ORIGINAL ARTICLE

Rasch Validation of the Falls Prevention Strategies Survey

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ABSTRACT. Finlayson ML, Peterson EW, Fujimoto KA, Plow MA. Rasch validation of the Falls Prevention Strategies Survey. Arch Phys Med Rehabil 2009;90:2039-46.

Objective: To validate the Falls Prevention Strategies Survey.

Design: Cross-sectional descriptive survey design. With the use of Rasch analysis, the following aspects of the Falls Prevention Strategies Survey were evaluated: rating scale structure, item quality, participant fit and participant ability, invariance structure, and the potential to change in response to intervention.

Setting: Community-based, national sample.

Participants: Adult registrants of the North America Research Committee on Multiple Sclerosis volunteer patient registry (N=457).

Interventions: Not applicable.

Main Outcome Measures: The Falls Prevention Strategies Survey is a self-report instrument addressing protective behaviors related to fall risk among adults with multiple sclerosis (MS) (eg, monitoring MS symptoms, wearing proper footwear, modifying activities). Response options reflect the frequency with which the respondent engages in the behavior (ie, never, sometimes, regularly).

Results: Analysis indicated that the rating scale structure (ie, response options) was valid. Of the original 19 items, 8 of them misfit and needed to be dropped to obtain a valid instrument under the Rasch model. With the final 11 items, the instrument was able to distinguish participants of different ability levels across a range of 11.58 logits. Invariance structure analysis demonstrated that the instrument functioned equally for men and women, for mobility device users and nonusers, and for participants with diagnosed MS for less than or greater than 10 years. Findings indicated that approximately 50% of respondents would have room to improve on their Falls Prevention Strategies Survey scores over time.

Conclusions: Rasch analysis supports the use of the Falls Prevention Strategies Survey to examine the frequency of engaging in protective behaviors related to fall risk among adults with MS. The instrument shows potential to track outcomes of behaviorally oriented fall reduction interventions in this population.

Key Words: Accidental falls; Multiple sclerosis; Rehabilitation.

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FALLS ARE A MAJOR public health problem and the leading cause of nonfatal injury in the United States across all ages.[1] Epidemiologic[2] and clinical research[3] studies have shown that approximately half of middle-aged and older adults with MS experience at least one fall over a 6-month period, and as many as one third fall at least once a month.[4] Up to 50% of the falls experienced by middle-aged and older adults with MS result in an injury that requires medical attention.[4,5]

Evidence-based interventions are now available to reduce fall risk, particularly among older community-dwelling adults.[6-8] Although these interventions often promote individual-level behavioral change to reduce fall risk (eg, exercising, removing home hazards), examples of direct measures of these changes have only recently appeared.[9,10] Instead, outcomes commonly seen include improvements in self-efficacy, activity level, and quality of life. These outcomes capture steps towards behavioral change (self-efficacy) or the outcomes of behavioral change (activity level, quality of life), rather than what people are doing to reduce their fall risk.

The limited availability of instruments to measure behavioral changes that support the prevention of falls created a problem for the developers of the Safe at Home BAASE program,[11] a program targeting adults with MS that focused on modifying current behaviors to reduce personal fall risk. In response, the Falls Prevention Strategies Survey was developed. Because of its behavioral focus, the Falls Prevention Strategies Survey may have utility in comprehensive MS clinics or outpatient rehabilitation settings, independent of the Safe at Home BAASE program. Therefore, the purpose of this study was to refine and validate the instrument using the Rasch measurement model and the framework outlined by Wolfe and Smith.[12,13] This framework links Messick's unified theory of validity[14] and validation concepts outlined by the Medical Outcomes Trust Scientific Advisory Committee[15] to the analytic components of the Rasch model.

