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Environmental correlates of health-promoting leisure physical activity in persons with multiple sclerosis using a social cognitive perspective embedded within social ecological model

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ABSTRACT

There is abundant evidence for the benefits of physical activity (PA) among persons with multiple sclerosis, however only 20% of persons with MS engage in sufficient PA. This cross-sectional study examined features of the built environment, social environment, and individual as hierarchical correlates of PA in persons with MS from a social-cognitive theory (SCT) perspective embedded within a social-ecological model (SEM). Five hundred eighty eight persons with MS completed an online survey between September 2018–January 2019 including: demographics, Patient Determined Disease Steps (PDDS), abbreviated Neighborhood Walkability Scale (NEWS-A), Social Provisions Scale (SPS), Exercise Self-Efficacy Scale (EXSE), and Godin Leisure-Time Exercise Questionnaire (GLTEQ). Correlation analyses were used to examine associations among NEWS-A subscales, SPS, EXSE, PDDS, Employment, Education and GLTEQ. We then conducted hierarchical, linear regression analysis whereby we regressed GLTEQ with PDDS, Education, and Employment (Step 1), NEWS-A subscales (Step 2), SPS (Step 3), and EXSE (Step 4) based on a SEM. Land-use mix diversity, land-use mix access, aesthetics, crime, SPS, EXSE, and PDDS correlated with GLTEQ. PDDS was a significant correlate of GLTEQ in Step 1 ($\beta = -0.37$;$R^2 = 0.15$). Aesthetics ($\beta = 0.08$) and PDDS ($\beta = -0.33$) were significant correlates of GLTEQ in Step 2 ($R^2 = 0.18$). SPS ($\beta = 0.23$) and PDDS ($\beta = -0.30$) were significant correlates of GLTEQ in Step 3 ($R^2 = 0.23$). The final model in Step 4 identified PDDS ($\beta = -0.11$), aesthetics ($\beta = 0.07$), SPS ($\beta = 0.09$), and EXSE ($\beta = 0.54$) as correlates of GLTEQ ($R^2 = 0.43$). Such results may inform the design of multi-level interventions that target environmental and individual correlates of PA consistent with the SEM framework and guided by SCT.

1. Background

There is abundant evidence supporting the benefits of health-promoting leisure physical activity among persons with multiple sclerosis (MS). Participation in physical activity, particularly exercise training, may improve cognition, mobility, fatigue, mood, pain, and quality of life (Motl and Pilutti, 2012; McCullagh et al., 2008; Latimer-Cheung et al., 2013; Motl et al., 2009). Alarmingly, in one large study of persons with MS from the Midwestern portion of the United States (US), only 20% of the sample engaged in sufficient amounts of physical activity necessary for the accrual of the health-promoting benefits (Klaren et al., 2013). This underscores the importance of examining multi-level correlates of health-promoting leisure physical activity in persons with MS that can inform the design of behavioral interventions and formation of public policy.

Social cognitive theory (SCT) is an appropriate behavior change theory (Bandura, 2004) for understanding physical activity across populations (McAuley and Blissmer, 2000) including MS (Motl et al., 2018a). One central tenant of SCT is triadic reciprocal determinism involving the dynamic interaction between the person, environment, and behavior (Bandura, 2004). This tenant suggests that components of the person and environment directly and indirectly influence behavior. The primary person-level determinant of behavior is self-efficacy (i.e., situation specific belief in one's ability for executing a course of action), and self-efficacy can be influenced through interactions with both the built and social environment.

Abbreviations: MS, multiple sclerosis; SCT, social cognitive theory; SEM, social ecological model; NEWS-A, abbreviated neighborhood walkability scale; SPS, social provisions scale; EXSE, exercise self-efficacy scale; GLTEQ, Godin leisure-time exercise questionnaire; PDDS, patient determined disease steps; RRMS, relapsing remitting multiple sclerosis

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Social ecological models (SEMs) contextualize multiple, interrelated layers of physical, social, and individual level variables as determinants of health and health behaviors (Dahlgren and Whitehead, 1991). These models provide a framework that is applicable for health promotion initiatives highlighting the impact of macro- through micro-level environmental variables on health and health behaviors (Bronfenbrenner, 1979), and are particularly appropriate for describing physical activity and identifying targets of interventions that consider the environmental context of the desired behavior (Sallis et al., 2015). The consideration of SEMs provides a richer and more complete consideration of the variables that might influence health and health behaviors, and could provide context for the application and understanding of behavior change theory for physical activity in MS.

