



Original Research—CME

Relationship Between Fear of Falling and Physical Activity in People Aging With a Disability

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Abstract

Background: An estimated one billion people worldwide live with some form of disability and may face many challenges as they age, including increased fall risk. Understanding the risk factors linking falls, fear of falling, and activity restriction is critical for developing effective programs to increase activity levels among persons with disabilities.

Objectives: To determine if differences exist in the level of physical activity in people with different types of conditions associated with disability and to investigate if fear of falling is associated with physical activity in individuals who are aging with a long-term disability.

Design: Cross-sectional retrospective design.

Setting: Community.

Participants: A convenience sample of 1812 community-dwelling individuals who had one of four diagnoses: multiple sclerosis (MS), muscular dystrophy (MD), spinal cord injury (SCI), or post-polio syndrome (PPS).

Methods: Descriptive statistics, chi-square, and analysis of variance, followed by multivariate linear regression analysis were used to examine the association between physical activity status and fear of falling.

Main Outcome Measurements: Physical activity volume and fear of falling.

Results: After controlling for age, sex, duration of disability, and mobility level, there was variation across diagnostic groups ($P < .001$). People with SCI reported greater physical activity ($M = 25.19$) compared to other groups (MS: $M = 18.70$; MD: $M = 21.83$; PPS: $M = 15.47$). Patients with PPS had the greatest concerns about falling ($M = 16.08$), and patients with MS had the lowest ($M = 13.12$). Fear of falling was associated with physical activity ($P < .001$), which remained significant after controlling for diagnosis type, falls history, and level of mobility.

Conclusion: Level of physical activity appears to vary among disability diagnoses. These results highlight the importance of addressing fear of falling in people with long-term disability because fear of falling is associated with physical activity.

Introduction

An estimated one billion people worldwide live with some form of activities of daily living (ADLs) or mobility disability.¹ Due to demographic trends, including population aging, this number is expected to grow.¹ Included in this large and diverse group are people who first experienced physical impairments early in life, often due to injury or early onset medical conditions such as spinal cord injury (SCI) or multiple sclerosis (MS). These individuals are said

to be living with long-term physical disability and face many health-related challenges as they age, including worsening of secondary symptoms like pain and fatigue.^{2,3}

One important but understudied area in people aging with long-term physical disability is fall risk. It is known that older adults with long-term physical disability have an increased risk for falls as compared to age-matched community-dwelling older adults.⁴ Related to actual fall risk is fear or concern about falling, which is defined by Tinetti and Powell, as “an ongoing concern about falling

that ultimately limits the performance of daily living.”⁵ The development of fear of falling appears to be multifactorial.⁶ Among community-dwelling older adults, actual falls are a strong predictor of fear of falling.^{7,8} However, fear of falling has also been reported among older adults with no previous history of falls, suggesting that other factors may play a significant role in the development of fear of falling.⁷⁻¹⁰ Fear or concern about falling is a critical problem for persons aging with conditions like MS,^{11,12} SCI,¹³ and post-polio syndrome (PPS),^{14,15} and can significantly impact overall health, function, and quality of life for both older adults and those with long-term physical disability.^{8,16-20}

Key to reducing fall risk is an understanding of risk and preventative factors, which can be used to establish targets for intervention. One of the most studied fall prevention approaches is physical activity/exercise. Exercise (eg, strength, balance, and endurance training) has been identified as an effective fall prevention approach and is a recommended component of multifactorial fall prevention interventions for all older adults.²¹⁻²³ There is also growing evidence that modification of exercise programs (eg, adaptive equipment, awareness/understanding of secondary conditions) is an effective health promotion strategy for people aging with a long-term physical disability.^{24,25} The general benefits of engaging in regular physical activity/exercise are well recognized, and include reducing disease symptoms, enhancing overall health, and improving participation in daily activities and thus, quality of life.^{26,27} However, despite best practice recommendations, long-term engagement in exercise programs can be challenging for people who are aging with a long-term physical disability due to environmental, equipment, and health-related barriers.^{28,29} Although it is probable that falls and fear of falling may result in restricting physical activity among persons aging with long-term physical disability, there have been a limited number of studies looking at the relationship between these factors.^{12,13,30,31}

The evidence indicates that understanding the risk factors linking falls, fear of falling, and activity restriction may be critical to the development of effective programs to increase activity levels among persons with a long-term physical disability, especially those who may be at an increased risk for falling. Thus, the purposes of this study were to (1) determine if differences exist in the level of physical activity in people with different types of physical conditions associated with long-term disability, and (2) investigate if fear of falling is associated with physical activity, after controlling for confounders like age, sex, mobility level, falls history, and medical diagnosis.

