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Self-efficacy and environmental correlates of physical activity among older women and women with multiple sclerosis

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Abstract

Physical inactivity is a major health problem in the United States, particularly in elderly and disabled populations. Little research exists examining the relationships between aspects of the built environment and physical activity in older adults and individuals with multiple sclerosis (MS). We adopted a social cognitive perspective to examine the independent roles of perceptions of the environmental, self-efficacy and functional limitations in understanding physical activity levels among elderly women and women with MS. Older women ($n = 136$) and women diagnosed with MS ($n = 173$) were recruited to participate in separate cross-sectional studies. Individuals completed a battery of questionnaires and wore an activity monitor for 7 days. All measures were issued and collected through the mail with the use of self-addressed, pre-paid envelopes. Initial correlational analyses indicated that self-efficacy, functional limitations and environmental perceptions were significantly related to physical activity. Among older women, self-efficacy, functional limitations and street connectivity demonstrated independent contributions to physical activity behavior. Only self-efficacy and functional limitations demonstrated significant associations among women with MS. The prospective contributions of the environment and individual factors to changes in physical activity need to be determined.

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Introduction

The physical and psychological benefits of physical activity are well established [1]. Nevertheless, the prevalence of inactivity is quite pronounced in older adults and individuals with multiple sclerosis (MS) [2, 3]. We further note that there is an effect for gender on patterns of physical activity such that women report engaging in less physical activity than men independent of age [3], and MS affects nearly three times as many women as men [4]. Consequently, research examining the determinants (i.e. variables that correlate with physical activity) of physical activity behavior in older women and women with MS is of significant importance for encouraging physical activity and thereby capitalizing on the physical and psychological benefits.

There is a substantial literature examining factors associated with physical activity among older adults [5]. Factors such as self-efficacy [6] and physical function limitations [7] have been consistently associated with physical activity levels. The relationship between the built environment and physical activity in older adults, however, is less clear. Previous studies have reported inverse associations between insufficient lighting, lack of walking and bike paths, unsafe neighborhood conditions and other environmental variables with physical activity [8–12]. By comparison, there are far fewer studies examining the correlates of physical activity

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among individuals with MS [13]. The existing research indicates that self-efficacy, enjoyment and functional impairment have been associated with physical activity participation [14, 15]. To our knowledge, no studies have examined the role of the perceived environment in physical activity behavior in this population, but one study has reported that physical activity is lower among women with MS living in rural than with urban environments [16].

When examining correlates of physical activity behavior, it is important to do so within a theoretical framework that takes into account individual variables as well as the role of the built environment. Bandura's [17] social cognitive theory fulfills this role and has been recommended as a guiding framework for understanding physical activity in older adults and individuals with MS [13, 18]. Indeed, one central theme of this social cognitive perspective is that of reciprocal or bidirectional influences among the environment, the individual and behavior. Indeed, characteristics of the individual, behavior and the context (e.g. built environment) act as interdependent determinants whereby the environment may influence physical activity behavior through aspects of the individuals such as self-efficacy and functional limitations. Additionally, social cognitive factors, in particular self-efficacy, are theorized to have their strongest effects on behavior under challenging circumstances. Certainly, participation rates would suggest that physical activity offers a substantial challenge for older women and those with MS.

Another central feature of social cognitive theory is the notion of generality. Indeed, Bandura [19] argues that a notable strength of social cognitive theory is its ability to explain and predict behavior across a variety of conditions (e.g. settings, samples, behaviors). Nevertheless, we are not aware of research that has systematically focused on directly examining overlapping and central components of social cognitive theory between independent samples for understanding physical activity behavior.

Therefore, the objective of this study was to examine the independent contributions of perceived environment, self-efficacy and functional limitations to physical activity levels in two independent samples: older women and women with MS. This objective is in keeping with recent calls in the literature for research examining the influence of the environment on physical activity in a broad range of populations and in combination with psychosocial variables [20].