The Rasch model provides several benefits for instrument validation in comparison with classic test theory. When the data fit the model, Rasch enables people and items to be placed on the same interval scale, allowing direct comparison of the item difficulty and the person ability estimates through a common log-linear scale (ie, "logit" scale). Parameter estimates are separable, leading to person ability measures that are not dependent on the distributional properties of the item used, and item difficulty measures that are not dependent on a specific sample. Unique SEs are calculated for each person's measure and each item's difficulty estimates. In classic test theory, only a single SE is calculated, which assumes that uncertainty in the estimates is constant across all people and items. With the unique SEs calculated through Rasch, it is possible to estimate

List of Abbreviations

DIF	differential item functioning
MS	multiple sclerosis
NARCOMS	North America Research Committee on Multiple Sclerosis
PCA	principal components analysis

the amount of uncertainty across each item and each ability level during resampling. Finally, expected responses for each person-item interaction are produced, which makes it possible to examine the responses in relation to the model's expectation.[16]

METHODS

This study used a cross-sectional survey design, and data were collected using the online tool "Survey Monkey." The study was approved by the institutional review board of the authors' university (protocol no. 2004-0231).

Participants

The target population for the Falls Prevention Strategies Survey is adults with MS. Participants were recruited by a single e-mail invitation through the NARCOMS registry. This volunteer registry of people with MS had 33,466 unique enrollments at the time of the study (T. Tyry, personal communication, August 19, 2008) and reflects approximately 8% of the estimated 400,000 people with MS in the United States.

Two consecutive queries were done through the registry to identify persons with a history of quick response to online surveys. Query 1 identified 10,606 persons who were 18 years or older, resided in the United States, agreed to complete surveys online, had a valid e-mail on file, and had an active status in the registry as of August 2008. Two additional criteria were applied to this sample: completed both the fall 2007 and the spring 2008 NARCOMS update surveys online, and completed both of these surveys within a week. The resulting sample comprised 1079 persons. From this group, a random sample of 700 persons received an e-mail invitation to participate in the current study based on (1) available financial resources, (2) needing 300 to 400 responders for analysis, and (3) an anticipated nonresponse of 40%.

Data were collected in the fall of 2008. A total of 471 persons responded, and 457 provided usable data (response rate, 65.3%). Descriptive details on the participants are provided in table 1 (last column), with comparisons to both the 700 people invited to participate (middle column) and the larger group of 10,304 that completed the spring 2008 NARCOMS survey online (first column). Comparisons across the columns indicate that the survey respondents were comparable to the online sample and the spring 2008 NARCOMS respondents in terms of age, sex, and years since diagnosis. Almost 60% of survey respondents had experienced an MS-related fall in the past 6 months.

Table 1: Descriptive Details of the Sample

Characteristics	Spring 2008 Responders (n=10,304)	Online Sample (n=700)	Responders (N=457)
Sex*			
Female	7917 (76.4)	486 (69.4)	315 (69.4)
Male	2387 (23.6)	214 (30.6)	139 (30.6)
Age during 2008 (y)			
Range	18.0–92.0	28.0–82.0	26.0–78.0
Median	54.0	54.0	53.5
Mean ± SD	53.9±10.5	53.7±9.4	53.5±9.5
Age at diagnosis (y)			
Range	12.0–74.0	15.0–66.0	14.0–62.0
Median	38.0	37.0	38.0
Mean ± SD	38.1±9.7	37.2±9.5	37.9±9.5
Residence			
Private home	9432 (91.5)	671 (95.9)	
Private home with home health aide support	423 (4.1)	23 (3.3)	
Assisted living	67 (0.7)	1 (0.1)	NA
Nursing home	104 (1.0)	5 (0.7)	
Missing	278 (2.7)	0 (0.0)	
Patient-Determined Disease Steps			
Range	0.0–8.0	0.0–8.0	
Median	4.0	4.0	
Mean ± SD	3.7±2.5	3.7±2.4	NA
Fall due to MS			
Never			37 (8.1)
Yes, in the past 6mo	NA	NA	272 (59.5)
Yes, more than 6mo ago			149 (32.6)

NOTE. Values are n (%) or as otherwise indicated.
Abbreviation: NA, not available.
*Missing data for 3 people for this variable.

