ORIGINAL ARTICLE

Risk Factors for Falling Among People Aged 45 to 90 Years With Multiple Sclerosis

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ABSTRACT. Finlayson ML, Peterson EW, Cho CC. Risk factors for falling among people aged 45 to 90 years with multiple sclerosis. Arch Phys Med Rehabil 2006;87:1274-9.

Objective: To determine the factors associated with an increased likelihood of reporting a fall in the past 6 months among people between the ages of 45 and 90 who have multiple sclerosis (MS).

Design: Cross-sectional descriptive design by using telephone surveys.

Setting: States of Minnesota, Wisconsin, Illinois, Indiana, and Michigan.

Participants: Total of 1089 people with MS identified through the National Multiple Sclerosis Society and the MS registry maintained by the North American Research Committee on Multiple Sclerosis.

Interventions: Not applicable.

Main Outcome Measure: Self-reported fall to the ground in the past 6 months.

Results: Exactly 52.2% of participants reported a fall in the past 6 months. Factors associated with an increased risk of a fall included being male, fear of falling, variable or deteriorating MS status in the past year, never or occasional use of a wheelchair, problems with balance or mobility, poor concentration or forgetfulness, and incontinence of bladder.

Conclusions: There are a number of factors associated with an increased risk of falling among people aging with MS that are amenable to intervention and therefore warrant the attention of health care providers serving that population.

Key Words: Accidental falls; Fear; Rehabilitation; Risk factors.

FALLS ARE A MAJOR public health problem. Across the entire population in the United States, falls accounted for 4.7 deaths per 100,000 people in 1998 (age adjusted to year 2000 standard population) and are the leading cause of nonfatal injury[1] across all ages.[2] Falls can occur to anyone of any age; however, both the incidence of falls and the severity of fall-related complications rise steadily with increasing age. Although neurologic disease and increasing age are both risk factors for falls, little attention has been paid to understanding falls and fall-related risks among people aging with multiple sclerosis (MS).

MS is a chronic, debilitating neurologic disease that is typically diagnosed among people between the ages of 20 and 50.[3] MS is most common among people living in the northern latitudes, those who are of northern European ancestry, and women. Estimates of the prevalence of MS vary from 20 to 150 cases per 100,000 people, depending on the population under study and the geographic region of the world.[4-6] Conservative estimates suggest that there are 400,000 people living with MS in the United States,[3] whereas global estimates suggest that there are over 2.5 million people with MS worldwide.[5] For the majority of persons with MS, having the disease will not reduce their life expectancy.[7,8]

MS causes a range of symptoms including, but not exclusive to, loss of balance, weakness, fatigue, spasticity, incontinence, and vision changes. Symptoms can come and go as scars develop and heal on the central nerves. Consequently, the disease is unpredictable both day to day and over time.[9] Many of the symptoms of MS challenge a person's physical mobility and ability to safely ambulate in his/her home and community. Approximately 45% of persons with MS will use assistive devices such as canes, walkers, and wheelchairs to facilitate their mobility.[10] People with MS identify mobility limitations as one of the greatest challenges of having this disease[11] and continued loss of mobility as among their greatest concerns for their future.[12]

Many of the symptoms of MS are consistent with fall risk factors among community-dwelling older adults (eg, problems with balance, use of walking aids, visual impairment).[13] In addition, the risk of injurious falls may be greater among people with MS because of their reduced weight-bearing activities, and use of steroids for symptom management can contribute to the development of osteoporosis,[14,15] which further increases risk of hip fracture.[16]

Reduction of the hospitalization rate for hip fractures has been recognized as a major health priority for the nation.[1] Therefore, given the apparent risk for falls and fall-related injuries among people with MS, the lack of information regarding fall risk factors with this population is surprising. We found 1 published study[17] that addresses the issue. In that study, 50 people aged 25 to 65 were tested by using performance-based observational measures of balance and mobility. Findings indicated that 54% of the sample had experienced a fall in the past 2 months and that fallers were more likely to use a cane and have lower scores on ambulation and balance tests. The present study extends the work of Cattaneo et al[17] by examining a much broader range of potential risk factors for falling in a sample of 1089 people aged 45 to 90 with MS living in the midwestern United States. The objective of this analysis was to determine the risk factors that are associated with reporting a fall in the past 6 months among people between the ages of 45 and 90 who have MS.