Methods

Participants and Recruitment

Participants for these analyses were from the fourth - time-point of a longitudinal survey conducted by the

University of Washington, as part of a Rehabilitation Research and Training Center funded by the Administration on Community Living. Time point 4 was selected due to inclusion of fear of falling and self-reported fall assessment measures. Study participants were recruited initially through existing registries of individuals with long-term physical disabilities who were interested in participating in research (47%), through web and print advertisements distributed through national disability organizations (40%), and through other sources, such as clinic flyers (13%). Individuals who were interested in participating were screened by research staff over the phone. Eligibility requirements included the following: being at least 18 years of age; ability to read and write in English; and having a self-reported diagnosis of MS, MD (muscular dystrophy), SCI, or PPS (including having a history of polio or polio sequelae). All eligible and interested individuals received a paper survey, written consent form, and a postage-paid return envelope. All participants provided written consent prior to participation and all study procedures were approved by the institutional review board at the University of Washington.

Procedures and Data Collection

Data collection for this survey (time point 4) ran from August 2012 through February 2013. Participants who had not returned their surveys within 1 month received a reminder letter by mail, with a reminder phone call at 6 weeks. All returned surveys were reviewed for missing data and information discrepancies. Follow-up and missing data calls were made by phone and collected verbally by study staff. All data were then double entered into a central database. Of the 1864 participants who enrolled in the study at the first time point, 48 formally withdrew by the time data collection began for the fourth time point, such that 1816 surveys were mailed to continuing participants. Of these, 137 surveys were not returned, and 81 were not included for various reasons (eg, participant was deceased, returned to sender due to an invalid address, note declining participation), resulting in a final sample size of 1598 surveys. Of these, 1591 contained complete data and were included in this study analysis.

Measures

Surveys for this analysis included measures of descriptive demographics, self-reported diagnosis, physical function, severity of secondary health conditions, falls history, fear of falling, and physical activity. Key outcomes are described below.

Physical Activity

Physical activity was measured by participants reporting the number of days they spent doing more than 15 minutes of physical activity during their free time, over a 7-day period (1 week), in each of three categories

(strenuous, moderate, and mild). This item is based on the Godin Leisure-Time Exercise Questionnaire (GLTEQ), a self-reported measure of leisure-time physical activity level.^{32,33} To minimize participant response burden, our modified version asked participants the “number of days” spent in various exercise activities, rather than the “number of times” exercising (as in the original GLTEQ). Exercise examples are provided for each of the three categories (strenuous, moderate, and mild). The total activity score is then calculated by multiplying the frequency score (number of days in each category) by metabolic equivalents for each respective category (3 = mild, 5 = moderate, 9 = strenuous). For example, a participant indicating 1 day of strenuous and 2 days of moderate activity would have a total activity score of $19 = 9 (1) + 2 (5) + 0 (3)$. The GLTEQ has been used in adults with disability due to chronic health conditions such as MS.³⁴ It is important to note, however, that because of our modification to the reporting instructions, our total activity score is internally consistent but cannot be compared reliably to total activity scores published using the original measure.

Fear of Falling

The seven-item Falls Efficacy Scale-International (FES-I) was used to measure concern about falling.³⁵ The FES-I asks individuals to report their concern about falling when participating in various activities of daily living (or ADLs). Items are anchored on a 4-point Likert scale, ranging from 1, “not at all concerned” of falling, to 4, “very concerned.” Scores from all seven items are summed, with higher scores indicating greater fear of falling. This scale demonstrates good construct validity and has been used in people with MS.³⁶

Falls

History of falls was assessed using a single item from the survey: “Did you fall down in the past 6 months?” A fall was defined as “landing on the ground or at some other level, such as a chair or a bed.”³⁷ The participant could answer yes, no, or don’t know. For purposes of these analyses, only “yes” and “no” responses were included in analyses.

Mobility Level

Mobility was assessed using the Gross Motor Function Classification System (or GMFCS), a descriptive and subjective self-report of physical mobility originally designed for people with cerebral palsy.³⁸ This item specifically asks: “How would you classify your mobility, ability to get around?” Six response options range from: 0 = “no mobility limitations” to 5 = “severely limited in self-mobility even with use of assistive technology” (Table S1).

Data Analysis

Descriptive statistics, chi-square, and univariate analysis of variance (ANOVA) were used to examine differences in demographic characteristics across the four diagnostic groups. In addition, an ANOVA was used to examine the difference in physical activity, fear of falling, and mobility by diagnosis.

