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Cross-cultural adaptation and measurement properties of the Brazilian Portuguese version of the spinal cord injury - Falls Concern Scale

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STUDY DESIGN: Psychometric study.

OBJECTIVES: To cross-culturally adapt the spinal cord injury-falls concern scale (SCI-FCS) to the Brazilian Portuguese language and to evaluate its measurement properties.

SETTING: SARAH Network of Rehabilitation Hospitals, Belo Horizonte, Brazil.

METHODS: The SCI-FCS was translated and culturally adapted to the Brazilian- Portuguese language, following recommended guidelines. The following measurement properties were verified: internal consistency (Cronbach's *a*), test–retest reliability (ICC and quadratic-weighted kappa coefficients), and construct validity (Rasch analysis).

RESULTS: One-hundred and thirty individuals participated. The median SCI-FCS-Brazil score was 27 (22–34). The Cronbach's α was 0.95; ICC was 0.92 (95% CI, 0.86–0.95) for the total test–retest scores, and the Kappa coefficients ranged from 0.04 to 0.87 (95% CI, 0.01–1) for the item-level reliability. Rasch analysis reliability index was 0.81 and 0.98 and the separation index was 2.10 and 6.25 for the persons and items, respectively. Both items and persons fitted the statistics model's expectations, ensuring its unidimensionality.

CONCLUSIONS: The SCI-FCS-Brazil showed adequate measurement properties. Its use in manual wheelchair users with SCI is recommended to help defining rehabilitation strategies.

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INTRODUCTION

Rehabilitation of people with spinal cord injury (SCI) aims to achieve greater functional independence, considering their biopsychosocial aspects. Among several factors, it is important to take into consideration the influence of fall episodes and their adverse consequences, as fall-related injuries have negative impacts on psychological health [1, 2].

The occurrence of falls is more frequent among individuals with SCI than in other vulnerable population, such as the elderly. A recent meta-analysis [3] showed that, among community-dwelling individuals with SCI, 78% of ambulators and 69% of wheelchair users reported one or more falls over the last 12 months. These rates are 30% and 40% higher, when compared with community-dwelling and institutionalized elderly, respectively [2].

Wheelchair use is essential for many individuals, to ensure an active engagement in activities of daily living, however, it can also increase potential risks of falls [4, 5]. Wheelchair SCI users commonly experience falls during situations, such as transfers, propelling wheelchairs, reaching objects, moving in bed, and showering [4, 6, 7]. The occurrence of falls is partly attributed to inattentive behavior, inexperience in wheelchair use, and lack safety equipment [1]. Some of these are associated with greater concerns about falling, as they involve large movements of the

body's center of mass and require better trunk stability and wheelchair skills [8].

In addition to the risk of injuries, individuals who fall may experience feelings of embarrassment, disability, frustration, and exaggerated fear of falling, which could affect their emotional health [2, 4]. The great concern and consequences of falls may lead to limitations in carrying-out activities of daily living, as well as restrictions in work and community participation [1, 2, 4]. It highlights the importance of fall prevention. In Brazil, falls of wheelchair users are currently prevented by training wheelchair skills, transfers, reaching objects in a safety way and engaging individuals in educational programs [9]

The Spinal Cord Injury-Falls Concern Scale (SCI-FCS) was developed [8] for assessing levels of concern about falling during the performance of 16 activities of the daily life of people with SCI, who are manual wheelchair users. The levels of concern are scored on a four-point Likert scale (not at all concerned; somewhat concerned; fairly concerned; very concerned), and the total score ranges from 16 to 64. Higher scores indicate higher levels of concern about falling [8]. This scale was based upon the Falls Efficacy Scale–International (FES-I), which is considered the gold-standard measure of fear of falling in the elderly [10, 11]. Both the SCI-FCS structure and unidimensionality were supported by Rasch

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analysis, as well as excellent internal consistency and test-retest reliability [8].

Considering its usefulness within both research and clinical contexts, the SCI-FCS has been translated to various languages (Swedish, Norwegian, Italian, and Thai) and all translated versions demonstrated adequate measurement properties and clinical applicability [12–15].

Quantifying concerns about falling is particularly relevant, to ensure efficient and assertive interventions. It is important to standardize data collection, develop specific rehabilitation strategies, and promote further research in this area, including the development of comparable clinical studies across different cultures. However, there are no available scales for the assessment of concerns of falling in the Brazilian Portuguese language, for the assessment of SCI people, who are wheelchair users.

