Self-efficacy and Physical and Cognitive Function in Older Adults with Multiple Sclerosis

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Background: There is evidence of a demographic shift in the prevalence of multiple sclerosis (MS) such that it is now common in older adults. Older adults with MS undergo declines in function, and aging with MS may compromise one's perception of confidence for managing this disease and its manifestations. This cross-sectional study examined the associations between self-efficacy and physical and cognitive function in older (≥60 years) adults with MS.

Methods: The sample included 40 older adults with MS who completed the Multiple Sclerosis Self-efficacy (MSSE) Scale, undertook measures of physical and cognitive function, and wore an accelerometer for 7 days. The data were analyzed using partial Spearman correlations and linear regression.

Results: Correlation analyses indicated that function, but not control, subscale scores on the MSSE Scale correlated with all measures of physical, but not cognitive, function. Linear regression analyses indicated that the function subscale of the MSSE Scale was the only variable that consistently explained variance in physical function outcomes.

Conclusions: The findings are novel evidence of the association between self-efficacy for function and physical function outcomes in older adults with MS. Future research on self-efficacy is warranted with the goal of improving physical function in older adults with MS. *Int J MS Care.* 2019;21:63-69.

Multiple sclerosis (MS) is a chronic, often progressive, neurologic disease of the central nervous system[1] with an estimated prevalence of 1 per 1000 people in the United States.[2] This disease has typically been described as occurring most often in young and middle-aged adults, but there is increasing evidence of a demographic shift in the prevalence such that MS is now common in older adults. The average age of persons with MS is rising, and nearly 14% of persons with MS were 65 years or older in 2010[3]; this is a trend that will likely continue for the next few decades. People with MS are also living longer, such that 90% of adults with MS may live to be 70 years or older.[4]

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Aging with MS will likely compromise one's physical and cognitive functioning as well as one's perception of confidence for managing and controlling this disease and its manifestations.[5,6] There is evidence of a faster rate of disability progression in older adults with MS,[7] and reductions of motor function, in particular, are increased by aging with MS.[8] Previous research has demonstrated that older adults with MS experience large declines in physical function[9,10] and small declines in cognitive function[11] compared with controls.

There is an emerging body of evidence that physical activity (PA) is one factor that might be associated with declines in function among older adults with MS.[12] One previous study of older adults with MS demonstrated that objectively measured light PA (LPA) was associated with physical function in older adults with MS.[13] Another study demonstrated PA and sedentary behavior to be associated with physical function outcomes in older adults with MS.[9] This is buttressed by the results of a randomized controlled trial indicating that an exercise program that promotes LPA yielded improvements in physical functioning among older adults with MS.[14] We are aware of only one previous study that examined the associations between PA and cognitive function in older adults with MS[9]; although that study demonstrated very few associations, previous research in young and middle-aged adults with MS[15] and older adults with and without mild cognitive impairment[16] demonstrated associations between PA and cognitive function.

We are unaware of research examining psychological constructs derived from a theory, such as self-efficacy, as potential correlates of function in older adults with MS. Self-efficacy is a major component of social cognitive theory and is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives."[17] For example, individuals who believe in their capabilities in undertaking and completing everyday function tasks might perform better on balance or walking outcomes. A previous study in middle-aged adults with MS demonstrated self-efficacy to be an important predictor of self-reported physical, cognitive, and social functioning.[18] Another recent study of young and middle-aged adults with MS demonstrated significant and strong associations between self-efficacy, specifically for functioning with MS, and objective measures of walking performance.[19] There also has been much research on the associations of self-efficacy expectations and physical function in older adults in the general population.[20] To date, there has been no research examining the associations between self-efficacy and cognitive function in older adults with MS and very limited research in young adults with MS[21] and in healthy older adults.[22] Importantly, self-efficacy is a modifiable construct and can be manipulated by targeting sources identified in social cognitive theory.[17]

The present cross-sectional study examined the associations between self-efficacy and physical and cognitive function in older adults with MS. We expected that higher levels of self-efficacy for functioning with MS and managing MS would be associated with better physical, but not cognitive, function based on previous research.[19] We also expected that self-efficacy for function would be a stronger correlate of physical function than self-efficacy for managing MS. This pattern of results would support self-efficacy for functioning with MS as a specific substrate that is targeted in clinical rehabilitation practice or behavioral interventions for improving physical function in older adults with MS.