Multivariate linear regression with sequential block entry was used to examine the association of physical activity and fear of falling. Block 1 included age, sex, falls in the past 6 months (yes/no), and mobility. Block 2 included the four diagnostic groups with PPS as the reference group. Block 3 included FES-I total score, which was the key variable of interest. Covariates were selected based on existing empirical data and emerging theoretical perspectives about relationships among fear of falling and physical activity.^{12,39,40} Prior to proceeding with the linear regression analysis, multicollinearity among the covariates was assessed and no problems were identified. For each analysis, a *P* value of .05 was used to determine significance. No imputation for missing values was performed. SPSS V25.0 was used for the data analysis.⁴¹

Results

Demographic Characteristics and Summary of Outcomes

Participant demographics are displayed in Table 1. This sample included a group of that was predominantly female (63%), non-Hispanic white (91.2%), and college-educated (80.4%). The greatest percentage of people reporting a fall in the past 6 months were individuals with MD (63%), followed by those with PPS (50.4%), MS (46.8%), and SCI (36.5%). The mean scores on the FES-I reflect a moderate to high concern about falling among all four diagnostic groups per established cutpoints.⁴² Specifically, participants with PPS had the greatest concerns about falling ($M = 16.08$), and people with MS had the lowest ($M = 13.12$). People with SCI reported the most physical activity ($M = 25.19$), followed by participants with MS ($M = 21.83$), MD ($M = 18.73$), and PPS ($M = 15.47$).

Differences in Level of Physical Activity, Fear of Falling, and Mobility by Diagnostic Group

We conducted three, one-way ANOVAs using continuous measures of physical activity, fear of falling, and mobility as the outcomes, by diagnostic group. The unadjusted model showed a significant difference in physical activity by diagnostic group ($F = 1.78, P < .001$). Participants with SCI reported significantly more physical activity compared to all other groups ($P < .001$). In addition, there was a significant difference in fear of falling

Table 1
Participant demographics by diagnosis

†Characteristics	Multiple Sclerosis n = 506	Muscular Dystrophy n = 282	Spinal Cord Injury n = 414	Post-Polio Syndrome n = 389
Age, mean (SD), year***	57.42 (10.54)	55.95 (12.53)	53.48 (13.67)	70.11 (8.05)
Sex, No. (%)***				
Female	413 (81.6)	169 (59.9)	136 (32.9)	296 (76.1)
Race, No. (%)***				
White	473 (93.5)	269 (95.4)	348 (84.1)	361 (92.8)
Education, No. (%)***				
College graduate or higher	289 (57.1)	163 (57.8)	202 (48.8)	249 (64.0)
Partner status, No. (%)***				
Married/living w/ partner	355 (70.2)	208 (73.8)	214 (51.8)	225 (57.9)
Annual individual income, No. (%)***				
<\$55 000	365 (72.1)	178 (63.2)	301 (72.7)	280 (71.9)
\$56 000-85 000	51 (10.1)	33 (11.7)	43 (10.3)	42 (10.8)
>\$86 000	30 (6.0)	32 (11.3)	34 (8.2)	25 (6.4)
Years since diagnosis, mean (SD)***	17.98 (9.73)	17.48 (11.15)	18.83 (11.40)	18.63 (9.90)
Falls in last 6 mo, No. (%)***	237 (46.8)	178 (63.1)	151 (36.5)	196 (50.4)
‡Fear of Falling, mean (SD)*	13.12 (5.47)	15.36 (6.23)	16.08 (5.10)	14.93 (5.80)
§Physical Activity, mean (SD)***	21.83 (24.29)	18.70 (21.65)	25.19 (28.16)	15.47 (22.16)
¶Mobility, mean (SD)***	2.04 (1.64)	2.37 (1.54)	3.61 (1.24)	3.10 (1.30)
No limitations, No. (%)	137 (27.2)	47 (16.7)	14 (3.4)	22 (5.7)
Walk without restrictions, No. (%)	68 (13.4)	41 (14.5)	26 (6.4)	23 (5.9)
No assistive device, limitations walking outdoors, No. (%)	85 (16.9)	52 (18.4)	26 (6.4)	59 (15.2)
Walk with assistive device, No. (%)	100 (19.8)	65 (23.0)	51 (12.5)	123 (31.8)
Limited self-mobility, use power mobility outdoors, No. (%)	79 (15.7)	56 (19.9)	214 (52.5)	111 (28.7)
Severely limited mobility even with assistive technology, No. (%)	35 (6.9)	21 (7.4)	77 (18.9)	49 (12.7)

Chi-square and one-way ANOVA tests * $P < .05$, *** $P < .001$.

†Percentages may not add up to 100 due to missing data.