Methods

Participants

Older women (mean age = 69.6; n = 136) and women diagnosed with MS (mean age = 46.1; n = 173) were recruited to participate in separate cross-sectional studies of the correlates of physical activity. The sample of older women represented a subset recruited from a prospective study of older women's health [21] and were free from neurological disease. Participants were recruited from an ongoing study via an announcement in the project newsletter which described this separate, mail-based study. Although community dwelling, many of these women reported medical diagnoses of hypertension (36.6%), hyperlipidemia (27.6%) and functional impairment of the musculoskeletal system (85.1%).

The sample of individuals with MS was recruited through contact with the Greater Illinois, Indiana and Gateway chapters of the National Multiple Sclerosis Society. The Greater Illinois chapter covers a 73-county territory and has ~18 000 members. The Gateway Area Chapter serves >5000 people living with MS in a 90-county service area covering the eastern half of Missouri and the southern third of Illinois. The Indiana State Chapter serves >6500 registered clients in the state of Indiana. Of the 221 individuals who underwent the screening, there were 48 individuals who did not satisfy our inclusion criteria and were excluded from participation. Of the 173 participants with MS, 151 self-reported being diagnosed with relapsing-remitting MS, 3 self-reported being diagnosed with primary progressive MS, 3 self-reported being diagnosed with secondary progressive MS, 3 self-reported being diagnosed with benign MS and 1 self-reported being diagnosed with probable MS. The mean duration of time since MS diagnosis was 8.9 years (SD = 7.0). Both study samples included individuals recruited from urban and rural areas. Characteristics of both samples are presented in Table I.

Measures

Self-efficacy

Self-efficacy for exercise in both studies was measured by the exercise self-efficacy scale (EXSE) [22]. This measure assessed an individual's belief in their ability to accumulate at least 30 min of physical activity on 5 or more days of the week over the next 2 weeks to 6 months. Both efficacy scales employed a percentage scale ranging from 0% (not at all confident) to 100% (highly confident) in 10-point increments. The scores across all items were summed and divided by the number of items to arrive at a total score. The range of the total score value was 0–100. The EXSE has demonstrated reliability among individuals with MS and older adults [14, 18]. Internal consistency of this measure in the sample of older adults and individuals with MS was excellent ($\alpha = 0.99$).

Perceptions of the physical environment

Characteristics of the physical environment were assessed using the Neighborhood Environment Walkability Scale (NEWS) [23]. This measure assesses perceptions of nine environmental characteristics: residential density, land use diversity (presence and proximity of stores and facilities), access to services, street connectivity, walking/cycling areas, aesthetics, pedestrian safety from traffic, safety from crime and overall neighborhood satisfaction. All subscales, excluding the residential density and land use diversity scales, used a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). The total score for each scale was calculated by summing across all items and dividing by the number of scale items. High scores reflect favorable perceptions, whereas low scores reflect unfavorable perceptions of the environment. The residential density scale measures the prevalence of different residence styles in the neighborhood. The response items range from 1 (none) to 5 (all) and the mean value for all items serves as the total score. The land use diversity scale assesses the proximity of stores and facilities from the place of residence. Proximity was estimated by walking distance measured in minutes, using a scale from 1 (1–5 min) to 5 (31+ min); the total score for walking proximity was calculated as the mean across all items. High scores denote a greater proximity to facilities. Internal consistencies for this measure in both samples were small to moderate, with a range of 0.47–0.93 across all of the subscales. The street connectivity scale was the only NEWS subscale that demonstrated poor internal consistency ($\alpha = 0.47$ in both samples). Preliminary analyses suggested that this estimate could be improved by removing the first item. Removal of this item in the sample of older women resulted in a level of internal consistency that approximates acceptability ($\alpha = 0.62$), and the revised scale was used in subsequent analyses. Unfortunately, there were no indications that the internal consistency of this subscale could be improved in the sample of women with MS. Therefore, this subscale was not included in analyses of this sample.