Instrument and Its Development

Together with the first and second authors, an international work group consisting of a physician, a nurse, 3 physical therapists, and 3 occupational therapists contributed to the development of the original Falls Prevention Strategies Survey. Two members of the work group have MS themselves. The work group was actively involved in the development of the Safe at Home BAASE program and helped to identify specific behaviors expected to change as a consequence of program participation. These behaviors (ie, strategies) formed the foundation for the Falls Prevention Strategies Survey items.

The original Falls Prevention Strategies Survey instrument consisted of 14 items and used a "yes/no" response option format. Before the current study, the response option format was refined to capture the frequency with which persons performed behaviors to manage fall risk—never, sometimes, or regularly. In addition, the first 3 authors reviewed the instrument to ensure that all items were behaviorally oriented (eg, addressed actions rather than knowledge), were clear and unambiguous (eg, not double-barreled), and used consistent verb tense. Based on the review, 1 new item was written (no. 6 in table 2) and 4 others were divided to enhance clarity (eg, items 16 and 17 were originally 1 item). This resulted in 19 items for the Rasch analysis.

Data Analysis

The Rasch Rating Scale Model[17] was deemed appropriate for this analysis because the rating scale structure for all items contained the same response options, and a single set of thresholds was assumed to be appropriate for the rating scale structure. The Wolfe and Smith framework[12,13] discusses 5 aspects of validity (substantive, content, structural, generalizability, responsiveness) in relation to specific Rasch analytic procedures. Following this framework, the analysis proceeded in the sequence described below.

Substantive validity: examining the rating scale structure. In order to evaluate the rating scale structure of the Falls Prevention Strategies Survey (ie, 3 response options), 6 of the 8 guidelines recommended by Linacre[18] were adopted: (1) each response option contains at least 10 observations; (2) the average person ability measures should advance monotonically as the value of the rating scale response option increases in qualitative value (eg, the average person ability

Table 2: Falls Prevention Strategies Survey

No.	Strategy
1	I use the mobility device (eg, cane, walker, wheelchair) that is most likely to reduce my fall risk during the activity I will be doing.
2	**I move items in my home (eg, furniture, rugs, clutter) to reduce my fall risk (or have had other people do it for me).**
3	**I turn on the lights when I am moving around in my home to reduce my fall risk.**
4	I wear shoes that reduce my fall risk.
5	**As needed, I change the way I perform everyday activities in order to reduce my risk of a fall.**
6	**I avoid doing activities that are beyond my abilities and could put me at risk of a fall.**
7	I engage in exercise or other physical activities to ensure that poor physical condition does not increase my risk of falling.
8	I use grab-bars in my bathroom to reduce my fall risk when I am getting into or out of the shower or bathtub.
9	I check my mobility aids (eg, cane, walker, wheelchair) to ensure that they are in good working condition in order to reduce my fall risk.
10	**I ask other people for help with some activities in order to reduce my fall risk.**
11	**When I am fatigued, I change my activities to reduce my fall risk.**
12	**I monitor and manage my MS symptoms to reduce my risk of falling.**
13	I choose not to do some activities because they might lead me to fall.
14	I have made changes to the stairways or steps in my home to reduce my risk of falling (eg, installed railings).
15	I have made changes to my shower or bathtub to reduce my fall risk while I am showering or bathing (eg, installing a tub bench or a roll in shower).
16	**At least once a year, I ask my doctor to check whether any of the medications I take might increase my risk of a fall.**
17	**At least once a year, I ask my pharmacist to check whether any of the medications I take might increase my risk of a fall.**
18	**At least once a year, I ask at least one health care professional about ways to reduce my fall risk (eg, doctor, nurse, or therapist).**
19	**I plan what I will do in case I fall.**

