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Does the Relationship Between Physical Activity and Quality of Life Differ Based on Generic Versus Disease-Targeted Instruments?

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Abstract

Background—There has been an increased interest in the study of physical activity and its relationship with quality of life (QOL) and health-related quality of life (HRQL) in chronic disease conditions. The investigations have used either generic or disease-targeted instruments for measuring QOL and HRQL, but have not examined differences in the associations as a function of the types of instruments.

Purpose—The present study examined the associations among physical activity, QOL, and HRQL using generic and disease-targeted instruments in persons with multiple sclerosis (MS).

Methods—Participants were 292 individuals with MS who wore an accelerometer for 7 days and then completed the Godin Leisure-Time Exercise Questionnaire (GLTEQ), Multiple Sclerosis Impact Scale-29 (MSIS-29), Leeds Multiple Sclerosis Quality of Life Scale (LMSQOL), Short Form-12 Health Survey (SF-12), and Satisfaction With Life Scale (SWLS).

Results—Accelerometer counts and GLTEQ scores had similarly sized correlations with scores from generic (SF-12) and the disease-specific (MSIS-29) measures of HRQL and generic (SWLS) and the disease-specific (LMSQOL) measures of QOL. Path analysis indicated a similar pattern of directional relationships between accelerometer counts and GLTEQ scores with physical and mental HRQL and, in turn, physical and mental HRQL with QOL using generic and disease-targeted instruments.

Conclusions—Our results suggest that in cross-sectional analysis, physical activity is similarly related with QOL and HRQL using generic and disease-targeted instruments in persons with MS.

Keywords

Quality of life; Health-related quality of life; Physical activity

Introduction

There has been an increased interest by researchers in the study of physical activity, quality of life (QOL), and health-related quality of life (HRQL) in chronic disease conditions. QOL is a concept derived from the social and behavioral sciences for describing subjective well-being or global satisfaction with life. Indeed, QOL is a global psychological construct that takes into account the weighting or importance that individuals give to particular areas of their lives [1, 2]. This conceptualization of QOL differs from that of HRQL. HRQL reflects the biomedical and behavioral medicine position whereby functioning or physical health and well-being or mental health are two aspects of HRQL [3,4] that are influenced by health status. Therefore,

QOL and HRQL are related, but not isomorphic constructs [5]. There is even some evidence of a hierarchical model whereby proximal HRQL constructs predict distal QOL constructs [6,7], and HRQL constructs (e.g., scores from the SF-36 and SF-12 [3,4]) have accounted for the relationship between physical activity and QOL (e.g., Satisfaction With Life Scale [1,2] in older adults [5]).

The study of QOL and HRQL in the context of physical activity typically has been undertaken using generic and disease-targeted instruments. Generic instruments are designed to be relevant to anyone and provide information that can be compared across populations, but the scale items may not capture the relevant components of QOL and HRQL for particular disease conditions [8]. This issue has resulted in the development of disease-targeted instruments. The disease-targeted instruments capture unique information within a chronic disease condition that generic instruments do not and the items are often developed using qualitative data collection with focus groups and expert opinions [8].

Generic and disease-targeted instruments might provide different information about the relationship between physical activity and QOL and HRQL. Indeed, a recent meta-analysis of exercise training effects on QOL in individuals with multiple sclerosis (MS) supports the possibility of differential relationships between physical activity and QOL using generic and disease-targeted instruments [9]. The meta-analysis included 109 effect sizes from 13 studies with 484 MS participants and yielded a weighted mean effect of $g=0.23$. The overall effect size was moderated by type of QOL instrument ($Q_B=20.53$, $df=2$, $p=.0001$) and there was a significant effect for MS-specific QOL instruments, but a nonsignificant effect for generic QOL instruments. Such findings suggest indirect and partial support for the possibility that generic and disease-targeted instruments provide different information about the relationship between physical activity and QOL and HRQL. This qualification is based on the observation that there was not a single study that directly compared the effects of exercise training on both generic and disease-targeted measures of QOL and HRQL and the individual studies varied in design, exercise mode, program duration, and amount of weekly exercise.