Table I. *Percentages for demographic variables in older women*

Variable	Older women (%)	Women with MS (%)
Caucasian	84	94
Married	55	62
Education		
University degree	46	35
Annual income		
>$40 000	46	64
Age	69.7 (5.9)[a]	46.1 (9.5)[a]

[a]Values represent Mean (SD).

Functional limitation

Functional limitations were measured using the 'function' component of the abbreviated Late Life Function and Disability Instrument (LL-FDI) [21]. This measure is comprised of 15 items that examine upper extremity function, basic lower extremity function and advanced lower extremity function in older adults. The abbreviated version of the function component correlated very highly with the original LL-FDI relative to advanced lower body extremity function ($r = 0.97$), basic lower body extremity function ($r = 0.92$) and upper extremity function ($r = 0.95$) [21]. Participants indicated the level of difficulty experienced while performing an activity (e.g. walking a mile without stopping for rest), on a Likert scale ranging from 1 (none) to 5 (cannot do). Items are summed to arrive at a total score for function, resulting in a scale score ranging from 15 to 75. Higher scores indicate more functional limitations. Internal consistencies for the overall scale were strong ($\alpha > 0.90$).

Physical activity

Physical activity in both groups was measured using an Actigraph accelerometer (Health One Technology, Fort Walton Beach, FL, USA). Participants were instructed to wear the monitor for 7 days to collect objective physical activity data. The activity counts for each day were summed and divided by the total number of days worn to arrive at a daily average of activity. In comparisons with other activity monitors and self-report questionnaires, the Actigraph has demonstrated acceptable reliability and validity among young and middle-age adults [24–26]. Two studies reported adequate validity of the Actigraph monitor for use with older adults [27] and individuals with MS [28].

Procedures

All procedures were approved by the appropriate Institutional Review Board and informed consent was obtained from each participant prior to enrollment in the study.

All measures were distributed and collected through the mail with the use of self-addressed, pre-paid envelopes. Data collection and analysis for both samples were completed from 2004 to 2005.

Data analysis

We computed Pearson product-moment correlations to initially examine the bivariate associations among all variables with physical activity. The variables that demonstrated significant bivariate associations were entered into hierarchical multiple regression analyses to determine the unique contribution of the environment, social cognitive and functional limitations variables to physical activity. All data were analyzed using SPSS Version 12.0.

Results

Descriptive statistics

Mean scores and standard deviations for the measures are presented in Table II.

Correlational analyses

Table III provides the bivariate correlations among the variables for the sample of older women. Among the older women, physical activity was significantly associated with self-efficacy ($r = 0.42$) and functional limitations ($r = -0.41$). There were statistically significant associations for some environmental characteristics with physical activity, including street connectivity ($r = 0.25$), access to walking/cycling facilities ($r = 0.21$) and satisfaction with neighborhood aesthetics ($r = 0.21$).

Table IV provides the bivariate correlations among the variables for the sample of women with MS. Again, physical activity was significantly correlated with self-efficacy ($r = 0.34$) and functional limitations ($r = -0.46$). Additionally, only proximity to services (land use mix/diversity; $r = 0.20$) and access to services ($r = 0.18$) of the environmental variables were significantly associated with physical activity. Only those variables with significant bivariate associations with physical activity were retained in the regression analyses.

Multiple regression analyses: older women

In the sample of older women, the regression model examining the independent contribution of self-efficacy, functional limitations, aesthetics, street connectivity and walking/cycling facilities to physical activity was significant, $F(5130) = 11.89$, $P < 0.01$, $R^2 = 0.31$. Only self-efficacy ($\beta = 0.29$, $P < 0.01$), functional limitations ($\beta = -0.29$,