NOTE. Response options are as follows: never do, do sometimes, do regularly. Items that are bolded were retained for the final version of the Falls Prevention Strategies Survey.

measure for "never do" should be lower than for "do sometimes"); (3) the outfit mean-square value for each response option should be less than 2.0 in order to fit with the Rasch model expectations (potential range, 0 to infinity); (4) the logit values (ie, thresholds) that separate the response options should also increase monotonically as the response options increase (eg, the threshold value separating "never do" from "sometimes do" should have a lower logit measure than the one separating "sometimes do" from "do regularly"); (5) thresholds should advance by at least 1.0 logit, but (6) not more than 5.0 logits.

Content validity: evaluating item quality. Item Fit: The Winsteps software (version 3.64.2)[a] produces 2 types of fit statistics, outfit and infit. Fit statistics are reported as mean squares and provide information about the extent of randomness in people's responses to specific items. Outfit statistics are sensitive to detecting unexpected person responses to an item far away from ability level (ie, propensity to engage in the falls prevention behaviors). Infit statistics are less sensitive in this regard. Because the distribution for both outfit and infit statistics is not symmetrical, setting a symmetrical criteria about the means can lead to different type I error rates.[19]

By approximating a t statistic with a mean of 0.0, standardized fit statistics address this problem and provide a standard for identifying unexpected values (ie, ~2SDs from the mean).[20] Therefore, standardized fit statistics were examined to evaluate item quality, and greater weight was given to outfit statistics during the decision-making process. Items with standardized fit statistics less than -2.0 were considered to have too little variance (ie, overfit the Rasch model). Items with fit statistics greater than 2.0 were considered too erratic, suggesting that they may not belong with the other items (ie, misfit the Rasch model).

Each item with standardized fit statistics in these extreme ranges (<-2.0, >2.0) was examined to determine whether there was any theoretic reason to retain it. Final decisions to delete items were based on this combination of statistical findings and theoretic knowledge of falls prevention behaviors.

Point-measure correlation. The point-measure correlations identify the degree to which the responses to an item correlate with the person ability measures (ie, estimate of latent ability in logits). A person with higher ability is expected to endorse the higher response options compared with a person with less ability. Thus, negative or zero correlations for items suggest that those items may not be functioning as intended. For this analysis, at least a moderate correlation (≥.30) was expected for the item to be considered to be functioning in the manner intended.

Structural validity: examining the principal components analysis of the residuals. If the instrument measures one dimension, the standardized residuals—the portion unexplained by the unidimensional Rasch model—should display no systematic pattern.[21] Thus, one way to investigate multidimensionality is to search for a systematic pattern in the residual variance using a PCA. If more than one dimension is detected, the assumption of unidimensionality may be violated. To determine whether multiple dimensions existed, the percentage of the variance accounted for by the first contrast in the observed data had to exceed the percentage of variance accounted for by the first contrast from simulated data based on the parameters from our sample.[22]

Generalizability: examining the spread of items. To see whether a range of item difficulty level existed, the item separation reliability statistic was examined. There is no formal equivalent between this statistic and any measure of reliability from classic test theory. Usually for the item separation reliability statistic, the higher the value, the less likely all items share the same difficulty level and the greater the likelihood that the ordering of the items will be similar on retesting. For item separation reliability, we selected a cutoff value of at least .70 to be consistent with the value used for spread of person abilities (see below).

Substantive Validity: Participant Fit

The fit of the response patterns for each participant was assessed by inspecting the standardized outfit statistics. Linacre[19] noted that about 1% of the persons will misfit. Therefore, the response strings of participants with questionable fit statistics (ie, >3.0 and <−3.0, which reflects greater than 3.0 SDs from the mean) were examined. If at least half of a participant's responses were extremely unexpected or overly consistent with the expectations of the Rasch model, then that participant was identified as misfitting, and his/her responses were removed from the analysis.