This study examined the associations among physical activity, QOL, and HRQL using generic and disease-targeted instruments in individuals with MS. We compared the magnitude of bivariate correlations between scores from objective and self-report measures of physical activity and scores from the generic and disease-targeted measures of QOL and HRQL. After comparing the magnitude of correlations, we tested a model whereby physical activity was indirectly associated with QOL through HRQL [5] with the generic and disease-targeted instruments separately. Overall, we expected that physical activity would have stronger associations with disease-targeted measures than generic instruments in this sample of persons with MS based on the results from a previous meta-analysis [9].

Materials and Methods

Participants

We recruited a sample of individuals with MS through (a) research announcements mailed to past study participants, (b) advertisements placed in *MS Connection* quarterly publications, and (c) e-mail messages that were distributed to registered members of three National MS Society chapters. There were 511 individuals who expressed interest in the study, and 387 of those individuals underwent screening. The screening criteria involved (a) having an established definite diagnosis of MS, (b) being relapse free in the last 30 days, and (c) being ambulatory with minimal assistance. Of those who were screened, there were 27 individuals who did not satisfy our inclusion criteria and 16 individuals who declined participation. We sent an informed consent document and verification letter to the remaining 344 individuals, and the forms were returned by 300 of the individuals. Of those who returned the forms, eight

did not continue with participation for unknown reasons, and the final convenience sample consisted of 292 individuals with MS. The sample consisted of 246 individuals with relapsing–remitting MS, 12 individuals with primary progressive MS, and 34 individuals with secondary progressive MS, and the mean duration of MS was 10.3 years (standard deviation (SD)= 7.9). The sample consisted of 245 women and 47 men with a mean age of 48.0 years (SD=10.3) and was mostly Caucasian (94%), married (68%), employed (53%), and educated (28% had some college education and 57.7% were college graduates) with a median annual household income exceeding \$40,000 (67.7%).

Instruments

Physical Activity—We measured physical activity using an ActiGraph accelerometer (model 7164 version, Health One Technology, Fort Walton Beach, FL) and the Godin Leisure-Time Exercise Questionnaire (GLTEQ) [10] because the measures have evidence of validity and reliability in individuals with MS [11–13]. The ActiGraph accelerometer provided an objective measure of physical activity. Participants recorded the time that the accelerometer was worn on a log, and this was verified by our inspection of the minute-by-minute accelerometer data. We further examined the accelerometer data for long periods of continuous zeros as a check of compliance with wearing the device and we used a criterion of 60 min of continuous zeros for noncompliance. Our rationale for this is that individuals with MS frequently take prolonged periods of rest for energy conservation and fatigue management. We based the judgment of a valid day of measurement based on 10 h of wear time during the waking hours [14], defined as the moment upon getting out of bed in the morning through the moment of getting into bed in the evening. We considered the data to be spurious when counts exceeded 20,000 per min [14], and we required that participants have three valid days of data for a reliable estimate of weekly physical activity [13]. There was one participant with three valid days, four with four valid days, one with five valid days, three with six valid days, and 283 with seven valid days of valid accelerometer data. Regarding data reduction, the downloaded data from the accelerometers were entered into Microsoft Excel for processing, and the movement counts for each day were summed and then averaged across the period of valid days of data. This resulted in accelerometer data expressed in total movement counts per day (i.e., usual physical activity).

The GLTEQ is a self-administered two-part measure of usual physical activity; we only included the first part in this study consistent with previous research [11,12]. The first part has three items that measure the frequency of strenuous (e.g., jogging), moderate (e.g., fast walking), and mild (e.g., easy walking) exercise for periods of more than 15 min during one's free time in a typical week. The weekly frequencies of strenuous, moderate, and mild activities are multiplied by 9, 5, and 3 metabolic equivalents, respectively, and summed to form a measure of total leisure activity.