To date, there is an abundance of research indicating that self-efficacy is an important correlate of physical activity in MS (Motl et al., 2018a), but very little research has examined social and built environmental variables as correlates. We located one study that examined built environmental correlates of physical activity in older women from the general population and women with MS, and reported that street connectivity was a significant correlate of physical activity among older women, but no environmental variables were significant for women with MS (Morris et al., 2008). Another study reported significant correlations between the presence of shops, stores, markets, or other places within walking distance, presence of transit stops within walking distance, and accessibility of free or low-cost recreation facilities as correlates of pedometer measured physical activity in persons with MS (Doerksen et al., 2007). Such research on environmental correlates has not been guided by a defining theory of behavior change and considering a SEM.

The present study examined correlates of health-promoting leisure physical activity from a SCT perspective embedded in a SEM among persons with MS. This study specifically examined features of the built environment (e.g., land-use mix), social environment (i.e., social support), and individual (i.e., self-efficacy) as hierarchical correlates of health-promoting leisure physical activity in a large sample of persons with MS. We hypothesized that perceived built environment, social support, and self-efficacy would be significantly correlated with physical activity. We further hypothesized the magnitude of correlations would become progressively larger when moving from the built environment toward self-efficacy based on SEM (Fig. 1). Such research might inform the designing multi-level interventions that target the exceeding low rate of physical activity participation in persons with MS.

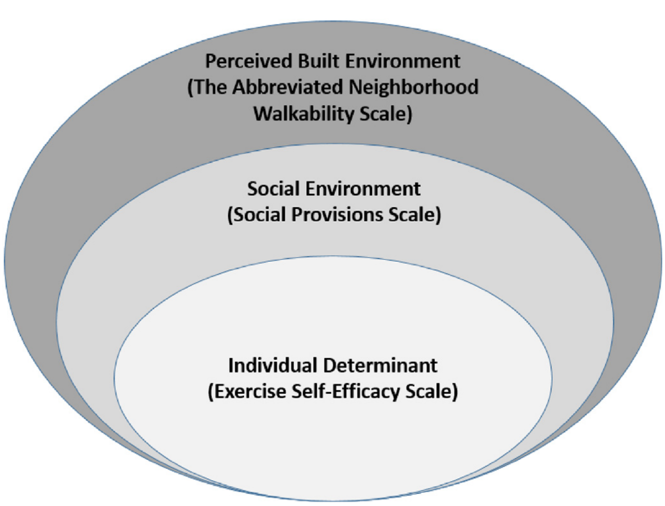

Fig. 1. Hypothesized conceptual model, social cognitive theory embedded in social ecological model.

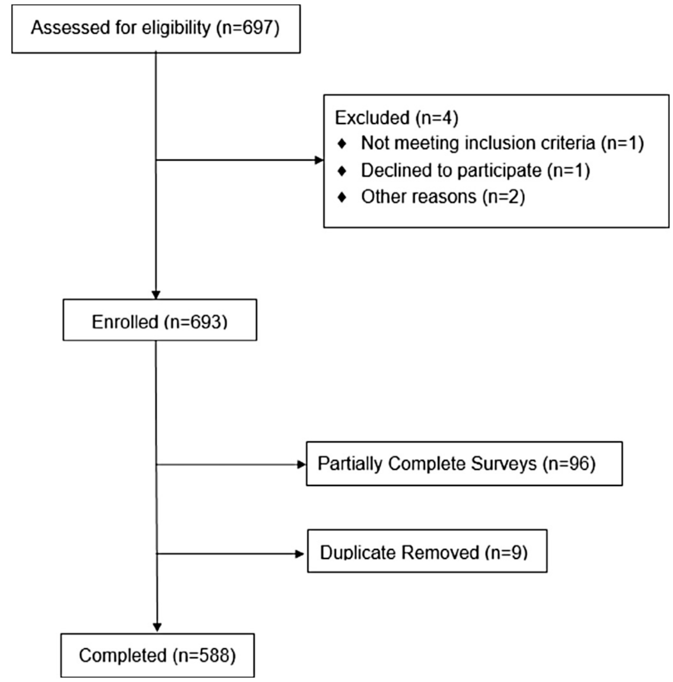

Fig. 2. CONSORT flow diagram.