Thus, the objectives of the present study were to translate and cross-culturally adapt the SCI-FCS to the Brazilian Portuguese language and to evaluated its measurements properties, such as internal consistency, test-retest reliability, and construct validity.

METHODS

Design

This methodological study was divided into two phases: phase I: translation and cross-culturally adaptation of the SCI-FCS and phase II: measurement properties of the adapted version. This study followed the COSMIN guidelines [16] and all participants provided written consent, prior to data collection, based upon approval from the ethical review boards of both the Universidade Federal de Minas Gerais (#CAAE:07050919.0.3001.5149) and the SARAH Network of Rehabilitation Hospitals, (#CAAE:07050919.0.0000.0022), Belo Horizonte, Brazil.

Translation and cross-cultural adaptation

Translation and cross-cultural adaptation of the SCI-FCS from the English to the Brazilian Portuguese language were authorized by the creators of the original scale, followed recommended guidelines [17, 18], and was carried out in five stages [16]. In Stage I, the SCI-FCS was translated from English to the Brazilian Portuguese language by two independent bilingual translators, whose native language was Portuguese. In Stage II, a synthesis (consensus version) of the two translated versions was produced by an expert committee composed of three physiotherapists/researchers. In Stage III, the consensus version was back-translated by two other bilingual translators, whose native language was English. They were not aware of the concepts and had no access to the original version of the scale. In Stage IV, an expert committee, which was composed of three physiotherapists, one translator, and one back-translator, verified the cross-cultural equivalence of the translated versions, to develop the pre-final version. In Stage V, the pre-final version was administered to 30 wheelchair users with SCI. The participants were asked whether they understood the items, by answering the following question: "How did you interpret/understand the question?". The final SCI-FCS version (SCI-FCS-Brazil) (supplementary information) was established, after ensuring that it was comprehended by at least 80% of the participants [18].

Participants

Participants were recruited from a tertiary and public rehabilitation service of the SARAH Network of Rehabilitation Hospitals during regular follow-up sessions, according to the following criteria: have a SCI diagnosis at any neurological levels according to the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) [19]; be manual wheelchair users for at least 75% of their mobility needs and ≥18 years old; and have no cognitive deficits, as determined by the Mini-mental state examination education-adjusted scores [20]. Individuals, who had any other neurological disorders not related to SCI, were excluded.

Procedures

The following data were collected from all participants (phases I and II): (1) SCI characteristics, (2) sociodemographic data (age, sex, schooling), (3) occurrence of falls and fall-related injuries over the past year, and (4) self-perceived fear of falling, which was assessed as follows: "In general, are you afraid of falling?" (1 = not at all; 2 = a little; 3 = quite a bit; 4 = very

much) [10, 14]. Item 1 was collected from the electronic medical records and items 2-4 from the interviews.

For the phase II participants, the following measures were added: (1) emotional state (21-item depression, anxiety, and stress scale (DASS-21) [21]; (2) and level of functional independence (Spinal Cord Independence Measure–version III (SCIM III) [22, 23].

The SCI-FCS-Brazil was administered to all participants by face-to-face interviews by the same physiotherapist, who had more than 10 years of clinical experience in SCI rehabilitation. For the test–retest reliability, 57 participants were assessed twice with an interval between three and seven days [24].

Data analysis

Descriptive statistics were used for the demographic and clinical characteristics of the participants. Test–retest reliability of total scores was analyzed using intra-class correlation coefficients ($ICC_{2,1}$), which were classified, as follows: $ICC \ge 0.75$ being indicative of "good" reliability and <0.75 indicative of poor to moderate reliability [25]. The item-level test–retest reliability was analyzed using the quadratic-weighted Kappa statistics, whose coefficients of the agreement were classified, as follows [26]: poor '0; slight = 0.01–0.19; fair = 0.20–0.39; moderate = 0.40–0.59; substantial = 0.60–0.79; and almost perfect = 0.80 to 1.00. Internal consistency was analyzed using Cronbach's- α coefficients. Adequate values should be between 0.70 and 0.95 [24, 25]. These analyses were performed with the VassarStats and SPSS (version 19) softwares, at a significance level of 5%.