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METHODS

Participant Selection

Participants for this study were part of a larger study focused on the unmet health-related needs of people aging with MS in the states of Minnesota, Wisconsin, Illinois, Indiana, and Michigan. Participants were recruited through advertising and direct mailing to the members of the National Multiple Sclerosis Society (NMSS) and registrants of the North American Research Committee on Multiple Sclerosis, a volunteer patient registry. Recruitment materials included a cover letter explaining the study, its purpose, and the risks and benefits of participating. People who were willing to be contacted for a telephone interview returned a form to the study office in a postage-paid return envelope. This form provided their contact information and the best days and times to reach them.

To be eligible to participate in an interview, people returning the forms had to be 45 years of age or older, have a self-reported diagnosis of MS, and be willing to participate in a telephone interview. The study was open to all people who met these basic criteria; no restrictions were placed based on location of residence (eg, community vs institution).

A total of 2277 people volunteered to participate in the study, 1498 between the ages of 45 and 64, with the remaining 779 aged 65 and over. Because of the focus and hypotheses of the original study, all of the 779 volunteers 65 or older were contacted for an interview, and 725 participated. Of the 54 who did not complete the interview, 3 could not be contacted, 6 had died, 19 refused, and 26 were unable to complete the interview process because of cognitive impairment or illness. For the 45- to 64-year-old group, 585 volunteers from the pool of 1498 were randomly selected and 557 actually completed the interview. Of the 28 who did not complete the interview, 13 could not be contacted, 3 had died, 7 refused, and 5 were unable to complete the entire interview because of cognitive impairment or illness.

The final sample for the overall study was 1282. Of these people, 1089 answered questions about their recent falls experiences and fear of falling. A descriptive profile of the participants who were included in the analyses for this study is provided in table 1.

Procedures

Participants were contacted by telephone by a trained project staff member. The structured interview guide was used to gather sociodemographic information, background about the participant's MS course, presence and extent of symptoms, presence of activity limitations, the use of assistive technology to aid in day-to-day tasks, availability of social support, and the use of a wide range of health and ancillary services. Information was also collected about falls in the past 6 months, fear about falling, and whether the participant curtailed activities he/she was capable of performing in case he/she might fall.

Wherever possible, the questions on the interview guide were based on existing needs assessment survey tools and interview guides, for example, functional status,[18,19] community type,[20] MS symptoms,[21,22] and income adequacy.[23] In addition, an advisory group was used throughout the study to provide feedback on the various stages of the project. These people included a neurologist specializing in MS, a social worker from an MS day program, staff from the NMSS, informal caregivers and/or family members of people with MS, and several people with MS. Members of the advisory group were instrumental in providing feedback about the interview guide items, response categories, and overall flow of questions. The average length of the interview among the 1089 people included in this analysis was 41 minutes (median, 39min).

Analysis

Data were entered into SPSS[a] and then imported into SAS[b] for analysis. Frequency distributions were performed to examine the presence of inappropriate values. Errors were checked and corrected against the raw data from the hard-copy interview guides.

Based on existing literature about risk factors for falling, the a priori hypothesis was that loss of balance, weakness, bladder incontinence, and fear of falling would be associated with an increased likelihood of falling. We were uncertain if any of the other variables would be related to falling and therefore assumed no relation. Based on this hypothesis, the dependent variable for the analysis was the participants' responses to the question "Have you fallen to the ground in the past 6 months?" Potential responses were "yes" or "no." Given the dichotomous nature of the responses, multivariate logistic regression models were used to examine the factors associated with higher odds of experiencing a fall.

A total of 18 covariates were initially considered for analysis including MS symptoms (12 questions) and course (2 questions: status of MS in the past year, MS course since diagnosis), fear of falling (yes, no), use of a wheelchair (never, sometimes, always), age, and sex. Based on the recommendation of the study advisory group, the response options for all symptom variables were as follows: the symptom is not a problem, the symptom interferes a little bit with everyday activities, or the symptom interferes a great deal with everyday activities. Age was used as a categorical rather than a continuous measure because of the goals and purpose of the larger study on the unmet health-related needs of people aging with MS.

To ensure that multicolinearity was not an issue for the analysis, 2 approaches were used. First, a preliminary colinearity analysis was performed by calculating Pearson correlation coefficient for all pairwise covariates. An absolute Pearson correlation coefficient of 0.7 was used as the criterion for assessing potential problems. Through this analysis, 2 MS symptoms, depression and loss of coordination, were found to be significantly associated with other symptoms. Therefore, a second approach to the colinearity analysis was to examine these symptoms by using multivariate ordinal logistic regression. Significant findings were again observed, and the decision was made to omit the symptoms of depression and loss of coordination from the model selection process for the risk of falling analysis. This decision resolved all initial concerns about multicolinearity.