Methods

Participants

The sample included 40 community-dwelling adults with MS aged 60 years and older.[9] The participants were recruited from a mailing list of persons with MS in Illinois, a database of previous research volunteers, and a research advertisement posted on the website of the Greater Illinois Chapter of the National Multiple Sclerosis Society. Participants were screened via telephone using the inclusion criteria for older adults with MS: 1) 60 years of age or older, 2) diagnosis of MS, 3) relapse free in the past 30 days, 4) ambulatory with or without assistance (ie, walk independently or walk with a cane/walker), and 5) willing and able to visit the laboratory for one testing session.

Measures

Self-efficacy

Self-efficacy was assessed using the Multiple Sclerosis Self-efficacy (MSSE) Scale.[23] The MSSE Scale has 18 items and measures two subscales: function and control. The function subscale contains nine items and measures confidence with performing behaviors associated with engaging in daily living activities (eg, walking 100 ft on flat ground or walking 10 steps down stairs). The control subscale contains nine items and measures confidence with managing disease symptoms, reactions, and effect on daily life activities (eg, controlling fatigue or dealing with the uncertainty of MS). The items were rated on a scale ranging from 0 to 100 with anchors of "very uncertain" and "very certain" and then averaged into total scores that range from 0 to 100 for both subscales of the MSSE Scale. Previous research has demonstrated the reliability and validity of scores from the MSSE Scale in persons with MS.[24]

Physical Function

Physical function was measured using a comprehensive battery of assessments for confirmation of possible robust associations between self-efficacy and physical function in older adults with MS. The Timed 25-Foot Walk (T25FW) test was administrated as a measure of walking speed,[25] with the outcome of mean walking speed based on two trials. The 6-Minute Walk Test (6MWT) was administered as a measure of walking endurance,[26] with the outcome of total distance traveled in feet. The Timed Up and Go (TUG) test was administered as a measure of functional mobility,[27] and the mean time across two trials was computed as the final score. The Six Spot Step Test (SSST) was administered as a measure of ambulatory function,[28] with the outcome as the mean of four trials. The Short Physical Performance Battery (SPPB) was administered as a measure of lower extremity function based on a three-part assessment including standing balance, gait speed, and chair rises.[29] We followed standard instructions for all physical function tests, and participants were asked to complete the test as quickly and safely as possible.

Cognitive Function

We also included multiple domains of cognitive function (ie, information processing speed and memory) for examining the robustness of association, if any, with self-efficacy. The Symbol Digit Modalities Test[30] and the Paced Auditory Serial Addition Test[31] were included as measures of information processing speed; the California Verbal Learning Test, Second Edition[32] was included as a measure of verbal learning and memory; and the Brief Visuospatial Memory Test–Revised[33] was included as a measure of visual learning and memory. The primary outcomes from each of those tests are expressed as raw scores.

Physical Activity

Physical activity was objectively measured using waist-worn ActiGraph GT3X+ accelerometers (Health One Technology, Fort Walton Beach, FL). To increase sensitivity for capturing low-frequency accelerations (ie, slow walking), the accelerometers were initialized using the low-frequency extension feature. The raw activity data were downloaded using software (ActiLife 8; ActiGraph, Pensacola, FL), and the data were processed into two separate Microsoft Excel files (Microsoft Corp, Redmond, WA). One file represented daily accelerometer wear time and the other file represented time spent in LPA (100-1722 counts/min).[34] Examination of LPA was based on previous research that showed associations between LPA and physical function in older adults with MS.[13] Participants were given written and graphic instructions to wear the accelerometer on a provided belt around the waist over the nondominant hip for all waking hours in a 7-day period (but not when swimming, bathing, or showering). Participants with at least 2 valid days (≥10 hours of wear time without periods of continuous zeros exceeding 60 minutes, indicative of noncompliance) were included in the analysis, based on accelerometer wear-time data checked against participant-recorded wear times from a log sheet.[35]

Procedures

This study was approved by the University of Illinois at Urbana-Champaign institutional review board, and all the participants provided written informed consent. Participants underwent a neurologic examination by a Neurostatus-certified examiner (R.E.B.) to generate Expanded Disability Status Scale (EDSS) scores[36] for describing the disability status of the sample. Participants underwent measurements of height and weight using a calibrated scale stadiometer and then provided sociodemographic and clinical characteristics for characterizing the sample. Participants also completed the measures of cognitive function and self-efficacy, followed by measures of physical function. Participants were then instructed to wear the accelerometer during waking hours and to document wear time in a log book for 7 days after the testing session.