The construct validity of the SCI-FCS-Brazil was also investigated by Rasch analysis [27–29] rating scale model, using the Winsteps (version 4.5.0) software, applying the following criteria:

Item/person separation and reliability coefficients analysis. Items with reliability index \geq 0.90, stratified into at least three levels of difficulty (low, medium, and high), and persons, with reliability index \geq 0.80, stratified into at least two levels of abilities (low and high) [29].

Rating scale analysis (four-point Likert scale). Frequency of at least 10 responses per category; progressive increases in the observed average measures in the category (logits); Andrich thresholds advancement of at least 1.4 logits and less than five logits for each category; fit statistics with Outfit mean square (MnSq) value <2 for each category [29].

Unidimensionality. Goodness of fit (fit statistics) for both items and persons if both Infit and Outfit MnSq values were between 0.60 and 1.30 with associated standardized Z-values between -2 and 2 (p < 0.05) [26, 27]. Items or persons would be considered misfit, when both Infit and Outfit values were out of parameters. Values of MnSq >1.3 with Z > 2 up to 5% of the items were considered acceptable [30]. For the principal component factorial analysis of the standardized residuals, it was expected that the principal component should explain at least 50% of the total residual variance and that the item/person residual interactions should explain less than 5% of the total variance with eigenvalue <2 [29]. Local Independence between the items was assured by positive correlation coefficients <0.7 [29].

Item-person map analysis. The distribution of the items and participants and the relationships between the items' difficulties and persons' abilities were examined.

RESULTS

From July to December 2019, 148 individuals were screened. Four refused to participate and 14 did not meet the inclusion criteria. Thus, 130 individuals were enrolled, being 30 in phase I and 100 in phase II. For the test–retest reliability analysis, 57 participants were assessed on two occasions.

As reported in Table 1, the 100 phase II recruited participants, 75% men, had a mean age of 37 (14) years. Their time since SCI was 4.2 years (5.7) and their median SCIM III score was 53 (IQR 36–65).

Translation and cross-cultural adaptation

Some item adjustments were carried out, to accommodate semantic and cultural differences. These adjustments were discussed with the developers of the original version, who agreed with the adjustments.

Variable		Pre-test group (n = 30)	Test-retest group (n = 100)
Age (years), mean (SD)		36 (12)	37 (14)
Gender, n men (%)		23 (77)	75 (75)
Schooling (years), mean (SD)		10 (3)	9.1 (3.4)
Time since SCI (years), mean (SD)		4 (7)	4.2 (5.7)
	≤1 year, <i>n</i> (%)	6 (20)	21 (21)
	1–2 years, <i>n</i> (%)	9 (30)	25 (25)
	≥2 years, n (%)	15 (50)	54 (54)
Traumatic SCI, n (%)		25 (83)	84 (84)
Complete SCI (AIS-A), n (%)		17 (57)	69 (69)
SCI level, n (%)	Cervical	10 (33)	34 (34)
	Thoracic 1–6	6 (20)	19 (19)
	Thoracic 7–12	12 (40)	43 (43)
	Lumbar	0 (0)	4 (4)
	Not reported	2 (6.7)	0 (0)
Falls over last 12 months, I (%)		13 (43)	54 (54)
Associated injury falls		2 (7)	8 (8)
Afraid of falling, n (%)	Not afraid	5 (17)	19 (19)
	Somewhat afraid	7 (23)	30 (30)
	Fairly afraid	8 (27)	24 (24)
	Very afraid	9 (30)	27 (27)
	Not reported	1 (3)	0 (0)
DASS-21 normal, <i>n</i> (%)		Not evaluated	72 (74)
SCI-FCS Brazil scores (16–64), median and [IQR]		31 (17–58)	27 (22–34)
SCIM III scores (0-100), median [IQR]		Not evaluated	53 (36–65)
	Self-care (0–20)	Not evaluated	14 (9–14)
	Respiration/sphincter management (0–40)	Not evaluated	25 (18–33)
	Mobility (0–40)	Not evaluated	14 (8–18)
CD Standard doviation IOD Inter quartile range	CCI Crainel Cand Inium, AIC American Crainel Iniu	w. Accordination Inconsistencent Cools	DACC 21 Demansion Anvioture

SD Standard deviation, IQR Inter-quartile range, SCI Spinal Cord Injury, AIS American Spinal Injury Association Impairment Scale, DASS- 21 Depression Anxiety & Stress Scales, SCI-FCS Brazil Spinal Cord Injury-Falls Concern Scale Brazil, SCIM III Spinal Cord Independence Measure.