2. Methods

2.1. Participants

This cross-sectional study recruited persons with MS from across the US. Participants were recruited through an e-mail distribution from the National Multiple Sclerosis Society. The exact number of persons receiving the recruitment e-mail is unknown, as this requires an indication and confirmation of those who actually opened and read the e-mail. The e-mail described the study as a survey focused on physical activity behaviors, neighborhood environment, thoughts, and health behaviors with a link to complete the survey online. The inclusion criteria were self-reported (a) age of 18 years or older and (b) diagnosis of MS. There were 697 people who were assessed for eligibility and 588 completed the full survey, a flow diagram is provided in Fig. 2. Partially complete surveys were not included, and only cases with complete data for all questionnaires were included in this study.

2.2. Measures

2.2.1. Demographics and clinical characteristics

Participants self-reported sex, marital status, date of birth, employment status, race, education, and annual household income using items from previous research in MS (Learmonth et al., 2013). Participants self-reported clinical characteristics of year of MS diagnosis and MS clinical course. Disability status was measured using Patient Determined Disease Steps (PDDS) scale (Learmonth et al., 2013).

2.2.2. Built environment

The Abbreviated Neighborhood Walkability Scale (NEWS-A) measured perceptions of neighborhood environment characteristics including eight multi-item subscales (residential density, land-use mix diversity, land-use mix access, street connectivity, infrastructure and safety for walking, aesthetics, traffic hazards, and crime) (Cerin et al., 2006). All NEWS-A items were rated on a 4-point Likert scale (1 = strongly disagree; 4 = strongly agree), except for the residential density and land use mix diversity subscales. Residential density items were assessed on a 5-point Likert-like scale and weighted relative to the average residential density (i.e., average person-density in the respondent's immediate neighborhood). Land-use mix diversity was assessed by the walking proximity from home to various locations, with responses ranging from 1- to 5-min walking distance to > 30-min walking distance. Higher scores on the land-use mix diversity subscale indicate closer average proximity of various types of stores and facilities. Higher scores for land-use mix access, street connectivity, infrastructure and safety for walking, and aesthetics indicate higher perceived walkability based on the 4-point Likert scale and higher scores for traffic hazards and crime indicate lower perceived walkability based on the 4-point Likert scale. Developmental studies validating the abbreviated NEWS-A demonstrate both factorial and criterion validity and this survey has been used in people with MS (Morris et al., 2008; Cerin et al., 2006).

2.2.3. Social support

An abbreviated Social Provisions Scale (SPS) measured perceptions of social support for physical activity (Konopack and McAuley, 2012). The SPS assesses perceptions of current relationships that support physical activity behaviors based on the original six domains of attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance. The six items were rated on a four-point scale from 1 (strongly disagree) to 4 (strongly agree), and then summed into a total score from 6 to 24; higher scores reflect more perceived support. Previous studies utilizing the abbreviated SPS in persons with MS demonstrate internal consistency $\alpha = 0.90$ (McAuley et al., 2003; Suh et al., 2014).

2.2.4. Self-efficacy

Self-efficacy was measured using the six-item Exercise Self-Efficacy Scale (EXSE). The EXSE assessed beliefs regarding the ability to engage in MVPA for at least 30 min, most days of the week in one month increments across the next six months. Items were rated on a scale from 0 (not confident at all) to 100 (highly confident), averaged into a total score with higher scores indicating more self-efficacy. This scale has been previously used in participants with MS (Motl et al., 2017a) and there is strong evidence for the internal consistency of the self-reported scores from people with MS ($\alpha = 0.99$) (Motl et al., 2006).