Table II. *Descriptive statistics for all measures*

Variable	Older women, mean (SD)	Women with MS, mean (SD)	Range of values
Actigraph accelerometer[a]	200 940 (85 476)	219 656 (111 720)	39 285–818 216
Exercise self-efficacy	76.9 (29.5)	63.2 (35.9)	0–100
LL-FDI[b]	24.9 (8.1)	35.3 (11.2)	15–57 (older women) 15–60 (MS)
Residential density	189.6 (24.5)	202.7 (53.1)	173–577
Land use mix/diversity	3.2 (0.9)	1.9 (0.8)	1.0–5.5
Access to services	2.6 (0.6)	2.5 (0.6)	1.1–4.0
Street connectivity	2.5 (0.7)	2.6 (0.8)	1.0–4.0
Walking/cycling facilities	2.4 (1.0)	2.6 (0.9)	1.0–4.0
Aesthetics	3.2 (0.6)	3.2 (0.6)	1.5–4.0
Safety from traffic	2.8 (0.6)	2.8 (0.5)	1.0–4.0
Safety from crime	3.3 (0.5)	3.3 (0.5)	1.7–4.0
Neighborhood satisfaction	3.8 (0.6)	3.8 (0.5)	1.9–4.9

[a]Reported unit of measurement is activity counts.
[b]Smaller values denote fewer functional limitations.

Table III. *Correlation coefficients among physical activity, self-efficacy, functional limitations and the environment for the sample of older women*

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Actigraph	—											
EXSE	0.42**	—										
LL-FDI	−0.41**	−0.36**	—									
Density	0.05	0.03	−0.10	—								
Land use	0.04	0.10	−0.02	−0.26**	—							
Access	0.08	−0.01	−0.13	0.30**	−0.53**	—						
Connectivity	0.25**	0.12	−0.13	0.27**	−0.33**	0.41**	—					
Walking/cycling	0.21*	0.14	−0.29***	0.40**	−0.37**	0.52**	0.63**	—				
Aesthetics	0.21*	0.07	−0.19*	0.23**	−0.20*	0.30**	0.58**	0.48**	—			
Traffic safety	0.11	0.14	−0.19*	0.05	−0.31**	0.28**	0.44**	0.54**	0.55**	—		
Crime safety	0.00	0.07	−0.10	−0.10	−0.29**	0.16	0.30**	0.35**	0.35**	0.68**	—	
Satisfaction	0.13	0.10	−0.30**	−0.02	−0.14	0.32**	0.22**	0.24**	0.41**	0.58**	0.50**	—

SSES-Friends = Friends Subscale, Social Support for Exercise Survey; SSES-Family = Family Subscale, Social Support for Exercise Survey; Density = Neighborhood Environment Walkability Survey-Residential Density Subscale; Land use = Neighborhood Environment Walkability Survey-Land Use Mix-Diversity Subscale; Access = Neighborhood Environment Walkability Survey-Access to Services Subscale; Connectivity = Neighborhood Environment Walkability Survey-Street Connectivity Subscale; Walking/cycling = Neighborhood Environment Walkability Survey-Walking/Cycling Facilities Subscale; Aesthetics = Neighborhood Environment Walkability Survey-Aesthetics Subscale; Traffic safety = Neighborhood Environment Walkability Survey-Safety from Traffic Subscale; Crime safety = Neighborhood Environment Walkability Survey-Safety from Crime Subscale; Satisfaction = Neighborhood Environment Walkability Survey-Neighborhood Satisfaction Subscale. *$P < 0.05$, **$P < 0.01$.

$P < 0.01$) and street connectivity ($\beta = 0.30$, $P < 0.01$) accounted for unique variance in physical activity. Thus, bivariate associations of aesthetics and access to walking/cycling facilities with physical activity were no longer significant when controlling for self-efficacy and functional limitations.

Multiple regression analyses: women with MS

In the sample of women with MS, the regression model examining the independent contribution of self-efficacy, functional limitations, land use diversity and access to services to physical activity was

Table IV. *Correlation coefficients among physical activity, self-efficacy, functional limitations and the environment for the sample of women with MS*