Data Analyses

All the data analyses were performed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp, Armonk, NY). We provided descriptive statistics as means (SDs), unless otherwise noted (eg, percentages). We examined the associations among MSSE subscale scores and physical and cognitive function using partial Spearman correlations (pr_s), controlling for age, sex, MS type and disease duration, and PA (ie, minutes of LPA daily). We interpreted the magnitude of the correlations using guidelines of 0.1, 0.3, and 0.5 as small, moderate, and large, respectively.[37] We then examined the independent associations between self-efficacy, demographic and clinical characteristics, PA, and function outcomes using multiple, hierarchical linear regression analyses. These analyses involved regressing physical function outcomes (SPPB, 6MWT, T25FW test, TUG test, and SSST) on demographic (age and sex) and clinical (MS type and disease duration) characteristics and PA (minutes of LPA daily) variables in model 1, and MSSE subscale scores in model 2 using direct entry of variables per step. We did not include EDSS score as a covariate because it strongly correlates with physical function outcomes and its inclusion would, therefore, leave limited variance in physical function outcomes for explanation by self-efficacy, demographic and clinical characteristics, and/or PA. We examined the standardized B coefficients for identifying the independent contributions of the variables in the model for explaining variance in physical function.

Results

Sample Characteristics

Sociodemographic and clinical characteristics are presented in Table 1. The mean (SD) age of participants was 65.3 (4.3) years, and the mean (SD) body mass index (calculated as weight in kilograms divided by height in meters squared) was 28.5 (6.9). Participants primarily had relapsing-remitting MS (67.5%), with a mean (SD) disease duration of 21.5 (8.6) years. The median (IQR) EDSS score was 4.0 (2.0), indicating mild-to-moderate disability.

Table 1. Sociodemographic, clinical, and physical activity characteristics for 40 older adults with MS

Variable	Value
Age, y	65.3 ± 4.3
Sex, female	62.5
Race, white	95.0
BMI	28.5 ± 6.9
Marital status, married	67.5
Employment status, employed	12.5
Education, some college	27.5
Annual household income, >$40,000	75.0
EDSS score	4.0 [2.0]
Disease course, RRMS	67.5
Disease duration, y	21.5 ± 8.6
LPA, min/d	245.5 ± 76.5

Note: Values are given as mean ± SD, percentage, or median [interquartile range].
Abbreviations: BMI, body mass index; EDSS, Expanded Disability Status Scale; LPA, light physical activity; MS, multiple sclerosis; RRMS, relapsing-remitting MS.

Descriptive Statistics

Table 2 provides the mean (SD) and range of scores for the MSSE Scale, physical function (ie, SPPB, 6MWT, T25FW test, TUG test, and SSST), and cognitive function (ie, Symbol Digit Modalities Test; California Verbal Learning Test, Second Edition; Brief Visuospatial Memory Test–Revised; and Paced Auditory Serial Addition Test) outcomes.

Partial Correlations

The pr_s and 95% CIs, controlling for age, sex, MS type and disease duration, and LPA, between scores from the MSSE Scale and the physical and cognitive function outcome measures are presented in Table 3. The function subscale of the MSSE Scale was significantly ($P < .05$) correlated with all measures of physical function, and these associations were moderate-to-large in magnitude ($|pr_s| = 0.53\text{-}0.63$). The control subscale of the MSSE Scale was not statistically significantly correlated with any of the physical function outcome measures. There were no statistically significant correlations between MSSE subscales and cognitive function outcome measures.

