chart 1 presents the MFS-B/ILPI with five items and their operational definitions adapted to the reality of the ILPI and the older adult.



Source: Authors, 2023.

Figure 1. Standardized factorial structure of MFS-B for unifactorial models with five items, excluding the "IV therapy/SHFC" item, and with six items (n=172). Porto Alegre, RS, Brazil, 2019.



Source: Authors, 2023.

Figure 2. ROC curve for the total score of MFS-B, with six and five items for the occurrence of falls in institutionalized older adults (N=172). Porto Alegre, RS, Brazil, 2019.

Chart 1. Morse Fall Scale - Brazilian version adapted for Homes for the Aged (MFS-B/ILPI), its scoring, and operational definitions of each item. Porto Alegre, 2023.

Morse Fall Scale – Brazilian version for institutionalized older adults (MFS-B/ILPI)		
MFS-B/ILPI item	Score	Operational Definition
1 - History of Falls		
No	0	If the older adult has no history of falls in the past three months.
Yes	25	If the older adult has fallen during their stay in the ILPIs or has a recent history (up to three months) of falls due to physiological causes such as seizures or compromised gait before institutionalization.
2 - Secondary Diagnosis		
No	0	If the older adult's medical record presents only one medical diagnosis.
Yes	15	If the older adult's medical record presents more than one medical diagnosis.
3 - Ambulation Assistance		
None / Bedridden / Assisted Ambulation by Healthcare Professional	0	If the older adult ambulates without assistive equipment (crutch, cane, or walker), OR If they ambulate with the assistance of a healthcare professional, OR If they use a wheelchair or are bedridden and do not get out of bed on their own.
Crutches/Cane/Walker	15	If the older adult uses crutches, cane, or walker.
Furniture/Wall	30	If the older adult moves by leaning on furniture/walls.

to be continued

Continuation of Chart 1

Morse Fall Scale – Brazilian version for institutionalized older adults (MFS-B/ILPI)		
MFS-B/ILPI item	Score	Operational Definition
4 – Gait		
Normal / No Ambulation, Bedridden, Wheelchair	0	Normal gait is characterized by walking with an upright head, arms swinging freely by the sides, and wide steps, without hesitation. It also receives the same score if the older adult is bedridden and/or uses a wheelchair (no ambulation).
Weak	10	Steps are short and may be hesitant. When the gait is weak, although the older adult leans forward while walking, they can raise their head without losing balance. Additionally, if they use furniture for support, it is done lightly only to feel secure, not to maintain an upright position.
Impaired/Wobbly	20	The older adult takes short, wobbly steps and may have difficulty getting up from a chair, needing to lean on the chair's arms to stand and/or propel the body (making several attempts to stand by pushing the body). With this type of gait, the older adult's head is lowered, and they look at the ground. Due to the lack of balance, they grasp furniture, a person, or use some walking aid equipment (crutches, canes, walkers) to hold onto and cannot walk without this assistance. When helping these older adults walk, the healthcare professional notices that they actually lean on them, and when the older adult leans on a handrail or furniture, they do so forcefully, until the joints of their fingers turn white.
5 – Mental status		
Oriented/ Capable of self-assessment	0	When asking the older adult, "Are you able to go to the bathroom on your own, or do you need help?" verify if the response **is** consistent with the information in the medical record and/or with your assessment. If so, the older adult is classified as capable.
Overestimates capacity/ Forgets limitations	15	When asking the older adult, "Are you able to go to the bathroom on your own, or do you need help?" verify if the response **is not** consistent with the medical record and/or your assessment or if the older adult's assessment is unrealistic. If this happens, this older adult is overestimating their abilities and forgetting their limitations.
Total score: Sum the points from each item of the MFS-B/ILPI and record the value. Risk classification: 0–24: Low Risk; 25–44: Moderate Risk; ≥45: High Risk.		

Source: Adapted from the MFS-B Operational Definition[7].

DISCUSSION

The validation of the MFS-B for the context of Homes for the Aged (ILPIs) resulted in the MFS-B/ILPI, a version that showed good accuracy in predicting falls in institutionalized older adults. A higher percentage of older adults who fell during this study had a high risk of falls (≥45 points). The occurrence of falls in patients classified as high risk for falls was also observed in studies that conducted the cross-cultural adaptation of the MFS for Brazil[5,7] and a study that applied the MFS in ILPIs[10].