Variable	1	2	3	4	5	6	7	8	9	10	11
Actigraph	—										
EXSE	0.34**	—									
LL-FDI	−0.46**	−0.29**	—								
Density	−0.10	0.09	0.18*	—							
Land use	0.20**	0.04	−0.09	0.27**	—						
Access	0.18*	0.09	−0.12	0.39**	0.59**	—					
Walking/cycling	0.08	0.05	−0.09	0.26**	0.24**	0.37**	—				
Aesthetics	0.06	0.04	−0.01	0.01	0.03	0.13	0.24**	—			
Traffic safety	−0.10	−0.02	0.00	−0.09	0.09	0.18*	0.27**	0.23**	—		
Crime safety	−0.11	−0.01	−0.05	−0.08	−0.02	0.04	0.17*	0.42**	0.49**	—	
Satisfaction	0.06	0.07	−0.13	0.08	0.05	0.19*	0.11	0.42**	0.41**	0.48**	—

SPS = Social Provisions Scale; Density = Neighborhood Environment Walkability Survey-Residential Density Subscale; Land use = Neighborhood Environment Walkability Survey-Land Use Mix-Diversity Subscale; Access = Neighborhood Environment Walkability Survey-Access to Services Subscale; Walking/cycling = Neighborhood Environment Walkability Survey-Walking/Cycling Facilities Subscale; Aesthetics = Neighborhood Environment Walkability Survey-Aesthetics Subscale; Traffic safety = Neighborhood Environment Walkability Survey-Safety from Traffic Subscale; Crime safety = Neighborhood Environment Walkability Survey-Safety from Crime Subscale; Satisfaction = Neighborhood Environment Walkability Survey-Neighborhood Satisfaction Subscale. *$P < 0.05$, **$P < 0.01$.

significant, $F(4168) = 16.58$, $P < 0.01$, $R^2 = 0.28$. However, only self-efficacy ($\beta = 0.22$, $P < 0.01$) and functional limitations ($\beta = -0.38$, $P < 0.01$) accounted for unique variance in physical activity with the environmental factors being non-significant.

Discussion

The objective of this study was to examine the unique contributions of perceptions of the environment, self-efficacy and functional limitations to physical activity levels in older women and those with MS. Although there were significant correlations between physical activity and all these factors, our findings suggest that self-efficacy and functional limitations were the strongest correlates of physical activity in both samples.

In the sample of older women, self-efficacy, functional limitations and street connectivity emerged as significant independent factors accounting for unique variance in physical activity. That street connectivity emerged as the sole environment variable is not surprising as this characteristic of the environment is closely linked with walking, the mode of activity most often engaged in by older adults. Interestingly, the strength of the associations with physical activity was comparable for all three of these variables suggesting that efficacy cognitions, functional limitations and street connectivity equally contribute to physical activity levels in older women. However, it is important to note that this sample of older women reported relatively few functional limitations and moderately high beliefs in capabilities to be physically active. Examining these relationships in a more variable sample may demonstrate relationships different in both magnitude and structure from those reported here.

In a similar vein, self-efficacy and functional limitations played equally important roles in the physical activity level of the MS sample but perceptions of the environment were not statistically significant in the regression analysis. Individuals living with MS experience a host of symptoms (e.g. muscle spasms, balance problems, thermoregulatory difficulties and muscle fatigue) and factors which can influence an individual's gait pattern, postural stability, functional ability and quite possibly their ability to engage in physical activity. Social cognitive theory would theorize that functional limitations influence physical activity behavior both directly and indirectly, through their effects on self-efficacy cognitions. Longitudinal studies are needed, however, to determine whether efficacy expectations play a mediating role in the functional limitations and physical activity relationship in those with MS.

We believe the findings of this study to be important from several perspectives. First, it is one of the few studies to examine the relationship of the environment to physical activity in older women using a social cognitive model to determine the unique contributions of the individual and the environment factors to physical activity behavior. Additionally, this is one of the first studies, to our knowledge, to examine these relationships in individuals with MS. With the number of Americans diagnosed with MS estimated at 400 000, and a worldwide prevalence of two million, the prevalence of this autoimmune disease is of concern [29, 30]. Importantly, although there is no known cure for MS, it is still possible for many individuals with MS to sustain a healthy lifestyle. In fact, physical activity may help minimize some of the exacerbations and symptoms associated with the disease, including fatigue and gait problems, and also decrease the risk for developing secondary diseases such as cardiovascular disease [13, 31–33]. Clearly there exists a need to identify those factors associated with physical activity in this understudied population, with the ultimate goal of improving the quality and effectiveness of exercise programs tailored to the needs of these individuals.