Leeds Multiple Sclerosis Quality of Life Scale—The Leeds Multiple Sclerosis Quality of Life (LMSQOL) scale provided a disease-targeted measure of QOL [15]. The items were derived through two focus group sessions with MS patients. The first session included open-ended questions for identifying areas of concern, and the second session involved generation of items for the measure. This resulted in 25 items that were analyzed through Rasch modeling and yielded the final version of the LMSQOL. The LMSQOL is an eight-item, unidimensional disease-specific measure of overall QOL. An example item is “I have felt happy about the future.” The scores can range between 8 and 32 with lower scores representing higher QOL. This scale has good internal consistency, test–retest reliability, and evidence of score validity and virtually no floor or ceiling effects [15]. Coefficient alpha for the LMSQOL was 0.82 in the present study.

Satisfaction With Life Scale—The Satisfaction With Life Scale (SWLS) provided a generic measure of QOL [1,2]. The SWLS is a five-item, unidimensional generic measure of overall QOL. An example item is “I am satisfied with my life.” The scores can range between 7 and 35 with higher scores representing higher QOL. The SWLS has good internal consistency, test–retest reliability, and evidence of score validity [1,2]. Coefficient alpha for the SWLS was 0.89 in the present study.

Multiple Sclerosis Impact Scale—The 29-item Multiple Sclerosis Impact Scale (MSIS-29) was used as a disease-targeted measure of HRQL [16]. The items were developed through semistructured interviews of people with MS, expert opinion, and a literature review. This yielded 129 items concerning the health impact of MS. The 129 items were reduced based on psychometric properties and principle components analysis and principle axis factor analysis. This resulted in the final version of the MSIS-29 as a disease-specific measure of the physical (20 items) and psychological (nine items) aspects of HRQL. An example item from the physical scale is “In the past two weeks, how much have you been bothered by problems with balance?” An example item from the psychological scale is “In the past two weeks, how much have you been bothered by feeling depressed?” The scores can range between 0 and 100 with lower MSIS-29 scores representing higher HRQL. There is evidence for the reliability and validity of the MSIS-29 in samples of individuals with MS [16,17]. Coefficient alpha for the physical and psychological subscales was 0.94 and 0.90, respectively, in the current study.

Short Form-12 Health Survey—The 12-item Short Form Health Survey (SF-12) was used as a generic measure of HRQL [18]. The SF-12 provides a measure of the physical (i.e., Physical Component Summary) and psychological (Mental Component Summary) components of HRQL. The scores can range between 0 and 100 with higher SF-12 scores representing higher HRQL. The SF-12 is one of the most widely used measures of HRQL and there is evidence for the reliability and validity of the SF-12 in many diverse samples including individuals with MS [18,19].

Procedure

After initial telephone contact and voluntary participation, an informed consent document and a form letter for verifying the participant’s diagnosis of MS were sent to all participants through the US postal service, along with prestamped and preaddressed envelopes for return postal service. After the informed consent was returned, we sent a battery of questionnaires and an accelerometer with instructions for wearing it correctly to all participants through the US postal service, along with a prestamped and preaddressed envelope for return postal service. We called all participants and further clarified the procedures and instructions for wearing the accelerometer. The participants wore the accelerometer for a 7-day period and then completed a battery of questionnaires on the eighth day. The surveys were completed in order of GLTEQ, MSIS-29, LMSQOL, SF-12, and SWLS. After wearing the accelerometer and completing the questionnaires, participants returned the study materials through the US postal service. All questionnaires were checked for completeness, and, in the event of missing data, participants were contacted by a member of the research team to collect the data over the phone. All participants received \$20 upon returning the study materials.