Table 2. Descriptive statistics for measure of self-efficacy and physical and cognitive functions

Variable	Value
MSSE Scale, function	91.3 ± 10.1 (57.8-100.0)
MSSE Scale, control	77.9 ± 17.1 (23.3-100.0)
Physical function	
SPPB score	9.0 ± 2.5 (2.0-12.0)
6MWT, ft	1318.8 ± 447.0 (326.0-2261.0)
T25FW test, ft/s	3.9 ± 1.4 (0.78-7.02)
TUG test, s	12.5 ± 10.0 (5.3-54.7)
SSST, s	14.5 ± 11.1 (6.0-52.4)
Cognitive function	
SDMT score	48.3 ± 11.2 (23.0-69.0)
CVLT-II score	49.9 ± 11.5 (22.0-72.0)
BVMT-R score	18.5 ± 7.0 (6.0-34.0)
PASAT score	41.2 ± 12.4 (9.0-59.0)

Note: Values are given as mean ± SD (range).
Abbreviations: 6MWT, 6-Minute Walk Test; BVMT-R, Brief Visuospatial Memory Test–Revised; CVLT-II, California Verbal Learning Test, Second Edition; MSSE, Multiple Sclerosis Self-efficacy; PASAT, Paced Auditory Serial Addition Test; SDMT, Symbol Digit Modalities Test; SPPB, Short Physical Performance Battery; SSST, Six Spot Step Test; T25FW, Timed 25-Foot Walk; TUG, Timed Up and Go.

Table 3. Partial Spearman correlations among scores from measure of self-efficacy and physical and cognitive functions

Variable	MSSE Scale, function	95% CI	MSSE Scale, control	95% CI
Physical function				
SPPB	0.53[a]	0.26 to 0.72	0.28	–0.04 to 0.54
6MWT	0.57[a]	0.31 to 0.75	0.33	0.02 to 0.58
T25FW test	0.61[a]	0.37 to 0.77	0.36	0.06 to 0.60
TUG test	–0.63[a]	–0.79 to –0.40	–0.32	–0.57 to –0.01
SSST	–0.60[a]	–0.77 to –0.36	–0.24	–0.51 to 0.08
Cognitive function				
SDMT	0.28	–0.04 to 0.54	0.23	–0.09 to 0.51
CVLT-II	0.03	–0.28 to 0.34	–0.04	–0.35 to 0.28
BVMT-R	0.08	–0.24 to 0.38	0.16	–0.16 to 0.45
PASAT	0.07	–0.25 to 0.37	0.11	–0.30 to 0.49

Note: Partial Spearman correlations control for age, sex, multiple sclerosis type and disease duration, and light physical activity.
Abbreviations: 6MWT, 6-Minute Walk Test; BVMT-R, Brief Visuospatial Memory Test–Revised; CVLT-II, California Verbal Learning Test, Second Edition; MSSE, Multiple Sclerosis Self-efficacy; PASAT, Paced Auditory Serial Addition Test; SDMT, Symbol Digit Modalities Test; SPPB, Short Physical Performance Battery; SSST, Six Spot Step Test; T25FW, Timed 25-Foot Walk; TUG, Timed Up and Go.
[a]Significant at $P < .05$.

Table 4. Summary of hierarchical linear regression analyses for variables predicting physical function outcomes