2.2.5. Physical activity

Physical activity was measured using the Godin Leisure-Time Exercise Questionnaire (GLTEQ). The GLTEQ contains three items that measure the frequency of engagement in strenuous, moderate, or mild physical activity for 15 or more minutes per day during the previous week (Godin and Shephard, 1985). The focus of this study was health-promoting physical activity, therefore we calculated GLTEQ health contribution score (HCS) by multiplying the frequency of strenuous and moderate physical activity by nine and five metabolic equivalents (METs), respectively, and summed the weighted scores (Motl et al., 2018b). Higher scores reflect great self-reported levels of health-promoting leisure physical activity. Of note, a recent review concluded that GLTEQ scores provide a valid and appropriate measure of physical activity for persons with MS ($\alpha = 0.74$, $r = 0.34$–0.60) (Sikes et al., 2018).

2.3. Procedures

All study procedures were approved by the University of Alabama at Birmingham Institutional Review Board. Interested participants were prompted to access the questionnaire online via Qualtrics. The active link then opened a consent form requiring participants to select an option (‘I consent’ or ‘do not consent’). Participants were then asked to confirm being 18 years of age or older (‘Yes’ or ‘No’) and MS diagnosis (‘Yes’ or ‘No’) to ensure all participants met inclusion criteria before accessing any questionnaires. Participants then completed all questionnaires using Qualtrics survey software and were asked to provide their address at the end of the survey in order to receive remuneration ($10 visa gift card). Participants were provided 1 week upon opening the consent form to complete the survey and average time to complete the survey was 27 min.

2.4. Data analysis

All analyses were performed using SPSS Statistics 24 (IBM, Inc., Armonk, NY). Baseline descriptive characteristics are reported as mean ± standard deviation with the number of cases included per variable. We used Pearson (r) and Spearman's Rank-Order (ρ) Correlations for examining associations among PDDS, Employment, Education, NEWS-A subscales, SPS, EXSE, and GLTEQ HCS. We interpreted the magnitude of correlation coefficients based on Cohen's guidelines for small ≥ 0.10, medium ≥ 0.30, and large ≥ 0.50 effect size (Cohen, 1988). We then conducted hierarchical linear regression analysis, whereby we regressed GLTEQ HCS with PDDS, Employment, and Education in Step 1, NEWS-A subscales (built environment) in Step 2, SPS (social environment) in Step 3, and EXSE (individual determinant) in Step 4; only significant bivariate correlates were entered into the regression analysis. We examined the β-coefficients for each outcome predicting GLTEQ HCS as well as model fit based on R^2 and change in R^2 (ΔR^2) per step of the model.

3. Results

Demographic data for the full sample are included in Table 1. Four participants did not meet screening criteria, ninety six participants were excluded because they did not complete all measures, and nine duplicate cases were identified and excluded (only their first response included in analyses). Participants had a mean age of 52 ± 12 years and had been diagnosed with MS for an average of 14 ± 10 years. The median (IQR Range) PDDS score was 2.0(0–8.0) indicating mild-moderate MS disability and most participants identified as females (84%). Approximately half of the sample was currently employed, 65% of participants were married, and the majority identified as Caucasian (91%). Education and income levels were both high with the majority of participants having at least a college degree (68%) and earning over $50,000 annually (66%). The overall sample included participants from 47 states.

Mean physical activity score (GLTEQ HCS) was 19.1 ± 21.1 arbitrary units of moderate-vigorous physical activity/week. Two-hundred and twenty participants reported zero times per week on the GLTEQ HCS (37.3%). Exercise self-efficacy (EXSE) mean score was 53.1 ± 37.8 and social support (SPS) 17.5 ± 3.5. Mean neighborhood density was 209.0 ± 70.5, land-use mix diversity 2.1 ± 1.0, land-use mix access 2.1 ± 1.0, street connectivity 2.6 ± 0.9, infrastructure and safety for walking 2.5 ± 0.9, aesthetics 3.2 ± 0.7, traffic hazards 2.6 ± 0.5, and crime 1.4 ± 0.5.

Results from Spearman Rank-Order and Pearson correlation analyses are presented in Table 2. PDDS, Education, and Employment were significantly correlated with GLTEQ HCS scores ($\rho = -0.42$, $r = -0.38$; $\rho = 0.11$, $r = 0.11$; $\rho = 0.18$, $r = 0.20$, respectively). Significant correlations were noted between the built environment variables of land-use mix diversity ($\rho = 0.22$, $r = 0.20$), land-use mix access ($\rho = 0.26$, $r = 0.23$), aesthetics ($\rho = 0.18$, $r = 0.16$) and crime ($\rho = -0.09$) and GLTEQ HCS. We further note significant correlations between SPS ($\rho = 0.35$, $r = 0.32$) and EXSE ($\rho = 0.69$, $r = 0.63$) scores and GLTEQ HCS scores. The correlations were small-medium in magnitude for built environment, and medium in magnitude for PDDS, Education, Employment and SPS and large for EXSE; this is expected based on SEM.