Generalizability: Spread of Participant Ability and Invariance of Item Parameters Across Subpopulations

Spread of participant ability. The participant separation reliability statistic was examined to see if the Falls Prevention Strategies Survey rating scale response options were successful at spreading the participants along the ability continuum. The person separation reliability is an internal consistency measure that informs us of the variance that is not due to error; it is somewhat analogous to the Cronbach alpha.[21] The higher the reliability statistic, the less likely all participants are of similar ability level and the greater the likelihood that the ordering of the participants will be similar on retesting. For this analysis, a reliability statistic of 0.7 or higher is expected.[23]

Invariance of item parameters across subpopulations. The invariance of item difficulty across subpopulations was examined by performing a DIF analysis across subgroups that may respond differently to items based on previous research on falls among people with MS (men vs women; diagnosed with MS for <10y vs ≥10y; uses walking aid vs does not use walking aid).[2,3] That is, the item difficulty was compared across subpopulations after controlling for ability; nonsignificant differences are needed to demonstrate that the items perform consistently across groups (ie, DIF does not exist).

Three criteria were established for an item to be considered to be displaying DIF. First, the difficulty level for an item had to be statistically different for the 2 subgroups after controlling for ability level. We set the alpha to .01 (to control for multiple tests) for each Welch *t* test, which controls for unequal variances. Second, we required the item difficulty level difference between the 2 groups to be at least 0.5 logits. Finally, if the first 2 criteria were met, then a theoretic rationale must not be available to explain the observed difference.

Potential of the Instrument to Capture Change Over Time

The potential of the Falls Prevention Strategies Survey rating scale to capture change over time was explored 2 ways. First, the location of the items was compared visually to the distribution of participants on the Winsteps variable map. If items are higher than the participants on the logit scale, then the Falls Prevention Strategies Survey may have the potential to capture change over time. Second, the response option frequency distribution was reviewed to determine how many respondents could potentially endorse a higher response option at some other point in time.

RESULTS

Figure 1 shows the Rasch variable map produced by the Winsteps software. Respondents with more ability appear higher on the map, while ones with lower ability appear at the bottom. The spread of the ability measures for respondents is about 14.0 logits. The items that respondents had more difficulty endorsing appear at the top, while items that were easier to endorse appear at the bottom. The spread of items in terms of difficulty is 7.69 logits.

Substantive: Rating Scale Structure

All 6 of the guidelines adopted to examine the rating scale structure for the Falls Prevention Strategies Survey instrument were met. Table 3 provides the count, average measure, outfit mean-square statistics, and step difficulty for each response category. These results indicate that each of the 3 response options has a point on the logit scale where it is the most likely one to be endorsed (ie, as can be seen by the monotonically increasing thresholds). These findings lend support to the substantive validity of the Falls Prevention Strategies Survey.

Content: Item Quality

Eight of the original 19 items developed for the Falls Prevention Strategies Survey rating scale misfit. To reach the final 11 items, analysis proceeded in an iterative fashion. Item fit statistics were examined and discussed by all authors using specific criteria (see Data Analysis section). Potential explanations for each misfitting or overfitting item were identified based on the authors' knowledge of MS, fall risk factors, survey item development, and Rasch output. Misfitting (ie, >2.0) or overfitting (ie, <−2.0) items were removed one at a time, starting with the item with the greatest misfit/overfit (item no. 7; standardized fit statistic, 9.9). All items were misfitting rather than overfitting.

After removing the most misfitting item, the fit statistics were recalculated and reevaluated. This process continued until the remaining items fit together well. The order of item removal was as follows (see table 2; nos. 7, 4, 13, 8, 14, 15, 9, 1). Item numbers 1, 8, 9, 14, and 15 reflect falls prevention behaviors that may not apply to all people (eg, using mobility devices, using stairs) or that reflect changes that must only be done a single time rather than regularly (eg, installing grab-bars). A review of item number 7 concluded that it was double-barreled (ie, exercise or physical activity), which may have contributed to erratic responses. Item number 13 may have been too ambiguous (ie, what activities?) and resulted in different interpretations among respondents. Finally, choosing safe shoes (item no. 4) may be a behavior that people do, but do not recognize as being a strategic falls prevention behavior.