For instance, items 11 to 14 describe wheelchair propulsion activities using the term "pushing wheelchair". This term was cross-culturally adapted to "pushing wheelchair or being pushed", in order to include individuals, who need assistance to perform the task [12]. Inconsistencies were found in items 3 "Inserting enema or toileting" and 16 "Lifting heavy objects across body". In item 3, the following information was added: "using a bath chair, if necessary", to better describe the possibilities to perform the task. In item 16, more details were added, to better describe the movements involved in the task "Lifting and transferring heavy objects from side to side, crossing the front of the body".

After these adjustments, at least 80% of comprehension was achieved for all items (80–100%), as recommended and the final version of SCI-FCS-Brazil was established (supplemental appendix S1).

Internal consistency and test-retest reliability

Table 1. Characteristics of the participants.

Both the SCI-FCS-Brazil internal consistency (Cronbach's $\alpha = 0.95$) and test–retest reliability of the total scores were excellent (ICC = 0.92; 95%CI, 0.86–0.95). Test–retest reliability of the individual items showed substantial to almost perfect agreement in 14 of the 16 items (Kappa coefficients ranging from 0.67 to 0.87; 95% CI, 0.40–1.0). Item 3 ("Inserting enema or toileting using a bath chair, if necessary") showed moderate agreement (k = 0.56; 95% CI, 0.25–0.86) and item 11 ("pushing wheelchair or being pushed on a flat ground"), showed poor agreement (k = 0.04; 95% CI, 0.01–0.42).

Rasch analysis

Item/Person separation and reliability coefficients. Reliability index was 0.81 and 0.98 for persons and items, respectively. The separation index for persons was 2.1, ie, participants were stratified into 2.4 levels of abilities. The separation index for the items was 6.25, ie, the items were stratified into eight levels of difficulty.

Rating scale analysis (four-point Likert scale). The frequency, the average measure of each category, and the Infit/Outfit mean square values were adequate. The Andrich thresholds were disordered and poorly differentiated (-0.55; 0.29; 0.27), mainly between the scores 3 e 4.

Unidimensionality. The participants' average measure was -1.38 logits. The average fit statistics values for the items were: Infit: [MnSq = 1.08; Z = 0.40]; Outfit: [MnSq = 0.94; Z = -0.08], and for the persons they were Infit: [MnSq = 0.99; Z = 0.06]; Outfit [MnSq = 0.94; Z = 0.07], which reveals adequate fit statistics values for both items and persons. Regarding item calibration (Table 2), item 11 ("pushing wheelchair or being pushed on a flat ground") showed lower concerns about falling and item 13 ("pushing wheelchair or being pushed up/down gutters or curbs") showed greater concerns about falling (Fig. 1).

Only two (2%) out of 100 individuals were misfitted, being less than 5% of the total participants, as recommended.

Table 2. Calibration and item fit statistics of the SCI-FCS-Bra	azil.
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Item	Measure	Model (SE)	Infit		Outfit	
			MnSq	Zstd	MnSq	Zstd
11. Pushing wheelchair on flat ground	2.17	0.34	1.08	0.34	0.63	-0.50
15. Shopping	1.53	0.25	1.30	1.04	0.96	0.05
10. Cooking or food preparation	1.04	.20	1.29	1.21	0.88	-0.22
1. Getting dressed or undressed	0.68	0.17	1.16	0.83	0.91	-0.22
8. Reaching for high objects	0.59	0.17	1.07	0.41	1.13	0.52
2. Moving around the bed	0.32	0.15	0.91	-0.50	0.67	-1.33
6. Transferring in/out of bed	0.13	0.14	0.78	-1.37	0.61	-1.80
3. Inserting enema or toileting	0.05	0.14	1.16	1.02	0.96	-0.11
7. Transferring in/out of a car	-0.01	0.14	1.01	0.12	0.79	-0.93
4.Washing or showering self	-0.14	0.13	1.16	1.02	1.05	0.30
9.Picking objects up from the floor	-0.28	0.13	1.41	2.51	1.29	1.35
16. Lifting heavy objects across body	-0.46	0.13	1.15	1.04	1.08	0.47
5.Transferring on/off a commode or toilet	-0.46	0.13	0.95	-0.33	0.99	0.03
12.Pushing wheelchair on an uneven surface	-1.53	0.12	0.93	-0.47	1.13	0.78
14. Pushing wheelchair up/down a slope	-1.65	0.12	1.02	0.22	1.18	1.01
13. Pushing wheelchair up/down gutters or curbs	-1.98	0.13	0.90	-0.67	0.87	-0.64

SE standard error, MnSq mean square, Zstd standardized Z value.