The significant correlates in the bivariate analysis were then regressed on GLTEQ HCS in a hierarchical linear regression analysis. Step 1 included PDDS, Education, and Employment as possible confounding variables and only PDDS was significantly correlated with GLTEQ HCS

Table 1
Sample demographics and clinical characteristics.

Variable, *units* (n)	
	Mean ± SD
Age, *years* (588)	51.5 ± 11.8
MS Duration, *years* (586)	14.0 ± 10.0
	Median(IQR Range)
PDDS, (588)	2.0(0–8.0)
	n(%)
MS Clinical Course, (588)	
RRMS	465(78.9)
Primary progressive	41(7.0)
Secondary progressive	82(13.9)
Gender, (588)	
Female	492(83.7)
Male	96(16.3)
Marital status, (588)	
Married	383(65.1)
Single	97(16.5)
Divorced/Separated	89(15.1)
Widow/Widower	19(3.2)
Employed, (588)	
Yes	303(51.5)
No	285(48.5)
Race, (588)	
Caucasian	533(90.6)
African American	22(3.7)
Latino/a	12(2.0)
Other	21(3.6)
Education, (588)	
High School	44(7.5)
1–3 Years College	144(24.5)
College graduate	220(37.4)
Masters degree	138(23.5)
PhD or equivalent	42(7.1)
Annual Household Income, (552)	
Less than $15,000	36(6.5)
$15,000–24,000	46(8.3)
$25,000–49,000	103(18.7)
$50,000–74,000	99(17.9)
$75,000–99,000	95(17.2)
$100,000 or greater	173(31.3)

Note: PDDS = Patient determined disease steps.
RRMS = Relapsing remitting multiple sclerosis.

Table 2
Correlations among patient determined disease steps, perceived built environment, social support, exercise self-efficacy, and physical activity (n = 588).

Variable	GLTEQ HCS	
	ρ	*r*
Control		
Patient determined disease steps	−0.42**	−0.38**
Education	0.11**	0.11*
Employment	0.20**	0.18**
Built environment		
NEWS-A residential density	0.04	0.04
NEWS-A land-use mix diversity	0.22**	0.20**
NEWS-A land-use mix access	0.26**	0.23**
NEWS-A street connectivity	0.04	0.02
NEWS-A infrastructure and safety for walking	0.08	0.07
NEWS-A aesthetics	0.18**	−0.16**
NEWS-A traffic hazards	−0.02	−0.02
NEWS-A crime	−0.09*	−0.05
Social environment		
Social provisions scale (SPS)	0.35**	0.32**
Individual determinant from SCT		
Exercise self-efficacy scale (EXSE)	0.69**	0.63**

Note: NEWS-A = The Abbreviated Neighborhood Walkability Scale.
Godin Leisure-Time Exercise Questionnaire Health Contribution Score (GLTEQ HCS).
*P < .05, **P < .01.

Table 3
Hierarchical linear regression SEM Model predicting physical activity N = 588.