Model selection was performed on the final set of 16 potential covariates by using 3 different model selection methods: stepwise, backward, and forward. For all models, a P value of .05 was used for both entry into and remaining in the model. The models obtained from the 3 methods were then compared to assess whether there were discrepancies. If discrepancies were found, Akaike information criterion (AIC) statistics from the models were assessed to obtain the "best" model. AIC criterion, commonly used to compare models that are not nested, is a penalized model selection criterion that penalizes models with additional noninformative variables. The model with the lowest AIC statistic is considered the "best" model out of the group of comparison models. Finally, the Hosmer-Lemeshow goodness-of-fit test was used to assess the overall fit of the selected model, and the results provided no evidence of a lack of fit ($P=.931$).

Table 1: Sociodemographic Characteristics of Participants in Analysis

Characteristics	Response Categories	Men (n=288)		Women (n=801)	
		n	%	n	%
Age (y)	45–54	52	18.06	164	20.47
	55–64	56	19.44	205	25.59
	65–74	149	51.74	330	41.20
	75+	31	10.76	102	12.73
Race	Black (non-Hispanic)	2	0.69	25	3.12
	White (non-Hispanic)	283	98.26	766	95.63
	Other	2	0.69	5	0.62
	Missing	1	0.35	5	0.62
Marital status	Married or common law	243	84.38	502	62.67
	Widowed	8	2.78	126	15.73
	Separated	3	1.04	6	0.75
	Divorced	23	7.99	103	12.86
	Single	11	3.82	61	7.62
	Missing	0	0.00	3	0.37
Highest education	8th grade or less	4	1.39	4	0.50
	9–11 grades	8	2.78	12	1.50
	High school	61	21.18	245	30.59
	Technical or trade school	17	5.90	37	4.62
	Some college	77	26.74	269	33.58
	Bachelor's degree	67	23.26	157	19.60
	Master's degree	33	11.46	63	7.87
	Doctorate	21	7.29	10	1.25
	Missing	0	0.00	4	0.50
Type of housing	House	220	76.39	587	73.28
	Apartment	14	4.86	65	8.11
	Condominium	23	7.99	72	8.99
	Nursing home	4	1.39	22	2.75
	Assisted living facility	3	1.04	9	1.12
	Other	23	7.99	43	5.37
	Missing	1	0.35	3	0.37
Type of community	Primarily urban	59	20.49	135	16.85
	Primarily suburban	111	38.54	280	34.96
	Small town	63	21.88	250	31.21
	Rural	55	19.10	128	15.98
	Missing	0	0.00	8	1.00
Income adequacy	Totally inadequate	1	0.35	18	2.25
	Not very well	9	3.13	27	3.37
	With some difficulty	41	14.24	129	16.10
	Adequately	124	43.06	366	45.69
	Very well	113	39.24	250	31.21
	Missing	0	0.00	11	1.37

Ethics

This project was reviewed and approved by the institutional review board of the researchers' university. All procedures, including contact and recruiting materials, were approved for use.

RESULTS

Across the 1089 people included in this analysis, 52.25% (n=569) reported that they had experienced a fall in the past 6 months. The average age of the fallers was 63.6±9.2 years, compared with 64.0±9.6 years for the nonfallers. Based on bivariate analyses (data not shown), fallers and nonfallers differed significantly in terms of sex, MS status in the past year, MS course since diagnosis, fear of falling, and wheelchair use. In addition, fallers and nonfallers differed significantly in their experience of several MS symptoms including fatigue, weakness, spasticity, tremors, vision, concentration and forgetfulness, and bladder incontinence.

Table 2 shows the parameter estimates, *P* values, and odds ratios (ORs) from the multivariate logistic regression analyses. After adjusting for the other covariates in the model, age did not have a significant association with the likelihood of falling in the past 6 months. Men were found to have greater fall risk than women (OR=1.50; 95% confidence interval [CI], 1.10−2.03). Participants who reported fear of falling were more likely to report a fall in the past 6 months compared with participants who did not report this fear (OR=1.74; 95% CI, 1.32−2.31). The status of the participants' MS over the past year played an important role in fall risk, particularly for those persons who reported that their MS was either deteriorating or had been variable in its progression over the past year. Compared with participants who had experienced a stable or an improving course, those participants who had experienced deterioration or variability experienced a greater likelihood of falling.