Fig. 1 Rasch bubble chart for the SCI-FCS-Brazil as a graphical representation of measure and fit values. Items assessing lower levels of concern about falling are at the top (positive logits) and items assessing higher levels are at the bottom (negative logits). The horizontal axis shows the weighted *t* statistics (infit standardized value 'Zstd') with a *t* zstd value above ± 2 representing misfitting items.

Principal component analysis revealed that 53% of the total residual variance was explained by the principal component. The eigenvalue for the second component was 2.1, which explained 6% of the remaining variance. Local Independence was demonstrated by item correlations <0.41.

Item-person map. The item-person map showed that most of the participants were distributed into the bottom-half of the continuum, whereas the majority of the items fell in the middle third of the continuum (Fig. 2).

DISCUSSION

In the present study, the cross-cultural adaptation of the SCI-FS to the Brazilian Portuguese language of the SCI-FCS was successfully achieved. The measurement properties of the SCI-FS-Brazil were adequate, with attention to little discrimination between scores 3 and



Fig. 2 Item-person map of the SCI-FCS-Brazil. The left-hand column (first column) locates the person measures along the continuum of concern about falling, with a mean t ability of -1.38 logits (low level of concerns. Item locations are displayed on the right-side column. They were distributed along the continuum (different levels of difficulty) although the majority were in the middle (intermediate level).

Similar to previous studies, both internal consistency and test-retest reliability showed to be adequate [8, 12, 13, 15]. At the item-level reliability, only item 11 showed poor agreement. This could be due to low score variability (low score item and high prevalence of score of 1), which could result in higher random agreement and low Kappa value.

Similar to previous studies [8, 14], Rasch analysis revealed adequate reliability, unidimensionality, construct validity, and ability to discriminate between two levels of concern about falling. Both item/person separation indices and reliability coefficients were good, as well as excellent construct validity, with a goodness of fit for all items and for 98% of the participants. The principal component analysis ensured the unidimensionality of the SCI-FS-Brazil, since misfitting values were found only for 2% of the participants. Although the standardized residual loadings for the items suggested the presence of two distinct dimensions (daily living and mobility activities, such as transfers and wheelchair propulsion). the analysis of two dimensions did not show adequate reliability. Therefore, as demonstrated in previous studies, the unidimensionality of SCI-FCS-Brazil was supported and it was considered appropriate to maintain a single set of items [8, 14]

Item 9 ("Picking up objects from the floor") had a Z Infit value higher than that expected for the Rasch model. Some participants, indeed had unexpected scores on this item, because they had never done this task before and, therefore, could not rate their real concern about falling. This difficulty was also observed for other activities, which were never previously performed. According to the original SCI-FCS version, the participants should answer all questions about their concerns about falling, even if they had never done some of the activities. In addition, they were asked to rate how their concern about falling would be if they performed such activity. Marquez et al. [13], who performed the italian SCI-FCS version, suggested that this could be interpreted as a bias of the scale [13]. Therefore, caution should be taken, when interpreting the responses to items that represent activities that were never performed by the individual.

Regarding the item calibration, concerns about falling were lower for item 11 "pushing wheelchair or being pushed on a flat ground" and higher for items 12, 13, and 14, which include tasks, such as pushing wheelchair on an uneven surface, up/down gutters or curbs and on a slope, respectively. These findings corroborate those of other validation studies [8, 12, 14, 15] and reinforce the scale's ability to discriminate between various levels of concern about falling. Activities with higher concerns about falling are usually more complex and involve a greater center of mass displacement, with actual higher risk of falling. This highlights the importance of intensive wheelchair skills training during rehabilitation interventions, to reduce concerns about falling