GLTEQ HCS	*B*	*SE B*	β	R^2	ΔR^2
Step 1					
PDDS	−3.63	0.41	−0.37***	0.15	0.15***
Education	3.28	1.73	0.07		
Employment	0.95	1.76	0.02		
Step 2				0.18	0.03***
PDDS	−3.29	0.42	−0.33***		
Education	1.69	1.75	0.04		
Employment	0.49	1.75	0.01		
NEWS-A land-use mix diversity	1.36	1.08	0.06		
NEWS-A land-use mix access	1.98	1.04	1.00		
NEWS-A aesthetics	2.58	1.28	0.08*		
NEWS-A crime	−1.83	1.52	−0.05		
Step 3				0.23	0.05***
PDDS	−3.00	0.41	−0.30***		
Education	1.31	1.70	0.03		
Employment	0.21	1.70	0.01		
NEWS-A Land-use Mix Diversity	1.28	1.05	0.06		
NEWS-A Land-use Mix Access	1.30	1.02	0.06		
NEWS-A Aesthetics	2.00	1.25	0.06		
NEWS-A Crime	−0.53	1.49	−0.01		
SPS	1.37	0.23	0.23***		
Step 4				0.43	0.20***
PDDS	−0.1.10	0.38	−0.11**		
Education	0.19	1.47	0.004		
Employment	−1.48	1.47	−0.04		
NEWS-A land-use mix diversity	1.01	0.91	0.05		
NEWS-A land-use mix access	−0.02	0.89	−0.001		
NEWS-A aesthetics	2.33	1.08	0.07*		
NEWS-A crime	1.49	1.30	0.04		
SPS	0.53	0.21	0.09*		
EXSE	0.30	0.02	0.54***		

Note: GLTEQ HCS = Godin Leisure-Time Exercise Questionnaire Health Contribution Score; PDDS = Patient Determined Disability Steps; NEWS-A = The Abbreviated Neighborhood Walkability Scale; SPS = Social Provisions Scale; EXSE = Exercise Self-Efficacy Scale.
*P < .05, **P < .01, ***P < .001.

(β = −0.37), which explained 15% of the variance (R^2 = 0.15). Step 2 included built environment variables and there was only a significant associations for aesthetics (β = 0.08) and PDDS (β = −0.33) with GLTEQ HCS and those variables explained 18% of the variance in physical activity (R^2 = 0.18). Social environment was included in Step 3 with SPS (β = 0.23) identified as a significant correlate of GLTEQ HCS as well as PDDS (β = −0.30). Those variables explained 23% of variance in physical activity (R^2 = 0.23) and the addition of SPS explained an additional 5% of variance over built environment variables in Step 2 (ΔR^2 = 0.05). The final regression model included self-efficacy in Step 4 as an individual determinant and PDDS (β = −0.11), aesthetics (β = 0.07), SPS (β = 0.09), and EXSE (β = 0.54) were correlates of GLTEQ HCS and those 4 variables explained 43% of variance in physical activity (R^2 = 0.43); the addition of EXSE explained an additional 20% of variance over PDDS, Education, Employment, built and social environment variables in Step 3 (change R^2 = 0.20). The full model results are presented in Table 3. We tested for multicollinearity using VIF in the regression model and reported no evidence of multicollinearity.

4. Discussion

Results from this study indicate that the pattern of bivariate correlations among environmental and individual correlates of health-promoting leisure physical activity differed in magnitude from built environment toward self-efficacy. This finding was expected based on SEM as more significant correlates of physical activity manifest when moving from macro-environmental to micro-environmental and individual level factors. When these variables were further examined using hierarchical regression, the expected pattern based on SEM and

SCT manifested such that exercise self-efficacy accounted for much of the association between built and social environment and physical activity. This has implications for the design of physical activity interventions such that we can target multiple layers of influence based on SEM and guided by principles of SCT.

Previous research examining perceptions of the built environment in persons with MS highlights significant correlations between pedometer steps and the presence of shops, stores, markets, or other places within walking distance, presence of transit stops within walking distance, and accessibility of free or low-cost recreation facilities (Doerksen et al., 2007). Previous studies of general adults with physical disabilities also highlight the built environment (e.g., greater land use mix and more destinations) as a correlate of physical activity (Botticello et al., 2014; Eisenberg et al., 2017). These findings align with the present study demonstrating significant associations among physical activity and crime, land-use mix access and land-use mix diversity. Such environmental factors may be crucial when promoting neighborhood-level health-promoting leisure physical activity in persons with MS, however aesthetics, disability status, social environment and self-efficacy accounted for the majority of variance in this sample.

Aesthetics was identified as a the only significant built environmental correlate of health-promoting leisure physical activity when accounting for multilevel environmental correlates and further research is needed as this perception may be critical to engagement in neighborhood-level physical activity. Based on previous literature in MS it is not surprising that PDDS was significantly associated with physical activity in this sample (Motl et al., 2009). Disability status may be further considered when tailoring intervention strategies and curricula for persons with MS. Social support and self-efficacy are further highlighted as significant correlates of physical activity in this sample consistent with previous research in the MS population (Motl et al., 2009; Morris et al., 2008; Uszynski et al., 2018). However, this study is the first to examine these variables from a theoretical lens (SCT) embedded within SEM providing a richer understanding of the significant influence of exercise self-efficacy in driving physical activity behavior in persons with MS.

