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Physical Activity and Quality of Life in Older Adults: An 18-Month Panel Analysis

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Abstract

Purpose—Although physical activity has been associated with quality of life (QOL), the empirical evidence regarding the mechanisms underlying this relationship is limited. In the present study, we examined the mediating roles played by self-efficacy and health status in the physical activity-QOL relationship from baseline to 18-month follow-up in a sample of community dwelling older adults.

Methods—Community dwelling adults ($N = 321$, M age = 63.8 years) were recruited to participate in a cross-sectional study and were later contacted to participate in an 18 month follow-up. Individuals completed a battery of questionnaires assessing physical activity, self-efficacy, physical self-worth, disability limitations, and quality of life. A panel analysis within a covariance modeling framework was used to analyze the data.

Results—Overall the model was a good fit to the data ($\chi^2 = 61.00$, $df = 29$, $p < 0.001$, Standardized Root Mean Residual = 0.05, Comparative Fit Index = 0.97) with changes in physical activity indirectly influencing change in life satisfaction from baseline to 18 months via changes in exercise self-efficacy, physical self-worth, and disability limitations independent of baseline relationships and demographic factors. Specifically, increases in physical activity were associated with increases in exercise self-efficacy which, in turn, was associated with higher physical self-worth and fewer disability limitations which were associated with greater life satisfaction.

Conclusions—The findings from this study suggest the relationship between physical activity and global QOL in older adults may be mediated by more proximal modifiable outcomes that can be targeted in physical activity programs and interventions.

Keywords

physical activity; quality of life; self-efficacy; older adults

Introduction

Older adults are the fastest growing segment of the U.S. populations [1]. As such, issues relative to maintaining and improving quality of life (QOL) in older adults in face of common side effects of aging (e.g., chronic diseases and conditions, functional impairment and disability) are becoming increasingly important. Physical activity is one lifestyle factor that has been shown to reduce the risk, delay the on-set, or lessen the severity of many of the side effects of aging [2, 3]. Furthermore, engaging in physical activity is associated with improved QOL in older adults[4, 5].

However, the mechanisms underlying the relationship between physical activity and QOL are not well understood, due, at least in part, to the inconsistency in defining this construct in the physical activity literature [5]. In the medical literature, QOL has typically been characterized as an “umbrella term” under which a broad array of health status and health outcomes reside [6]. This perspective has come to be viewed as health-related quality of life (HRQOL). It has further been argued that QOL should be viewed as a psychological construct incorporating the subjective nature and the process of comparing one’s current life to some self-determined criteria [7]. Diener’s [8] definition of QOL as the conscious cognitive judgment of one’s current satisfaction with one’s life has become one of the most commonly adopted definitions of QOL as a global construct in the social psychology and health behavior literature.

The early physical activity and QOL literature adopted the HRQOL perspective focusing on two broad categories: functioning (e.g. ability to perform activities of daily living, physical abilities) and well-being (e.g. psychological well-being, global measures) [9]. However, in a major review of the physical activity and QOL literature, Rejeski and Mihalko [5] suggested that QOL should be elevated to the status of a psychological construct in order to create consistency and allow for strong conclusions to be drawn and that the mediators of the relationship between physical activity and global QOL should be examined.

In order to address these recommendations, McAuley and colleagues [4] tested a social cognitive model of physical activity and global QOL. In this model, physical activity is proposed to exert its effects on QOL indirectly through the more proximal physical activity outcomes of self-efficacy, perceptions of physical health status and mental health status. Specifically, physical activity is proposed to directly influence self-efficacy which, in turn, indirectly influences global QOL via physical and mental health status. This model has been replicated longitudinally [10] in older women, as well as in individuals with multiple sclerosis [11]. In addition, White and colleagues [12] reported similar relationships in a cross-sectional sample of community dwelling men and women aged 50 and older. In this latter study, perceived disability was used as an indicator of physical health status because of its relationship to both aging and physical activity. A domain-specific measure of self-esteem, physical self-worth, was chosen as an indicator of mental health status, as self-esteem has been shown to be both an important outcome of physical activity participation and has consistently been associated with global QOL [13,14].