	SPPB			6MWT			T25FW test			TUG test			SSST		
Variable	B (SE)	95% CI	β	B (SE)	95% CI	β	B (SE)	95% CI	β	B (SE)	95% CI	β	B (SE)	95% CI	β
Model 1															
Age	0.04 (0.10)	−0.17 to 0.25	0.07	−17.9 (18.5)	−55.8 to 19.9	−0.17	−0.03 (0.06)	−0.15 to 0.09	−0.09	−0.14 (0.38)	−0.92 to 0.64	−0.06	−0.05 (0.45)	−0.96 to 0.86	−0.02
Sex	0.97 (0.79)	−0.65 to 2.6	0.20	210.8 (141.9)	−79.4 to 501.0	0.24	0.57 (0.46)	−0.37 to 1.5	0.20	−1.2 (3.0)	−7.3 to 4.8	−0.06	−1.6 (3.4)	−8.6 to 5.4	−0.07
MS type	−0.12 (0.53)	−1.2 to 0.96	0.83	7.1 (94.4)	−186.0 to 200.2	0.01	0.04 (0.31)	−0.58 to 0.67	0.03	1.3 (2.0)	−2.8 to 5.3	0.11	1.5 (2.3)	−3.2 to 6.2	0.12
Disease duration	−0.002 (0.05)	−0.10 to 0.09	−0.01	0.40 (8.4)	−16.8 to 17.6	0.01	0.001 (0.03)	−0.06 to 0.06	0.01	0.05 (0.18)	−0.31 to 0.41	0.05	0.15 (0.20)	−0.27 to 0.57	0.12
LPA	0.01 (0.01)	0.001 to 0.02	0.38[a]	2.4 (0.97)	0.46 to 4.4	0.43[a]	0.01 (0.003)	0.001 to 0.01	0.43[a]	−0.06 (0.02)	−0.10 to −0.02	−0.50[a]	−0.07 (0.02)	−0.12 to −0.03	−0.51[a]
R^2, P value	0.21, P = .18			0.26, P = .11			0.22, P = .16			0.32,[a] P = .03			0.33,[a] P = .03		
Model 2															
Age	0.02 (0.09)	−0.16 to 0.20	0.04	−15.5 (15.9)	−48.1 to 17.1	−0.14	−0.04 (0.05)	−0.14 to 0.05	−0.13	−0.05 (0.23)	−0.53 to 0.42	−0.02	0.04 (0.32)	−0.61 to 0.70	0.02
Sex	1.3 (0.69)	−0.14 to 2.7	0.26	309.9 (124.9)	53.7 to 566.1	0.35[a]	0.77 (0.36)	0.02 to 1.5	0.28[a]	−2.7 (1.8)	−6.4 to 1.0	−0.14	−3.1 (2.5)	−8.2 to 2.0	−0.14
MS type	−0.22 (0.46)	−1.2 to 0.73	−0.08	−5.4 (82.4)	−174.5 to 163.6	−0.01	−0.03 (0.24)	−0.54 to 0.47	−0.02	1.2 (1.2)	−1.3 to 3.7	0.11	1.6 (1.7)	−1.8 to 5.0	0.12
Disease duration	−0.05 (0.04)	−0.14 to 0.04	−0.20	−10.5 (7.9)	−26.7 to 5.7	−0.22	−0.04 (0.02)	−0.08 to 0.01	−0.23	0.24 (0.12)	0.001 to 0.48	0.23	0.36 (0.16)	0.03 to 0.69	0.29[a]
LPA	0.01 (0.01)	−0.01 to 0.02	0.17	1.9 (0.89)	0.06 to 3.7	0.33[a]	0.003 (0.003)	−0.002 to 0.01	0.18	−0.03 (0.01)	−0.06 to −0.01	−0.27[a]	−0.04 (0.02)	−0.08 to −0.01	−0.29[a]
MSSE Scale, function	0.13 (0.04)	0.05 to 0.21	0.52[a]	30.5 (10.3)	9.3 to 51.7	0.52[a]	0.09 (0.02)	0.04 to 0.13	0.59[a]	−0.77 (0.11)	−0.98 to −0.55	−0.76[a]	−0.79 (0.15)	−1.1 to -0.49	−0.67[a]
MSSE Scale, control	0.02 (0.03)	−0.04 to 0.07	0.11	1.8 (5.5)	−9.5 to 13.1	0.06	0.01 (0.01)	−0.02 to 0.04	0.14	0.09 (0.07)	−0.06 to 0.24	0.13	0.05 (1.0)	−0.15 to 0.25	0.06
R^2, P value	0.24,[a] P = .006			0.24,[a] P = .005			0.33,[a] P = .0001			0.45,[a] P = .0001			0.35,[a] P = .0001		

Abbreviations: 6MWT, 6-Minute Walk Test; LPA, light physical activity; MS, multiple sclerosis; MSSE, Multiple Sclerosis Self-efficacy; SPPB, Short Physical Performance Battery; SSST, Six Spot Step Test; T25FW, Timed 25-Foot Walk; TUG, Timed Up and Go.
[a]Significant at $P < .05$.