One noteworthy point in the results concerns the reliability of the items in the MFS-B, as the set of six items demonstrated acceptable reliability. A similar result was found in a study that applied different scales to assess the risk of falls in institutionalized patients, which identified that the MFS can be used in this context[10]. However, in the ILPIs investigated, the item "IV therapy/SHFC" scored mostly zero, except for three older adults. This fact may be justified because ILPIs have residential characteristics, where older adults who need intravenous medications are generally referred to health services for this procedure.

The exclusion of this item was also evidenced in the Exploratory and Confirmatory Factor Analyses of the instrument, as it obtained the lowest factor loading and isolated itself in Factor 2. Thus, the limited use of intravenous devices in institutionalized older adults prompted the indication of the need for an adaptation

of the six-item MFS-B to a scale composed of five items - the MFS-B/ILPI. This reduction resulted in a slight increase in the magnitude of the correlation with falls when compared to the MFS-B.

The same performance was maintained in the analysis of the correlation between the MFS-B (six items) and the proposed version of MFS-B/ILPI (five items) with falls. Although both showed a high correlation, the magnitude increased in the adapted version for ILPI. All tests applied in the follow-up of the validation analyses indicated good fit, high explanatory power, high precision regarding the real sample data, and satisfactory adequacy of the estimated model. Thus, the quality indicators for the model of the MFS-B/ILPI scale with five items proved to be well-adjusted. Furthermore, if necessary due to the use of intravenous therapy, the original Brazilian version of MFS-B7[7] can still be utilized.

The MFS-B proved to be adequate for predicting the risk of falls in 80% of institutionalized older individuals and had a satisfactory peak in the ROC curve (0.807). However, there was an improvement in this predictive capability, reaching 81% when excluding the item "IV therapy/SHFC" (MFS-B/ILPI). Similar to the validation study of MFS for Brazil[5], the cutoff point for high risk remained at 45 points, with good sensitivity and specificity, indicating that this score should be maintained for the establishment of more robust measures or strategies for reducing falls in this institutionalized setting.

Indeed, research on the risk of falls, especially in institutionalized older individuals, is complex because falls are multifactorial events, and institutionalization significantly increases the risk of falls[11]. The higher incidence of falls in this population may be related to frailty and functional decline associated with the aging process[11].

In this context, the MFS-B/ILPI can contribute to analyzing the factors predisposing falls in ILPIs. It can also signal the risk of falls for older individuals and engage interdisciplinary teams and older person themselves. Through collaborative work, prevention actions for falls in ILPI environments can be planned and implemented. These aspects are highlighted in the WHO's Global Strategy on Aging and Health and the "Decade of Healthy Aging 2020-2030" plan, which includes a specific area for providing long-term care to older when needed[12]. Preventing avoidable harm related to falls is also addressed in the WHO's "Global Patient Safety Action Plan 2021-2030," launched in 2021[13].

The inclusion of only philanthropic ILPIs may represent a limitation and a selection bias in this research. However, it is worth noting that this is the first study to adapt and validate the MFS-B for use in the context of institutionalized older individuals to the best of our knowledge.

CONCLUSIONS

It is concluded that the MFS-B/ILPI with five items (excluding "IV therapy/SHFC") demonstrates predictive and construct validity for assessing the risk of falls in older individuals in ILPIs. The cutoff point for high risk remained ≥45, as in the assessment of hospitalized adults. The use of MFS-B/ILPI is suggested in future studies in ILPIs to corroborate these findings. Additionally, in ILPIs where older individuals use intravenous devices, the original version of MFS-B can be utilized.

AUTHORSHIP

- Vitor Pena Prazido Rosa: conception, analysis and interpretation of data, writing of the paper, approval of the version to be published, responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work.
- Thiana Sebben Pasa: analysis and interpretation of data, writing of the paper, approval of the version to be published, responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work.
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- Janete de Souza Urbanetto: conception, analysis and interpretation of data, writing of the paper, approval of the version to be published, responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work.

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