Data Analysis

The data were analyzed using bivariate correlations and path analysis. We computed bivariate correlations between accelerometer counts and scores from the generic and disease-specific measures of QOL and HRQL as Pearson product–moment correlation coefficients using SPSS for Windows, Version 15.0. We computed the 95% confidence interval (95% CI) around the correlation coefficients for a comparison of differences in the magnitude of the correlation between physical activity and generic and disease-specific measures of QOL and HRQL. We

then tested a directional model for describing the relationships among physical activity, HRQL, and QOL with the generic and disease-specific instruments separately using path analysis with Full-Information Maximum Likelihood (FIML) estimation in *Mplus* 3.0 [20]. The FIML estimator was selected because there were missing accelerometer data (5% of participants missing data) and the FIML estimator is an optimal method for the treatment of missing data in covariance modeling [21]. We tested a model (Fig. 1) whereby physical activity and QOL were indirectly related through physical and mental components of HRQL for the generic and disease-targeted instruments. This model (a) regressed physical and mental components of HRQL on accelerometer counts, (b) regressed QOL on physical and mental components of HRQL, and (c) included a correlation between physical and mental components of HRQL. We based a good-model data fit on a nonsignificant chi-square value and combinatory rules of standardized root mean squared residual (SRMR) ≤ 0.08 and comparative fit index (CFI) ≥ 0.95 [22].

Results

Descriptive Statistics and Bivariate Correlations

The descriptive statistics and bivariate correlations for the variables are in Table 1. The bivariate correlations along with 95% CIs are provided in Fig. 1 for visual inspection. Accelerometer counts had similar sized relationships with scores from generic (SF-12 Physical; $r=0.38$ [95% CI=0.27, 0.47]; SF-12 Mental; $r=0.09$ [95% CI=0.03, 0.21]) and the disease-specific (MSIS-29 Physical; $r=-0.33$ [95% CI=-0.22, -0.43]; MSIS-29 Mental; $r=-0.14$ [95% CI=-0.02, -0.25]) measures of HRQL. The bivariate correlations further indicated that accelerometer counts had similar sized relationships with scores from generic (SWLS; $r=0.15$ [95% CI=0.03, 0.26]) and the disease-specific (LMSQOL; $r=-0.14$ [95% CI=-0.02, -0.25]) measures of QOL.

Self-reported physical activity had similar sized relationships with scores from generic (SF-12 Physical; $r=0.28$ [95% CI=0.17, 0.38]; SF-12 Mental; $r=0.12$ [95% CI=0.01, 0.23]) and the disease-specific (MSIS-29 Physical; $r=-0.26$ [95% CI=-0.15, -0.36]; MSIS-29 Mental; $r=-0.17$ [95% CI=-0.06, -0.28]) measures of HRQL. The bivariate correlations also indicated that self-reported physical activity had similar sized relationships with scores from generic (SWLS; $r=0.21$ [95% CI=0.10, 0.32]) and the disease-specific (LMSQOL; $r=-0.22$ [95% CI=-0.11, -0.33]) measures of QOL.

There were large bivariate correlations between scores from the generic and disease-targeted measures of mental HRQL (i.e., SF-12 Mental and MSIS-29 Mental; $r=-0.58$), physical HRQL (i.e., SF-12 Physical and MSIS-29 Physical; $r=-0.67$), and QOL (i.e., SWLS and LMSQOL; $r=-0.69$). Importantly, all of the negative correlations were expected as the disease-targeted measures are scored such that a lower score represents higher QOL or HRQL.