Table 4 presents the item difficulty measures, standardized outfit statistics, and point-measure correlation coefficients for the 11 final items (nos. 2, 3, 5, 6, 10–12, 16–19). All item standardized outfit statistics fell between the desired ranges of −2.0 to 2.0, and all of the point-measure correlation coefficients were above .30, which support the assertion that all items are measuring a single construct.

Structural: Principal Components Analysis of the Residuals

The results of the PCA residuals inform us that the Rasch Rating Scale Model explains 95.6% of the variance in our data. Of the unexplained variance, the first contrast only explains .80%. Data were simulated based on the parameters of our data to get a comparison value for how much the first contrast should explain the residual variance. The PCA of the residuals on the simulated data revealed that the first contrast should explain .40% of the residual variance. The .8% from the actual data is close to what is expected from the simulated data. Furthermore, our unidimensional model explains 95.6% of the variance in the data. Thus, this analysis also lends additional support that all items are measuring the same construct.

Measure in logits	+Respondents	-Items
	Higher Ability	Difficult
8	.#	
	.#	
6		
		FPSS17
5		
	.#	
4		
	.#	
3	.#	
		FPSS16 FPSS18
	####	
2	.######	
	.#######	
	.	
1	.##########	
	.########	
	.	FPSS19
	.##########	
0	.##########	
	.	
	.########	FPSS10
.	###########	
-1		
	.########	FPSS2
		FPSS12
	#####	
-2	.	FPSS11 FPSS3 FPSS5
	.####	FPSS6
	.#	
-3		
	.##	
	.#	
-4		
	.	
-5		
	.	
-6	.	
Measure in logits	+Lower Ability	-Easy

Fig 1. Rasch variable map: the distribution of people ability and items on a common log-linear scale. NOTE. In the second column, the number sign (#) and period (.) represent the respondents, with each number sign representing 4 respondents and each period representing 1 respondent. Abbreviation: FPSS, Falls Prevention Strategies Survey.

Table 3: The Count, Average Measure, Outfit Mean-Square Statistic, and Step Difficulty for Each Category

Category	Count	Average Measure	Outfit MNSQ	Step Difficulty
Never do	44	−2.26	0.87	None
Do sometimes	174	−0.44	1.37	−1.32
Do regularly	219	1.02	1.03	1.32

Abbreviation: MNSQ, mean-square statistic.

Generalizability: Spread of Items

The population (real) item separation reliability index (R=1.00) suggests that the items were spread out along the difficulty continuum (see fig 1). The difference between the easiest and most difficult item to endorse is 7.69 logits. A range of difficulty level appears for our items.

Substantive: Participant Fit

Throughout the analysis process, several respondents were identified for further investigation because their standardized outfit statistics were greater than 3.0. Like the item analysis, the removal of the respondents was an iterative process (ie, identify problematic respondent, remove respondent, rerun analysis). This process continued until there were no concerns with the response strings of the remaining respondents. In total, 10 respondents' data were removed because their response strings were too erratic.

Generalizability: Spread of Participant Ability and Invariance of Item Parameters Across Subpopulations

The population (real) separation reliability index without the extreme scores (R=.79) suggests that the items have separated the respondents with respect to their ability levels. The difference between the respondent with the lowest ability and the respondent with the highest ability was 15.45 logits. The average measure for respondent ability was .11, suggesting that the items are well matched to the respondent ability levels because the average item measure was fixed at 0.00 logits. The further these 2 values are from each other, the less likely the items are matched to the respondents. The variable map (see fig 1) further demonstrates that the respondents are distributed along a range of the ability continuum and not clustered at the same ability level.