In the present study, we report data collected in a post-hoc 18-month follow-up of those participants in the White et al. study [12]. This approach allowed us to examine the extent to which there were relationships among changes in the model constructs across this period and thereby generalize the McAuley et al. [10] model to both older men and women. We hypothesized that: changes in physical activity over the 18-month period would be directly associated with changes in self-efficacy; changes in self-efficacy would be directly associated with changes in physical self-worth and disability; and changes in physical self-worth and disability would be directly associated with changes in global QOL.

Methods

Participants and Recruitment

Three hundred and twenty one older adults ($M_{age} = 63.8$ years; range = 50–90 years) were initially recruited to participate in a cross-sectional study examining older adults’ beliefs about exercise in the fall of 2007 and were re-contacted 18 months later to participate in a follow-up study. Of the original sample, 227 individuals (70.7% of total sample) were available for follow-up assessments. All study procedures were approved by the University Institutional Review Board and each participant completed a written informed consent at

study entry. Participants were recruited via electronic advertisements and paper fliers posted throughout the community. All individuals who participated in the study at baseline were contacted via e-mail and/or telephone a minimum of two times for recruitment into the 18-month follow-up study. Reasons for attrition at follow-up included failure to respond to repeated recruitment efforts ($n=35$; 10.9%), invalid contact information/change of address ($n=21$; 6.5%), failure to return 18-month questionnaire packet ($n=14$; 4.3%), no longer interested ($n=23$; 7.2%), and deceased ($n=1$; 0.3%). Additional information relative to study inclusion criteria, recruitment methods and baseline characteristics have been reported elsewhere [15].

Measures

Demographics—A brief questionnaire assessed basic demographic information including sex, race, education, and income.

Physical Activity—The Physical Activity Scale for the Elderly (PASE) [16] was used to assess physical activity. The PASE is a 10-item instrument designed to assess self-reported physical activity levels over a 7 day time period in older adults across three different domains: leisure, household and occupational activity. PASE assesses activity counts based upon the frequency, duration, and metabolic equivalent value of physical activity and has acceptable psychometric properties [17, 18].

Self-Efficacy—The 6-item Exercise Self-Efficacy Scale [19] was used to assess participant beliefs about their ability to continue to exercise over a 12-week period in two week increments, at moderate intensities, five times per week, and for 30 or more minutes per session. Participants indicate their confidence to execute the behavior on a 100-point percentage scale (10-point increments), ranging from 0% (not at all confident) to 100% (highly confident). Self-efficacy is then calculated by summing the confidence ratings and dividing by the total number of items in the scale, resulting in a maximum possible score of 100. Scores on this measure were highly reliable in the present study ($\alpha = .99$) at both baseline and follow-up.

Disability Limitations—The eight-item disability limitations subscale of the abbreviated Late Life Function and Disability Instrument (LL-FDI) [20] was used as an indicator of physical health status. Participants indicate how limited they feel in their ability to do each of 8 activities (e.g. visiting friends and family in their homes, personal needs) on a scale from 1 (“completely limited”) to 5 (“not at all limited”) with higher scores reflecting fewer limitations. This measure is an indicator of physical health status in the context of carrying out household and social activities and these scores demonstrated acceptable consistency at baseline ($\alpha = 0.83$) and follow-up ($\alpha = 0.82$).

Physical Self-worth—The 6-item physical self-worth scale (PSW) of the Physical Self-Perception Profile (PSPP) [21] was used as an indicator of mental health status. Participants indicated the degree to which each item was characteristic of them (e.g. “I am extremely satisfied with the kind of person that I am physically;” “I am not happy with the way that I am or with what I can do physically”) on a scale from 1 (“not at all true”) to 4 (“completely true”). This scale has consistently been used to assess physical self-worth in the physical activity literature. In this study, the internal consistency of the physical self-worth scale at baseline ($\alpha = 0.90$) and follow-up ($\alpha = 0.90$).