Table 2: Results From Logistic Regression Analysis on Risk Factors Associated With Falls Among People Aging With MS

Parameter	Estimate	Standard Error	Degrees of Freedom	*P*	OR	95% CI
Intercept	−1.580	.279	1	**<.001**	NA	NA
Age (y) (ref: 45−54)			3	.433		
55−64	−0.259	.205	1	.207	0.77	0.52−1.15
65−74	−0.147	.187	1	.431	0.86	0.60−1.25
75+	−0.380	.258	1	.140	0.68	0.41−1.13
Sex (ref: female)	0.403	.155	1	**.009**	1.50	1.10−2.03
MS status in past year (ref: stable)			3	**<.001**		
Improving	−0.329	.376	1	.381	0.72	0.34−1.50
Deteriorating	0.715	.163	1	<.001	2.05	1.49−2.82
Variable	0.438	.180	1	.015	1.55	1.09−2.21
Concerned about falling (ref: no)	0.555	.143	1	**.001**	1.74	1.32−2.31
Wheelchair use (ref: always use)			2	**.010**		
Never use wheelchair	0.514	.213	1	.016	1.67	1.10−2.54
Sometimes use wheelchair	0.761	.235	1	.001	2.14	1.35−3.39
Symptom: problem with balance or mobility (ref: not a problem)			2	**.010**		
Interfere a little bit	0.670	.267	1	.012	1.95	1.16−3.30
Interfere a great deal	0.797	.275	1	.004	2.22	1.29−3.80
Symptom: poor concentration or forgetfulness (ref: not a problem)			2	**.011**		
Interfere a little bit	0.087	.147	1	.553	1.09	0.82−1.46
Interfere a great deal	0.594	.216	1	.006	1.81	1.19−2.76
Symptom: incontinence of bladder (ref: not a problem)			2	**.004**		
Interfere a little bit	0.388	.168	1	.021	1.47	1.06−2.05
Interfere a great deal	0.486	.173	1	.005	1.63	1.16−2.28

NOTE. Boldface denotes significant *P* values.
Abbreviations: CI, confidence interval; NA, not applicable; ref, referent group for comparison.

Never or sometimes using a wheelchair was found to be associated with increased risk for a fall relative to using a wheelchair all of the time. The odds of a fall for never users was 1.67 (95% CI, 1.10–2.54), whereas for the sometimes users it was 2.14 (95% CI, 1.35–3.39). When compared with each other, never users and sometimes users were not significantly different in terms of their fall risk.

Although the bivariate analyses (data not shown) suggested that many of the symptoms of MS were associated with an increased risk of falling, the multivariate analyses found that only 3 symptoms maintained independent effects on the outcome after adjusting for the other covariates: problems with balance or mobility, problems with poor concentration or forgetfulness, and incontinence of bladder. For both balance or mobility and incontinence of bladder, any interference of these symptoms with the participants' daily activities (either a little or a great deal) was associated with an increased risk of falling. For problems with poor concentration or forgetfulness, a great deal of interference was associated with an increased risk of falling relative to both no problems with this symptom as well as relative to a little bit of interference from this symptom.

Based on the findings, the hypothesis that loss of balance, weakness, bladder incontinence, and fear of falling would be associated with an increased likelihood of falling was partially accepted because weakness was not maintained in the final model.

DISCUSSION

The findings of the current study are similar to those of Cattaneo et al[17] in that prevalence rates for a recent fall were similar (52.25% vs 54.00%), and both studies did not find a relation between age and risk of falling. Furthermore, both studies found that the use of ambulatory aids was associated with an increased likelihood of falling even though the 2 studies did not measure this variable in the same way. The Cattaneo study examined whether participants used a cane, whereas the current study focused on the use of a wheelchair and found that participants who never or sometimes used a wheelchair were at greater risk of a fall when compared with participants who used a wheelchair consistently. Given the variable and progressive nature of MS, the observed association between wheelchair use and fall risk points to a number of possible issues and questions for future research.

First, it is important to recognize that people who always use a wheelchair may be at less risk of a fall compared with never and sometimes users simply because they are not ambulatory. This finding does not imply that all people with MS should use a wheelchair all of the time to reduce their fall risk. The advantages of wheelchair use for issues such as safety and energy conservation must be balanced against disadvantages (eg, deconditioning, environmental accessibility).