Invariance of item parameters across subpopulations. The invariance of difficulty levels was examined for the 11 items retained for the Falls Prevention Strategies Survey rating scale and without the 10 participants whose response strings were problematic. For all 3 DIF analyses (men vs women; diagnosed with MS for <10y vs ≥10y; uses walking aid vs does not use walking aid), no problematic items were identified. That is, no Welch t test was significant at the .01 alpha level.

Potential of the Rating Scale to Capture Change

To determine whether the Falls Prevention Strategies Survey rating scale may have the ability to detect change in MS respondents over time, the variable map (see fig 1) was reviewed. Most respondents have approximately 4 items that are more difficult for them to endorse, which suggests that the Falls Prevention Strategies Survey rating scale has some room for detecting change in ability over time. In addition, table 3 shows that 44 people could improve 2 response options (from "never do" to "regularly do"), and 174 people could improve 1 response option (from "sometimes do" to "regularly do").

DISCUSSION

The current health care environment emphasizes evidence-based practice, accountability, and outcome measurement. To meet these demands, clinicians need valid measurement instruments for a wide range of potential outcomes. Until recently, instruments capturing behavior changes expected after falls prevention education have not been readily available.[9] The Falls Prevention Strategies Survey begins to address this gap for adults with MS.

The findings of this study lend support for several aspects of the validity of the Falls Prevention Strategies Survey. The instrument includes a set of items that was relevant to all adults with MS aged 26 to 78 years, 60% of whom had experienced a fall in the past 6 months. The analysis demonstrated that the instrument has structurally sound response options, a range of difficulty levels across the items, the ability to distinguish persons across different ability levels, performance consistency of items across subpopulations, and the potential to capture change in response to intervention for half the sample. Together, these findings offer initial evidence in support of substantive validity, generalizability, content validity, and the potential of the instrument to capture change over time. The unidimensional nature of the Falls Prevention Strategies Survey supports its structural validity.

Given the support for the structural validity of the Falls Prevention Strategies Survey, no refinement of the item response options was required. Results indicate that participants were able to make meaningful and consistent decisions about the extent of their falls prevention behaviors. The items dropped from the instrument were not relevant to all persons (eg, check working condition of mobility device) or reflected behaviors associated with environmental changes that only need to be made a single time (eg, install grab-bars). From a classic test theory perspective, it could be argued that the exclusion of the 8 items from the Falls Prevention Strategies Survey means that the instrument does not capture the full range of possible falls prevention behaviors for adults with MS. Yet, from a Rasch perspective, their exclusion means that these items are not relevant to all people with MS. Consequently, therapists must use their clinical judgment and recognize the importance of tailoring assessments and interventions to individually relevant risk factors. For example, for adults with MS who do use mobility devices, it is important for them to regularly make appropriate decisions about the use of their device (eg, when, where) and to check its working condition. In

Table 4: Item Difficulties and SEs, Standardized Outfit Statistics, and Point-Measure Correlations for Items Ordered From Most to Least Difficult

Item	Difficulty	SE	Outfit ZSTD	PtMeas Corr
17	5.53	.18	−0.7	.58
18	2.69	.12	−0.2	.63
16	2.67	.12	−0.3	.63
19	0.50	.09	0.4	.63
10	−0.44	.10	−0.4	.63
2	−1.34	.09	1.1	.60
12	−1.59	.10	0.2	.57
3	−1.94	.10	1.9	.52
11	−1.96	.11	−1.2	.61
5	−1.97	.10	−1.3	.62
6	−2.16	.11	0.2	.57

Abbreviations: Outfit ZSTD, standardized outfit statistics; PtMeas Corr, point-measure correlations.

its current 11-item form, the Falls Prevention Strategies Survey represents a unidimensional set of items relevant to adults with MS regardless of sex, time since diagnosis, or mobility level.