Quality of Life—The 5-item Satisfaction with Life Scale (SWLS) [22] was used to assess global QOL. Participants are asked to indicate how much they agree with each statement on a 7-point Likert scale from 1 (“strongly disagree”) to 7 (“strongly agree”). Higher scores

represent greater life satisfaction. The SWLS has acceptable psychometric properties in older populations [22, 23] and has been shown to be associated with physical activity levels [4, 24]. The internal consistency of SWLS scores in the present study were high at baseline ($\alpha = 0.90$) and follow-up ($\alpha = 0.90$). We view life satisfaction as a key indicator of global QOL and use these terms interchangeably throughout the manuscript.

Procedure

Contact information was verified and/or updated for all individuals interested in participating in the follow-up portion of the study. Two copies of an Institutional Review Board approved informed consent, the battery of questionnaires, and a self-addressed stamped envelope were sent to the participants via the U.S. Postal Service. Participants were asked to complete and return a signed informed consent (the second copy was for their own record) and the study questionnaire packet within a two week period. If study materials were not returned in a timely fashion, participants were contacted (up to three times) until these materials were received. All participants who returned completed follow-up study materials were entered into a drawing to win one of twenty \$50.00 cash prizes.

Data Analysis

Descriptive and bivariate correlation analyses were performed in SPSS, version 18.0 [26]. In order to examine the hypothesized relationships between physical activity, self-efficacy, health status indicators, and quality of life, a panel analysis within a covariance modeling framework was conducted using Mplus v6.0 [27]. Panel analysis allows for the examination of dynamics of relationship changes across time, independent of the baseline relationships and other variables in the model. As a result of the presence of missing data, the full-information maximum likelihood (FIML) estimator was used. The FIML estimator is a well documented approach to the analysis of missing data in structural equation modeling and has yielded accurate parameter estimates and fit indices with simulated missing data [28–30]. Preliminary analyses of the data were conducted in SPSS [26] to confirm the missing at random (MAR) assumption therefore justifying use of FIML estimation. The extent of missing data at baseline ranged from 0% (self-efficacy) to 5.9% (PASE). The extent of missing data at follow-up ranged from 29.3% (self-efficacy, disability limitations, physical self-worth) to 30.5% (PASE) and was largely the result of loss to follow-up.

Model specification and fit—At baseline, the hypothesized model specified: a) a direct path from physical activity to self-efficacy; b) direct paths from self-efficacy to physical self-worth and disability limitations; c) direct path from physical self-worth and disability to satisfaction with life. The same paths were hypothesized among changes in model constructs across the 18 month study period. Stability coefficients were estimated [31] to represent correlations between the same variables (e.g., PASE at baseline and 18-months) measured across time while controlling for the influence of other variables in the model. Finally, potential reciprocal relationships were examined by testing for cross lagged relationships among factors at baseline and follow-up. Overall, the stability coefficients were acceptable for all variables and ranged from $\beta = .45$ (exercise self-efficacy) to $\beta = .70$ (satisfaction with life). These paths are not shown in subsequent figures for the sake of clarity. We also tested the indirect relationship between physical activity and global quality of life via self-efficacy and physical and mental health status using the *indirect* command in Mplus. The effects of demographic factors including age, race, sex, education, and income were statistically controlled in all analyses.

Standard model fit indices were calculated including the chi-square goodness of fit, the standardized root mean residual (SRMR) and the Comparative Fit Index (CFI) [32]. A non-

significant chi-square, values greater than .95 for the CFI, and values of .08 or less for the SRMR are indicative of a good model-data fit [32, 33].

Results

Participants

As previously reported [11], the original sample ($N = 321$) was 80.1% female and 88.7% white. A majority of the sample (58.1%) had at least a college degree, and 65.1% had an annual household income greater than \$40,000. Baseline analyses comparing individuals who did not participate in the follow-up with those who did were nonsignificant ($p > .05$) for all variables except education (see Table 1). There were a significantly greater proportion of individuals with at least a college degree who participated in follow-up compared to those who did not.

Model Results

Table 2 details the descriptive statistics for all variables in the hypothesized model. There was a modest, but significant, decrease in exercise self-efficacy over the 18-month study period. There were no significant changes across time in any of the other constructs, although there was considerable variability among values at each time point. Table 3 shows the correlations for all of the variables included in the model.