There is growing interest in the interaction between built environment, social cognitions, and physical activity in the general population. A recent literature review investigated potential hypotheses of such interactions in which studies were classified based on hypothesis that the built environment versus social cognitions was the driving factor of physical activity behavior (Rhodes et al., 2018). There were no consistent findings supporting either hypothesis. However, the current study would support the hypothesis that social cognitive variables account for the majority of health-promoting physical activity behavior with some additional influence from the physical environment. Another recent study of African American adults and older adults using similar measures reported significant associations between physical activity and NEWS access to service and exercise self-efficacy but no social environment or NEWS variables (Gothe, 2018). Therefore, there is some evidence of consistent associations among built, social, and individual determinants of physical activity in the general population, however more research is needed as leisure physical activity through neighborhood walking is a major target for interventions with ambulatory people with MS.

Physical activity interventions for persons with MS informed by SCT demonstrate efficacy (Motl et al., 2018a; Motl et al., 2017b). These interventions specifically target self-efficacy as a primary determinant of physical activity. Self-efficacy is further correlated with physical activity in cross-sectional examinations of objective and self-report physical activity in persons with MS (Motl et al., 2009; Motl et al., 2006; Uszynski et al., 2018). These interventions could be further improved by incorporating a SEM-based multifactorial approach that targets the social and built environment as determinants of health-promoting leisure physical activity. For example, introductory activities in which participants identify social environment variables that influence their physical activity and how to either utilize positive aspects of their social environment (e.g., active community culture) or overcome negative aspects (e.g., low social support). Built environment variables may be incorporated in SCT-behavioral interventions in discussion of barriers and facilitators. For example, direct inquiry about perceptions of neighborhood walkability and aesthetics that can guide creation of action plans that address appropriate locations for physical activity. Particularly, these topics are important to address in SCT interventions as barriers are a focus and perceptions of social and built environment may significantly influence self-efficacy and facilitate behavior change in persons with MS.

This study includes a large, nationally representative sample of persons with MS. Mean scores on the GLTEQ are consistent with a recent meta-analysis in persons with MS (Sikes et al., 2018). However, limitations of this study include lack of inclusion of objective environmental assessments and a sample that was not completely representative of the US. Our results generalize primarily among persons with MS in the US who are female with higher socioeconomic status and mild or moderate MS impairment. The cross-sectional research design and use of self-report questionnaires limit causal inferences, but provide direction for future research. Participants were provided remuneration, which is a common practice in the US, but may represent an important potential motivator. This study focused on SCT, however a recent study of persons with spinal cord injuries examined the role of aesthetics and presence of sidewalks within the context of Theory of Planned Behavior on physical activity (Arbour-Nicitopoulos et al., 2010). Findings from this study underscore the strength of environmental correlates examined within a Theory of Planned Behavior lens in persons with other disabilities that could be applied in other studies. Future studies should include other SCT and social environment variables that may illuminate significant micro-level determinants of physical activity that would be addressed in conjunction with built environmental factors based on SEM in inclusive interventions that could benefit all persons with MS.

5. Conclusion

Our hypothesis was partially confirmed. Perceived built environment, social support, and self-efficacy were correlated with health-promoting leisure physical activity, however only self-efficacy, social support, and aesthetics remained significant when examining the multivariate relationships among variables and disability status. We deliberately examined a subset of SCT variables that are established correlates of physical activity in MS and future studies should incorporate more SCT variables in a comprehensive model including self-efficacy, outcome expectations, facilitators/barriers, and goal-setting/planning. Collectively, results from the current cross-sectional study further emphasize the need for physical activity interventions for persons with MS assessing self-efficacy and incorporating evidence-based behavior change methods to improve exercise self-efficacy. Environmental variables may further influence exercise behavior and should be addressed in the design of multi-level interventions that target environmental, social, and individual level correlates of health-promoting leisure physical activity consistent with the SEM framework and guided by SCT.

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