Path Analysis: Generic Instruments

The path model was first tested with the accelerometer and generic QOL instruments and it represented a good fit for the data ($\chi^2=0.02$, $df=1$, $p=0.90$, SRMR=0.00, CFI=1.00). The path coefficients are provided in Fig. 2 and indicated that those who were more physically active reported higher levels of physical ($\gamma=0.38$) and mental ($\gamma=0.09$) HRQL, and higher levels of physical ($\beta=0.33$) and mental ($\beta=0.40$) HRQL were associated with higher QOL. The correlation between physical and mental HRQL was not statistically significant ($\psi=0.04$). With self-reported physical activity, the same model represented a good fit ($\chi^2=2.50$, $df=1$, $p=0.11$, SRMR=0.02, CFI=0.99) and the pattern of relationships was similar to that observed with the accelerometer as seen in Fig. 2.

Path Analysis: Disease-Specific Instruments

The path model was then tested with the accelerometer and the disease-specific instruments and it provided an acceptable fit ($\chi^2=0.01$, $df=1$, $p=0.93$, $SRMR=0.00$, $CFI=1.00$). The path coefficients are provided in Fig. 2 and indicated that those who were more physically active reported higher levels of physical ($\gamma=-0.33$) and mental ($\gamma=-0.14$) HRQL, and higher levels of physical ($\beta=0.19$) and mental ($\beta=0.57$) HRQL were associated with higher QOL. The correlation between physical and mental HRQL was significant ($\psi=0.67$). Again, the negative coefficients were expected as lower score represents higher QOL or HRQL on the disease-targeted measures. With self-reported physical activity, the same model again represented a good fit ($\chi^2=3.20$, $df=1$, $p=0.07$, $SRMR=0.03$, $CFI=0.99$) and the pattern of relationships was similar to that observed with the accelerometer as seen in Fig. 2.

Discussion

This study involved an examination of the associations among physical activity, QOL, and HRQL using generic and disease-targeted instruments in a sample of individuals with MS. Our results indicated that objective and self-reported physical activity demonstrated similarly sized relationships with generic and disease-targeted QOL and HRQL instruments. For example, physical activity as measured by the accelerometer and the GLTEQ had similarly sized correlations with SWLS ($r=0.15$ and $r=0.21$, respectively) and LMSQOL ($r=-0.14$ and $r=-0.22$, respectively) scores as generic and disease-targeted measures of QOL, respectively; this same pattern of findings was observed with the generic and disease-targeted measures of HRQL. We further note that a path model whereby physical activity and QOL were indirectly related through physical and mental components of HRQL was tenable using both objective and self-reported physical activity and generic and disease-targeted instruments. Those findings support the possibility that researchers can study physical activity and its relationship with QOL and HRQL in individuals with MS and possibly other disease conditions using either objective or self-reported measures of physical activity and generic or disease-targeted HRQL and QOL instruments.

Our findings were inconsistent with our expectations based on the results of a recent meta-analysis of exercise training effects on QOL in individuals with MS [9]. The meta-analysis indicated that exercise training was associated with a larger improvement in MS-specific ($d=0.22$) than generic ($d=0.03$) measures of QOL. The results of the meta-analysis must be qualified based on the observation that there was not a single study that directly compared the effects of exercise training on both generic and disease-targeted measures of QOL and HRQL and all of the studies in the meta-analysis varied in methodology. Therefore, the present cross-sectional study compared the relationships between objective and self-reported physical activity and generic and disease-targeted measures of QOL and HRQL and we did not find differences in the associations based on type of instrument. Importantly, we recommend that future researchers directly examine the possibility that exercise training has similar or dissimilar effects on generic and disease-targeted measures of QOL (i.e., sensitivity analysis). Such an examination will further clarify the presumed advantage of disease-targeted instruments compared with generic instruments in the study of physical activity, QOL, and HRQL and may be a prerequisite step before researchers make decisions about the continued use of disease-targeted instruments.