Second, it is important to also consider the circumstances that would lead people with MS to report that they "never" or "sometimes" use a wheelchair. Our own clinical experience suggests that people who never use a wheelchair are most likely to be fully ambulatory in all or most situations or are able to manage with only a cane or walker. In this latter group, it is possible that they are never using a wheelchair, even in demanding ambulatory situations (eg, longer durations and/or distances), when using a wheelchair might be appropriate to reduce fatigue and fall risk. Consistent with this possibility are our clinical observations that people reporting "sometimes" use of a wheelchair are often primarily ambulatory but choose to use wheelchairs on a periodic basis to manage fatigue- and endurance-related issues. For example, they may "sometimes" use a wheelchair as a method of energy conservation when traveling longer distances or for special events (eg, shopping at the mall).[24] In this group of people, the use of a wheelchair is

a conscious choice, and therefore we must ask whether there are times when they did not choose to use a wheelchair but should have in order to reduce fall risk. In other words, we must ask whether fall risk among occasional wheelchair users is because of a lack of correspondence between their actual physical abilities and their choice of mobility aid on a given day. This explanation would be similar among people who are experiencing fluctuations in their mobility status day to day and choose different mobility devices as a result. Unfortunately, the data obtained through this study cannot test this possible explanation. Future studies need to examine when and in what circumstances never and occasional wheelchair users are falling.

Three of the MS symptoms explored in this analysis were found to be associated with an increased risk of falls: problems with balance or mobility, problems with concentration or forgetfulness, and incontinence of bladder. Each of these symptoms has also been shown to be associated with risk of falls in studies of older adults.[13] One symptom that has been significant in some studies of older adults but not in this study is lower-extremity weakness.[13] Although weakness is a common symptom of MS,[9] our analysis found that it did not retain an independent effect on fall risk after other symptoms had been considered.

Our finding that 60% of people who reported a fall also reported fear of falling warrants the attention of health care providers for several reasons. First, fear of falling has been associated with deconditioning.[25] It is well documented that deconditioning in persons with MS can increase levels of fatigue, which, in turn, can increase the extent of other MS symptoms.[26] Second, health care providers may have an important role in the prevention of activity curtailment among people who are afraid of falling. Howland et al[27] found that among older adults reporting fear of falling, those that communicated about falls and had more social support were less likely to curtail activity. Thus, initiating conversations about falls and assisting people with MS in their efforts to build social networks may positively impact activity levels among those persons who are afraid of falling. Third, given the association between fear of falling and reduced activity, fear of falling may negatively impact secondary prevention efforts, such as participation in outpatient rehabilitation programs or therapies involving exercises or activities intended to build skills for activities of daily living and instrumental activities of daily living. Participation in discretionary home programs, which are typically unstructured and unsupervised, may be especially difficult with people with MS who are afraid of falling. Finally, our findings suggest that fear of falling is associated with increased fall risk among people with MS. This finding is consistent with findings from prospective research examining fear of falling among older adults.[28]

The relation between fear of falling and fall risk among people with MS may or may not follow the model that is commonly applied to older adults. Among older adults, fear of falling is often associated with self-curtailment of activities that he/she is capable of performing.[29] This activity curtailment is thought to lead to deconditioning that ultimately increases fall risk. Logically, interventions to help older adults manage fear of falling often emphasize a realistic appraisal of physical capabilities and current levels of activity.[30] This approach may not be appropriate for people with MS. Qualitative research exploring the etiology of fear of falling among people with MS may be particularly useful to the development of interventions intended to reduce fear of falling and fall risk among people with MS.

Although this study contributes to and enhances the literature on fall risk among people with MS, it is limited by its cross-sectional design and its self-report format. In addition, sample selection used multiple methods, all of which were essentially convenience in orientation. Therefore, although our descriptive data correspond with other MS studies, we cannot be assured that our sample is representative of all older adults with MS. It is possible that the people volunteering for this study are more or less likely to fall than the general MS older adult population. Finally, actual falls were not tracked in this study, and no performance-based measures were used. Nevertheless, the findings are consistent with the current fall-related literature and do provide ample ideas for further research on this important topic.

CONCLUSIONS

Findings of this study verify the high prevalence of falls among people with MS, with 52.25% of the sample reporting a fall in the past 6 months. Male participants and those who reported fear of falling, never or occasional use of a wheelchair, problems with balance or mobility, problems with poor concentration or forgetfulness, and variable or deteriorating MS status in the past year were shown to be at greater risk of a fall than participants who did not report these characteristics. Fortunately, a number of these risk factors have the potential to be modified with intervention, including fear of falling and problems with balance or mobility. Wheelchair use may also be a modifiable factor if the risk is associated with decision making about appropriate ambulatory supports in different contexts. This issue is one that needs further investigation and clarification. In summary, falls are a serious concern for people aging with MS, and attention to potential interventions in this area would be worth further investigation.

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Suppliers

a. DataBuilder; SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.
b. Version 9.1; SAS Institute Inc, 100 SAS Campus Dr, Cary, NC 27513.