The panel model analyzing the relationships shown in Figure 1 provided an adequate overall fit to the data ($\chi^2 = 73.67$, $df = 30$, $p < 0.001$, $SRMR = 0.06$, $CFI = .96$). However, the modification indices for the model indicated that the model fit could be improved by allowing for a cross-lagged path between baseline exercise self-efficacy and 18 month physical activity. This is in line with the existing literature suggesting that self-efficacy for physical activity at one point in time is predictive of future physical activity participation [34, 35]. A second model incorporating this cross-lagged path provided an excellent fit to the data ($\chi^2 = 61.00$, $df = 29$, $p < 0.001$, $SRMR = 0.05$, $CFI = .97$). Next, we tested a model including cross-lagged paths between each predictor variable at 18 months and baseline outcome variables to test for other potential reciprocal relationships. While this model was still a good fit to the data ($\chi^2 = 51.19$, $df = 29$, $p < 0.01$, $SRMR = 0.03$, $CFI = .97$) none of the additional cross-lagged pathways were significant. Thus, we decided to use the model including only the cross-lagged path from self-efficacy at baseline to physical activity at 18 months as our final model described herein.

At baseline, more active individuals reported significantly, higher self-efficacy ($\beta = 0.30$, $p < 0.001$), fewer disability limitations ($\beta = .26$, $p < 0.001$) and higher physical self-worth ($\beta = 0.44$, $p < 0.001$). Both higher physical self-worth ($\beta = 0.41$, $p < 0.001$), and lower levels of disability limitations ($\beta = 0.15$, $p < 0.01$), were significantly associated with greater life satisfaction. At baseline, the indirect effects of physical activity on QOL via self-efficacy and physical self-worth and self-efficacy and disability limitations were also significant ($p < .05$).

At 18 months, increases in physical activity were significantly associated with increases in self-efficacy ($\beta = 0.20$, $p < 0.01$), which, in turn were associated with fewer disability limitations ($\beta = 0.12$, $p = 0.04$) increased physical self-worth ($\beta = 0.21$, $p < 0.001$). In turn, fewer disability limitations ($\beta = 0.11$, $p = 0.01$) and increases in physical self-worth ($\beta = 0.15$, $p < 0.01$) were significantly associated with improvements in satisfaction with life. Additionally, having higher self-efficacy at baseline was significantly associated with increased physical activity ($\beta = 0.21$, $p < 0.001$) at 18 months. At follow-up, the indirect effect of increases in physical activity on increases in QOL was significant only via changes

in self-efficacy and physical self-worth. Overall, the model accounted for 28% and 65% of the variance in satisfaction with life at baseline and follow-up, respectively.

There were a number of significant relationships among model constructs and demographic factors. At baseline, older adults had significantly higher self-efficacy ($\beta = 0.11, p < 0.001$), physical self-worth ($\beta = 0.23, p < 0.001$) and satisfaction with life ($\beta = 0.12, p = 0.03$). Additionally, women reported fewer disability limitations ($\beta = 0.23, p = 0.03$), and individuals with a higher educational attainment reported significantly greater satisfaction with life ($\beta = 0.12, p = 0.02$). At 18-months, older adults reported a greater decrease in physical activity participation ($\beta = -0.22, p < 0.001$) and fewer disability limitations ($\beta = 0.14, p = 0.02$). Additionally, males reported a borderline significant greater increase in physical activity ($\beta = 0.11, p = 0.05$) than females.

Discussion

The purpose of this study was to longitudinally examine a model of the physical activity and quality of life relationship which hypothesized mediation through self-efficacy and health status indicators and applying it to community-dwelling older men and women. The proposed model specified that physical activity would indirectly influence global QOL across time via more proximal outcomes of physical activity including self-efficacy and health status indicators (i.e., disability limitations and physical self-worth). The test of this model resulted in a good model-data fit controlling for baseline associations, stability measures over time, and demographic variables. However, further testing of cross-lagged reciprocal relationships suggested the model fit could be improved by adding a path from baseline self-efficacy to 18 month physical activity. These findings support McAuley and colleagues' [4] hypothesis that the relationship between physical activity and QOL across time can be understood as incorporating more proximal, modifiable, and temporally sensitive factors (e.g. self-efficacy), as well as more stable and global constructs (e.g. satisfaction with life). These data extend the findings from other tests of this model by 1) demonstrating that indicators of physical and mental health status can adequately be used as outcomes of physical activity and predictors of global QOL across time, thereby enhancing its generalizability and ability to be tested in other populations, 2) establishing that this model holds longitudinally in a sample of older adults consisting of both men and women and 3) providing evidence for the reciprocal nature of the relationship between self-efficacy and physical activity participation.