Additionally, our results may carry implications for future translational research. Although we acknowledge that these data are preliminary in nature, our results suggest that activity-based interventions designed utilizing a social cognitive framework need not necessarily be population specific, consistent with the generality principle of social cognitive theory [17]. That is, interventions which are tailored to the psychosocial determinants governing behavior, as opposed to a select range of conditions (e.g. sample, context of the behavior), are expected to be most effective in providing mastery experiences, and ultimately, changing behavior. Our results suggest that the integration of efficacy-enhancing techniques and education materials relative to the beneficial effects of physical activity on everyday functioning are worthy of consideration for future exercise interventions.

We do recognize the limitations inherent in our data. First, the cross-sectional nature of our data precludes statements regarding causality. Second, our results are also limited by the characteristics of our samples, i.e. primarily Caucasian, female and well educated. Examination of the proposed relationships in more diverse samples is warranted. The inclusion criteria used to screen for the MS study may have excluded important segments of this population, particularly those with more severe ambulatory problems. Although we would expect results similar to those reported here, the strength of the associations may differ in these groups. Our assessments of environment-level correlates were of a self-report nature. Previous research suggests that perceptions of the environment may be more closely aligned with actual behavior than objectively assessed environmental characteristics [33]; however, assessing both the built and perceived environment provides a more comprehensive assessment of this important factor.

Additionally, our reliance on an accelerometer as a measure of physical activity in persons with MS may appear troublesome in light of potential gait difficulties and tremors in the extremities associated with MS. However, our previous research has demonstrated the validity of self-report and objective measures of physical activity among those with MS [28] and similar arguments for the validity of accelerometers as an ideal measure of physical activity in MS have been forwarded by Ng and Kent-Braun [34]. Although we framed this study within social cognitive theory, it is recognized that there is a need to include other social cognitive factors beside self-efficacy. Indeed, there have been very few applications of a full social cognitive model, as proposed by Bandura [17], which include goals, outcome expectations and facilitators and inhibitors of behavior. Subsequent endeavors are encouraged to include such constructs with a view to determining whether they account for substantially more variance in physical activity than self-efficacy consistently is reported to do so.

Finally, the internal consistency of the street connectivity subscale of the NEWS appears suspect in both samples. Thus, we urge caution in interpreting any role that this variable may or may not play in these samples. Additionally, we are unaware of any other studies that have used this scale in individuals with MS, thus we are not able to comment on the extent to which these results coincide with internal consistency scores reported elsewhere.

Recent proposals by environment behavioral researchers to improve public health have included recommendations to modify those characteristics of the environment which have been identified as barriers to physical activity [10, 35]. Although recent reports suggest a significant association of the environment with physical activity, our results indicate that such findings may be the result of the exclusion of other influential variables in the models tested. Importantly, our results do not state that the environment is an unimportant variable to consider with respect to health behavior. Instead, our results suggest that in these two independent samples, the personal factors are operating as the predominant influence on behavior. These results are consistent with a social cognitive perspective, by which the reciprocality that exists among these determinants is not necessarily symmetrical with regard to strength [19]. Clearly, our findings need to be replicated and, more importantly, prospective studies are needed to determine how environment, individual and functional factors influence physical activity behavior over time. The value of longitudinal research to inform future activity interventions and provide evidence as to the predictive power of SCT cannot be overstated. Social cognitive theory is one theoretical approach that allows one to integrate in a meaningful way the contributions of the environment, individual and social influences on behavior and has demonstrated its effectiveness for understanding physical activity behavior among older women and women with MS [14, 18, 36]. The consideration of other theoretical approaches, however, is also warranted.

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Conflict of interest statement

None declared.

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