‡Falls Efficacy Scale-International.

§Godin Leisure-Time Exercise Questionnaire.

¶Gross motor classification system.

Table 2
Linear regression predicting physical activity

	Block 1			Block 2			Block 3		
	b	95% CI	P value	b	95% CI	P value	b	95% CI	P value
Age	-0.10	-0.29, -.09	<.001	-0.05	-0.21, 0.02	.098	-0.03	-1.7, 0.05	.271
Sex	-0.09	-7.31, -2.07	<.001	-0.05	-5.41, 0.22	.071	-0.05	-5.36, 0.20	.069
Mobility	-1.67	-3.47, -1.84	<.001	-0.21	-4.19, -2.45	<.001	-0.09	-2.49, -0.43	.006
Falls	-0.02	-3.55, 1.23	.345	0.00	-2.39, 2.44	.983	0.01	-1.20, 2.78	.749
Diagnosis									
PPS	Reference								
MS				0.04	-1.56, 5.66	.266	0.04	-1.65, 5.47	.292
MD				-0.02	-5.20, 3.04	.606	0.00	-4.10, 4.05	.991
SCI				0.16	4.90, 13.55	<.001	0.14	3.72, 12.29	<.001
FES-I							-0.20	-1.13, -0.61	<.001

PPS = post-polio syndrome; MS = Multiple sclerosis; MD = muscular dystrophy; SCI = spinal cord injury; FES-I = Falls Efficacy Scale-International. Bold variables were significant in the linear regression.

by diagnostic group ($F = 3.63, P < .01$). People with MS reported a significantly lower fear of falling compared to other groups ($P < .01$). Finally, there were significant differences in level of mobility by diagnostic group, with participants with SCI reporting greater mobility impairment compared to the other groups ($F = 52.29, P < .001$).

The Association Between Physical Activity and Fear of Falling

Multiple linear regression with sequential predictor entry was used to test the incremental variance in physical activity accounted for by each of the respective

predictors. Age, sex, fall history, and mobility, which were entered first into the model, accounted for 5% of the variance in physical activity: $F(4, 1480) = 19.47$, $P < .001$. Diagnostic group accounted for an additional 1.8% of the variance in physical activity after controlling for age, sex, fall history, and mobility: $F_{\text{change}}(3, 1477) = 9.29$, $P < .001$. Fear of falling score, entered last, accounted for an additional 2.5% of the variance in physical activity, $F_{\text{change}}(1, 1476) = 41.99$, $P < .001$, above and beyond diagnosis, age, sex, fall history, and mobility (Table 2).

Discussion

This study had two objectives. First, we compared the level of physical activity among adults living with long-term physical disability by diagnostic group (MS, MD, SCI, or PPS). Second, we sought to determine if fear of falling is associated with physical activity across these same groups after controlling for confounders like age, sex, mobility level, falls history, and diagnostic group.

Differences were found in physical activity between each diagnostic group, even after controlling for variables that may have contributed to more or less physical activity participation. Surprisingly in this study, age did not emerge as a significant contributor to physical activity, above and beyond sex, mobility, and falls history. Older adults are often the target of fall prevention programs due to a common belief that increasing age alone is associated with greater fall risk. Results from this study suggest that the effects of age on fall risk may occur due to age-related variables, including mobility level and falls history. These results also highlight that among people living with long-term physical disability, fall prevention and education programs may be beneficial throughout the lifespan.

Physical activity recommendations for persons with a long-term physical disability are similar to those for older adults and the general population: 150 minutes of moderate intensity or 75 minutes of vigorous intensity aerobic exercise spread throughout the week, which can be accumulated in 10-minute bouts.^{43,44} However, evidence-based physical activity guidelines have also been developed for people with MS,⁴⁵ and SCI⁴⁴: at least 30 minutes of moderate intensity aerobic exercise for people with MS (two times per week), and 20 minutes of moderate to vigorous intensity for people with SCI. Guidelines for people with MD and PPS are yet to be established. Although the benefits of participating in physical activity are well known, the challenge is in promoting long-term adherence and increasing exercise self-efficacy in people with disabilities, especially given environmental barriers. Results of this study suggest that when promoting physical activity in these populations, an intervention to reduce fear of falling may also be required.

Results from this study found that fear of falling was significantly associated with physical activity status, even

after accounting for the relationship of age and fall history. A relationship between fear of falling and physical activity has been reported previously in people with MS and SCI, regardless of whether they were wheelchair users.^{12,30,46,47} Our findings suggest that fear of falling contributes to lower levels of physical activity, or conversely that individuals with higher levels of activity may have greater confidence in their mobility ability without the risk of falling. However, further research is necessary to establish if there is a cause and effect relationship between fear of falling and physical activity in these populations.