Moreover, the findings from this study provide additional support for the role of self-efficacy as not only a predictor and outcome of physical activity participation, but as a predictor of more distal physical activity outcomes. This is important, as self-efficacy can be modified by targeting mastery experiences (e.g. creating a progressive program), social persuasion (e.g. exercise buddies or encouraging exercise leaders), social modeling (e.g. group exercise classes with adults of similar ages and abilities), and interpretation of physiological factors (e.g. teaching participants how to rate their perceived exertion and adjust intensity accordingly) [36]. Thus, physical activity interventions designed to target self-efficacy have the potential to not only increase physical activity participation, but to improve physical self-worth and reduce disability limitations which, in turn, enhance global QOL. Improvements in these constructs could serve as a motivating factor for the adoption and maintenance of physical activity, as well as adherence to physical activity interventions and community programs for older adults and other segments of the population.

There were a number of interesting associations among demographic characteristics and model constructs. The positive relationship between age and satisfaction with life is consistent with other studies [37–39] and may be reflective of the relationship of age to

other model constructs and suggest that individuals may be more accepting of themselves and their life as they age [40]. Additionally, greater efficacy for physical activity may indicate that older adults are more likely to be retired and have fewer factors competing for their time to be active than younger adults who are still working or caring for children. Women reporting fewer disability limitations may be a function of the social nature of many items on the LL-FDI and the tendency for women to be more engaged socially [41]. Findings relative to the relationship between educational attainment and satisfaction with life were consistent with those from the general QOL literature [42]. It was also not surprising that older individuals exhibited lower physical activity levels over the 18 month period and that men reported greater increases in physical activity. These are consistent demographic predictors of physical activity participation and accordingly physical activity campaigns and programs directed towards older adults should take into account life stage, as well as gender, in their design in order to have the greatest QOL benefits.

We note a number of limitations within this study. Although our longitudinal design is strength, randomized controlled exercise trials are necessary to determine whether the hypothesized relationships hold as a result of a physical activity intervention. Second, the study sample was largely homogenous (i.e., primarily White, female, and highly educated). Thus, it is important to examine these relationships in more diverse samples older adults as well as other age groups to determine if they still hold. Additionally, our analyses were conducted using manifest constructs rather than latent variables. Future studies should be conducted to effectively determine which factors play a role in representing the latent elements of physical and mental health status in order to further understand their roles in the relationship between physical activity and QOL. Finally, we assessed physical activity by self-report and acknowledge the importance of objectively measuring this health behavior to eliminate over- or under- reporting on self-report measures. Additionally, determining whether different modes (e.g. aerobic vs. non-aerobic) or intensities (e.g. light vs. moderate) of physical activity differentially influence the model relationships is warranted. We further recognize that our assessments of physical and mental health status were restricted to disability limitations and physical self-worth, respectively. Clearly, other variables have the potential to be included as indicators of physical and mental health status and include functional limitations, symptoms, depression, and anxiety, as well as cognitive and social elements of health status.

In conclusion, our findings provide further, longitudinal support for the role of self-efficacy and health status indicators in understanding the relationship between physical activity and QOL. As the population continues to age, it is becoming progressively more important to understand, not only how to maximize life expectancy and reduce the risk of disease and disability, but how QOL during those years can be enhanced. Although physical activity has been shown to have numerous health benefits for older adults, this group remains one of the most inactive segments of the population [43]. Consequently, developing a better understanding of the role physical activity plays in QOL is crucial, as it may well be a more salient reason for older adults to participate in physical activity and could have a significant impact on public health.