The Andrich's threshold between the scores 3 and 4 was disordered and had small gaps, suggesting little discrimination between these levels of concern about falling. Further analysis unifying scores 3 and 4 was conducted, but the SCI-FCS items showed minimal improvement in the model's "goodness-of-fit". As suggested by Forslund et al. [14], the union of some scores can be an alternative for better functioning of the instrument. Score 3 ("fairly concerned about falling") and score 4 ("very concerned") had low frequency (11% and 12%, respectively), which may be due to low levels of concern about falling or difficulty in understanding the meaning of these scores (3 and 4). The term fairly concern is not widely used among some individuals and, in some cases, its meaning would require better explanation. Therefore, the importance of ensuring that individuals have a good understanding of the scores should be emphasized during the SCI-FCS-Brazil application. Concern about falling is subjective. In addition, there is variability in the way of performing the SCI-FCS tasks. The use or not of transfer board during daily transfers could minimize or increase concerns about falling, for example. This can make it difficult to compare concerns about the falling of different individuals, even if they have similar SCI characteristics.

Some factors, such as biological (muscle strength, trunk control, spasticity, age, gender), behavioral (poor concentration, fear, risk behaviors) and environmental (accessibility, type of wheelchair, presence or not of a caregiver, quality of assistive products) may interfere with concerns about falling [1, 4]. For instance, individuals, who have lower wheelchair skills and access to accessible environments, may be less concerned about falling, than those who are more skilled, but must propel their wheelchair in inaccessible environments. In addition, those, who are dependent on caregivers for wheelchair driving, may have different concerns about falling, depending upon the confidence and ability of their caregivers.

Despite the low values, the median score of the SCI-FCS - Brazil was higher than that found in previous validation studies, suggesting that the individuals in the present study were more concerned about falling. This may be related to the characteristics of the sample, which was composed of younger adults with less time since SCI [12–15]. The average time since SCI was 4 years and almost half of the participants were in their first stage of rehabilitation, without having explored their full functional potential. In addition to shorter time since SCI and the fact that many participants were in the initial rehabilitation process, about 25% had some degree of emotional alteration, assessed by the DASS-21. This may have contributed to higher SCI-FCS-Brazil scores.

The median SCI-FCS score was low in all versions, which, according to previously reported results [12, 13, 15], indicates that the scale fails to capture concerns about falling in individuals, who have the higher functional ability. However, the present results showed that many individuals did not really have such an important concern about falling. This may reflect the profile of people with SCI, mostly men and young. Although 81% of the participants in the present study reported fear of falling, 30% reported little fear of falling, usually related to one or two specific tasks, which does not increase the total SCI-FCS score. Previously reported results suggested that the SCI-FS would be more relevant to those who have low functional ability and shorter time since SCI [8, 14].

The SCI-FCS-Brazil appears to be relevant for the screening of activities that generate greater concerns about falling, allowing for targeting rehabilitation interventions to those who will most benefit. It also may assist in guiding the prescription of assistive devices and wheelchairs, according to individual skills and concerns about falling. For individuals with higher functional dependence, it may indicate the need for more caregiver training and support. In addition to the raised issues, it can also guide the need for psychological approaches to reduce concerns about falling.

The present study is not without limitations. First, the use of a convenience sample from a single rehabilitation center may have limited the generalization of the findings for the Brazilian population of wheelchair users with SCI. In addition, memory bias regarding the occurrence of falls over the previous year, may have occurred. Further studies are needed to assess the sensitivity to changes of the SCI-FCS-Brazil scores after intervention, its use in motorized wheelchair users, to establish its cut-off scores for different levels of concerns about falling, and its relationships with trunk control, physical ability, and emotional aspects.

For clinical purposes, the SCI-FCS-Brazil seems to be useful, mainly for individuals with higher concerns about falling, low functional ability, and shorter time since SCI. Although it is a selfreported scale, we recommend a previous explanation on the differences between the levels of concern about falling, to ensure proper comprehension. In addition, care should be taken when interpreting levels of concern about falling in activities never experienced by the individuals.

The cross-cultural adaptation of SCI-FCS-Brazil was successfully achieved and the Brazilian version showed adequate measurement properties for use within both clinical and research contexts in Brazil, and cross-cultural validity for use in international/multicentric studies. In addition, the SCI-FCS-Brazil may be useful to screen and guide rehabilitation interventions of manual wheelchair users with SCI.

DATA AVAILABILITY

Anonymized data will be shared by request from any qualified investigator.

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COMPETING INTERESTS

The authors declare no competing interests.

ETHICS

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

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