Hierarchical Linear Regression Analyses

The results of the regression analyses are provided in Table 4. The regression analyses all yielded comparable results. A significant amount of variance in all physical function outcomes in model 1 was explained by LPA; the function subscale of the MSSE Scale explained significant variance in all physical function outcomes, even with the inclusion of covariates, in model 2. Of note, LPA was associated with physical function outcomes in model 1, but the association became weaker when controlling for the MSSE subscales in model 2.

Discussion

The present study examined the associations among self-efficacy and physical and cognitive function in a sample of older adults with MS. The results indicated that self-efficacy for function, but not for control, was correlated with all the physical function outcome measures (ie, SPPB, 6MWT, T25FW test, TUG test, and SSST), even when controlling for other demographic, clinical, and behavioral factors, including LPA. This complements a previous study in young and middle-aged adults with MS that demonstrated that self-efficacy for function was the primary correlate of walking speed and endurance compared with self-efficacy for control.[19] This result suggests that confidence with performing daily behaviors (ie, walking 100 ft on flat ground or getting dressed or undressed without assistance) is a stronger predictor of actual physical function performance compared with self-efficacy for control (ie, managing disease symptoms, reactions, and effect on daily life activities) in older adults with MS. The present results demonstrate that the self-efficacy for function consistently was the only variable that explained variance in all physical function outcomes, even with the inclusion of other covariates, such as demographic (ie, age and sex) and clinical (ie, MS type and disease duration) characteristics and PA (ie, minutes of LPA daily). We also demonstrate that LPA was associated with physical function outcomes, but these associations became weaker when controlling for the subscales of the MSSE Scale. Therefore, the present results are in agreement with previous research that suggests LPA as a target of future behavioral interventions[13] and further suggest that targeting self-efficacy for function may be as, if not more, important for improving physical function in older adults with MS.

One novel aspect of this study is that we included cognitive function outcome measures in addition to physical function outcome measures. Importantly, self-efficacy for neither function nor control was associated with any of the cognitive function outcome measures. This suggests that self-efficacy for functioning with MS and managing its consequences is specific for physical function. However, note that the items included in the MSSE Scale are focused more on an individual's physical function compared with cognitive function, and future research might consider focusing on specific types of self-efficacy for understanding cognitive functions in older adults with MS.

The present results build on previous research that suggests that self-efficacy for functioning with MS may be an important aspect of focal research for improving physical function. Social cognitive theory has recognized four categories of sources for improving self-efficacy expectations: mastery performance, vicarious experiences, verbal persuasion, and physiologic or affective experiences.[17] Researchers and clinicians might consider using these sources in theory-based behavioral interventions or rehabilitation practice for manipulating self-efficacy for functioning with MS. Importantly, there is a wide range of approaches for manipulating self-efficacy expectations for older adults with MS that could inform interventions for improving physical function.

There are several limitations of the present study. This study used a cross-sectional design and, thus, the results only suggest correlations between self-efficacy and physical function. The results cannot determine whether self-efficacy influences physical and cognitive function or vice versa. The present sample of older adults with MS was relatively young, and perhaps the results may not be fully generalized to adults older than 65 to 70 years. Most of the sample of older adults with MS were women who had mild-to-moderate disability (ie, median EDSS score, 4.0), and, therefore, the present results may not be generalized to older men with MS with higher levels of disability. The present study did not include other measures that may inform self-efficacy or physical function, such as fall history, fear of falling, and physical deconditioning, which are highly prevalent

PRACTICE POINTS

- Self-efficacy for performing daily function behaviors was correlated with physical function outcome measures in older adults with MS.
- Light physical activity was associated with physical function outcome measures, which suggests that it might be a target of future behavioral interventions in older adults with MS.
- Clinicians might consider using sources of self-efficacy in rehabilitation practice for manipulating self-efficacy for improved functioning with MS.

in MS and have been previously associated with walking impairment.[38,39]

In conclusion, we provide novel evidence of the association between self-efficacy for function and physical function outcomes in older adults with MS. These results support continued research on self-efficacy and its sources of influence for informing behavioral interventions or rehabilitation practice with the goal of improving physical function in older adults with MS. □

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