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Figure 1. Panel Model of Physical Activity and Quality of Life

Note: PASE= Physical Activity Scale for the Elderly; SE= Exercise Self-efficacy Scale; DLIM= LL-FDI Disability Limitations Subscale; PSW= PSPP Physical Self-Worth Subscale; SWLS = Satisfaction with Life Scale

Table 1

Comparison of Baseline Characteristics for 18 Month Follow-up Participants v. Nonparticipants

Variable	Follow-up Participants (n= 227)	Non- participants (n = 94)	Comparison Statistic ^a
Age	64.01 (9.59)	63.37 (9.71)	0.54
Percentage Female	81.5%	76.6%	1.50
Race			4.17
White	89.3%	87.2%	
African American	7.1%	11.7%	
Asian	3.1%	1.1%	
Other	0.4%	0%	
At Least College Degree	63.7%	46.8%	11.15 *
Annual Income \$40,000	68.0%	68.2%	0.13
Physical Activity Scale for the Elderly	154.01 (81.63)	135.91 (75.60)	1.80
Exercise Self-efficacy Scale [0–100]	68.19 (33.30)	60.16 (35.01)	1.94
LL-FDI Disability Limitations Subscale [8–40] ^b	37.02 (4.18)	37.26 (5.51)	–0.46
PSPP Physical Self Worth Subscale [6–24]	17.31 (4.28)	16.76 (4.26)	1.04
Satisfaction with Life Scale [5–35]	25.93 (6.37)	24.45 (7.07)	1.83

* significant at $p < 0.05$; t-test static for continuous variables; Chi-square statistic for categorical variables;

^b Higher scores reflect fewer limitations;

M= mean; SD= Standard Deviation; LLFDI = Late Life Function and Disability Instrument; PSPP= Physical Self-Perception Profile; Physical Activity Scale for the Elderly; numbers in brackets indicate the scale score range; positive values on all scales are optimal except where indicated

Table 2

Descriptive Statistics of Model Variables at Baseline and 18-months

Variable	Baseline (n=321) <i>M</i> (<i>SD</i>)	18-months (n=227) <i>M</i> (<i>SD</i>)	<i>t</i>
Physical Activity Scale for the Elderly	154.97 (81.80)	159.23 (78.96)	0.78
Exercise Self-efficacy Scale [0–100]	68.19 (33.30)	62.06 (34.81)	−2.71 *
LL-FDI Disability Limitations Subscale [8–40] [†]	37.02 (4.18)	37.40 (3.91)	1.43
PSPP Physical Self Worth Subscale [6–24]	17.31 (4.27)	17.23 (4.24)	0.37
Satisfaction with Life Scale [5–35]	25.91 (6.37)	25.37 (6.33)	−1.88

* significant at $p < 0.05$;

M= mean; SD= Standard Deviation; LLFDI = Late Life Function and Disability Instrument; PSPP= Physical Self-Perception Profile; numbers in brackets indicate the scale score range; positive values on all scales are optimal except where indicated

[†] Higher scores reflect fewer limitations

Table 3

Correlations Among Model Constructs

	Baseline					Follow-up				
	PASE	SE	PSW	DLIM	SWLS	PASE	SE	PSW	DLIM	SWLS
PASE	1.00									
SE	0.28**	1.00								
PSW	0.18**	0.44**	1.00							
DLIM	0.15**	0.28*	0.23	1.00						
SWLS	0.05	0.28**	0.45**	0.28**	1.00					
PASE	0.52**	0.33**	0.23**	0.21**	0.08	1.00				
SE	0.19**	0.50**	0.36**	0.24**	0.26**	0.33**	1.00			
PSW	0.13	0.39**	0.74**	0.20**	0.34**	0.20**	0.44**	1.00		
DLIM	0.03	0.15*	0.23**	0.51**	0.28**	0.09	0.25**	0.27**	1.00	
SWLS	0.01	0.24**	0.37**	0.29**	0.78**	0.14*	0.29**	0.42**	0.35**	1.00

Note:

** = significant at $p < 0.001$;* = significant at $p < 0.05$;

PASE= Physical Activity Scale for the Elderly; SE= Self-efficacy; PSW= Physical Self-Worth; DLIM= Disability Limitations; SWLS= Satisfaction with Life Scale