The Falls Prevention Strategies Survey demonstrated a clear item hierarchy, with some falls prevention behaviors being more difficult for participants to perform on a regular basis. This finding offers initial evidence in support of the generalizability and substantive validity of the instrument. Three of the 4 most difficult items involved talking with health care providers about fall risk (no. 16–18). The fourth item (no. 19) was having a plan in case a fall occurred. At the core of these behaviors are the skills to self-manage fall risk. According to Lorig and Holman,[24] key self-management skills include finding and using resources, developing partnerships with health care providers, problem solving, decision making, action planning, and self-tailoring. These behaviors require that persons acknowledge that a serious fall is possible and disclose their concern to other people to get assistance. Some older adults may view falls as a marker for impending dependency and a sentinel event leading to institutionalization, and thus may be reluctant to disclose fall experiences.[25] Future qualitative studies may offer insights into the nature of these issues for supporting falls prevention behaviors among adults with MS.

For clinical use, the 11-item version of the Falls Prevention Strategies Survey has the potential to be quick and easy to administer, and could be used in pencil and paper format. It could facilitate conversations about fall risk reduction during a therapy contact, which may contribute to a therapist's clinical reasoning about therapeutic goal setting, intervention, and discharge planning. Furthermore, the item hierarchy may provide a useful guide for tailoring intervention efforts, particularly if intervention is framed from the perspective of self-management. Future research to examine the clinical utility of the instrument and to determine what constitutes clinically meaningful change would be valuable.

Although this study used a large sample, it is limited by having little additional descriptive data on the participants and an unclear understanding of how the sampling and data collection processes may influence generalizability. For example, the approach to sampling targeted persons with a history of quick responses to NARCOMS electronic surveys, but it is unclear if or how these people are different from the general adult MS population. Therefore, the true representativeness of the sample is unknown despite the similarities in fall rates between this sample and previous MS samples,[2-4] as well as the demographic similarities between NARCOMS registrants and the participants of the Sonya Slifka Longitudinal Multiple Sclerosis Study[26] and the New York State MS Registry data.[27]

While the Falls Prevention Strategies Survey demonstrates strong potential, several issues require further investigation. First, the Falls Prevention Strategies Survey needs to be evaluated for reliability, responsiveness to change as a result of intervention, and for clinical utility. Second, differential item functioning across settings should be investigated to ensure that the instrument works across specific subgroups of adults with MS (eg, home care, inpatient rehabilitation, outpatient rehabilitation). Expansion of the Falls Prevention Strategies Survey items may be needed to enhance the clinical utility of the instrument for specific MS subsamples (eg, more items at particular levels on the logit scale). Third, there would be value in extending the analysis to explore whether specific MS symptoms (eg, cognitive impairment, fatigue, depression) are associated with engaging in particular falls prevention behaviors. This knowledge may facilitate intervention development for adults with MS. Finally, while the Falls Prevention Strategies Survey was designed specifically for adults with MS, it would also be valuable to test it with other disability groups (eg, stroke, Parkinson's) and with the healthy elderly. Such testing would require that item number 12 be modified to focus on managing general health-related symptoms rather than MS-specific symptoms.

CONCLUSIONS

Falls are a common experience for adults with MS and often require medical attention.[4,5] Comprehensive falls prevention programs promote individual-level behavioral change to reduce fall risk, yet instruments that directly measure these changes are rare. While measuring the steps towards behavioral change is important (eg, self-efficacy), clinicians and researchers need to know what people are actually doing to reduce their fall risk. Without this knowledge, it will be difficult to develop, implement, and evaluate tailored interventions that enable people to self-manage their fall risk. This analysis offers evidence in support of several aspects of the validity of the Falls Prevention Strategies Survey, and therefore this instrument may provide a new assessment option for clinicians and researchers who are working to reduce fall risk among adults with MS.

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