Although fear of falling was associated with physical activity status in our analyses, prior history of falls was not. Asking about falls in the previous 6 months is recommended in the current American Geriatric Society/British Geriatric Society guidelines²¹ on fall prevention in older adults, but asking about fear of falling is not. However, the Centers for Disease Control and Prevention's (CDC's) Stopping Elderly Accidents, Deaths and Injury (STEADI) program does recommend that health care providers (HCPs) ask older adults (age 65 and older) about falls in the past year, if they feel unsteady when walking, and if they worry about falling.⁴⁸ The findings in this study suggest that HCPs might consider asking about fear of falling routinely, especially when working with people who have MS,⁴⁹ MD, SCI, or PPS. At a minimum, responses to such questions may be useful for determining who is or is not likely to be meeting recommended physical activity guidelines. If future research supports a causal effect of fear of falling on willingness to engage in physical activity, information about fear of falling may be useful in addressing this potential barrier to engagement in programs promoting physical activity.^{14,50}

Fear of falling has been found to be a modifiable risk factor in community-dwelling older adults.⁵¹ Results of a recent Cochrane Review found that fear of falling decreased immediately following completion of the exercise/physical activity interventions, without increasing fall risk or fall frequency⁵²; however, it is not known fully whether this intervention decreases fear of falling beyond the length of participation. Evidenced-based programs, such as A Matter of Balance⁵¹ and Stepping On,⁵³ have been developed specifically to address fear of falling and increase physical activity in older adults. Safe at Home BAASE (Behavior, Attitudes, Activity, Symptoms, Environment)⁵⁴ and, more recently, Balance Right in MS (BRiMS), are similar programs that have been developed specifically for people living with MS, with BRiMS targeting individuals with secondary progressive MS.⁵⁵ All of these programs provide knowledge regarding falls and fall risk factors and empower participants to manage their fall risk. These approaches could be effective for managing fear of falling among people living and aging with a long-term physical disability as well. Creating greater reach of these programs for adults with long-term physical disability is an ongoing effort and may require

minor adaptations and consideration of ways to remove barriers.

Study Limitations

There were several limitations of this study. The data analyzed were from a self-reported survey. The accuracy of these data and recall of both falls and the amount of physical activity are subject to recall bias. Future studies in this area should include objective measures of falls (eg, chart review, ActiGraphs) whenever possible. In addition, the data are cross-sectional and the time frame for questions or instruments vary (eg, in the last 6 months, 7 days, today). Future work should examine these factors and their reciprocal causal relations over time. In addition, the participants in the survey were not recruited randomly but from a volunteer participant pool, and 56.8% reported being college graduates or higher, so our findings may not be generalizable to other populations of people aging with a long-term physical disability. Finally, the recommendations for physical activity in persons with physical disabilities as outlined by the CDC,⁵⁶ the National Center on Health, Physical Activity and Disability,⁵⁷ and the two evidence-based guidelines for people with MS⁴⁵ and SCI⁴⁴ include muscle strengthening, which was not included in the GLTEQ-based questions. These recommendations also stress the importance of engaging in physical activity within a person's abilities, which may not have been accurately reflected via the two questions (strenuous and moderate activity) that were included in the survey.

Conclusions and Clinical Implications

The findings of this study suggest that people living with a long-term physical disability such as MS, MD, SCI, and PPS who are fearful of falling are less likely to be physically active. This decrease in physical activity may increase the risk for falls. These results suggest that it would be important to ask about fear of falling during health care visits, even if an individual reports no history of falls and especially when working to promote physical activity. Fear of falling can be measured using the FES-I and the Activities-Specific Balance Confidence (or ABC) Scale (both of which have been validated in people with MS^{58,59}) or other fear of falling measures. Fear of falling is also a modifiable risk factor⁵¹ and should be considered when recommending a physical activity program for people living with a long-term physical disability who report fear of falling. The results of this study also suggest that an intervention to reduce fear of falling may be of benefit for all diagnostic groups studied.

Future research should (1) explore the predictive relationships between fear of falling, physical activity, and mobility limitations to determine possible causal influences and directional effects; and (2) evaluate the effectiveness of programs developed to decrease fear of

falling, increase physical activity, and reduce fall risk factors in people with MS, MD, SCI, and PPS who report fear of falling.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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Disclosure

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CME Question

In these groups of people with disabilities, which factor was most associated with decreased physical activity during the survey time period?

- a. Prior falls
- b. Fear of falling
- c. Age
- d. Mobility

Answer online at <http://me.aapmr.org>