We tested a model for describing the relationships among physical activity, HRQL, and QOL using path analysis. The model suggests that physical activity is indirectly linked with QOL by way of mental and physical aspects of HRQL. This model is consistent with the conceptual relationships among physical activity and QOL constructs [6,7] and has been tested for describing the nature of relationship between physical activity and QOL in older adults [5]. Indeed, self-reported physical activity was associated with mental ($\gamma=0.29$) and physical

($\gamma=0.56$) health status, and mental ($\beta=0.45$) and physical ($\beta=0.39$) health status were in-turn associated with global QOL [5]. That model was only tested using self-reported physical activity and generic measures of HRQL and QOL. The present study replicated and extended those results using both the generic and disease-targeted instruments and objective and self-reported measures of physical activity in a sample of individuals with MS. With the generic measures, physical activity was associated with higher levels of mental and physical HRQL, and higher levels of mental and physical HRQL were associated with higher QOL. With the disease-targeted measures, physical activity was associated with higher levels of mental and physical HRQL, and higher levels of mental and physical HRQL were associated with higher QOL. This evidence suggests that the pattern of relationships among physical activity, HRQL, and QOL seem to be similar with older adults and individuals with MS as well as with generic and disease-targeted instruments. The evidence further supports the argument that physical activity likely has its strongest effects on more proximal outcomes associated with health status that are, in turn, related with the distal outcome of QOL [6,7].

This study is not without limitations. We recognize that we examined the relationships among physical activity, QOL, and HRQL using a limited range of possible generic and disease-targeted instruments, and the results might not generalize beyond the instruments used in this study. Another limitation is that the sample mostly consisted of well-educated, Caucasian women with relapsing–remitting MS. Although the sample characteristics were generally consistent with the demographics of MS [23], future researchers might consider using a more diverse sample of people with MS and other chronic disease conditions. This would allow for a broader generalization of the findings among less representative groups of individuals with MS such as men and persons who are not Caucasian as well as other chronic disease conditions. One final potential limitation is that we used measures of habitual physical activity (i.e., average daily activity counts and total leisure activity) when examining the relationships with generic and disease-targeted measures of HRQL and QOL. The relationships might differ based on the specific characteristics of physical activity, for example, the intensity of movement. This is an important direction for future research. Nevertheless, our results indicated that physical activity was similarly related with QOL and HRQL using generic and disease-targeted instruments in persons with MS.

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Fig. 1. Graphic display of correlation coefficients and 95% confidence intervals for associations between objective (*top*) and self-report (*bottom*) physical activity with generic and disease-targeted measures of health-related quality of life and global quality of life. *SF-12* Short Form-12 Health Survey, *MSIS-29* Multiple Sclerosis Impact Scale-29, *LMSQOL* Leeds Multiple Sclerosis Quality of Life Scale, *SLWS* Satisfaction With Life Scale

Fig. 2.

Path models that were tested for understanding the associations among physical activity, health-related quality of life, and global quality of life using objective and self-reported measures of physical activity and generic and disease-specific instruments in a sample of 292 individuals with multiple sclerosis. Note: All coefficients are standardized estimates.

GLTEQ Godin Leisure-Time Exercise Questionnaire, *SF-12* Short Form-12 Health Survey, *MSIS-29* Multiple Sclerosis Impact Scale-29, *LMSQOL* Leeds Multiple Sclerosis Quality of Life Scale, *SLWS* Satisfaction With Life Scale

Table 1

Correlations and descriptive statistics for the eight measures for the sample of 292 individuals with multiple sclerosis

Variable	1	2	3	4	5	6	7	8
1. Accelerometer	–							
2. GLTEQ	0.40	–						
3. SF-12 Physical	0.38	0.28	–					
4. SF-12 Mental	0.09	0.12	0.07	–				
5. MSIS-29 Physical	–0.33	–0.26	–0.67	–0.38	–			
6. MSIS-29 Mental	–0.14	–0.17	–0.33	–0.58	0.68	–		
7. SWLS	0.15	0.21	0.36	0.43	–0.50	–0.57	–	
8. LMSQOL	–0.14	–0.22	–0.42	–0.63	0.58	0.70	–0.69	–
Mean score	220.154 ^a	26.5 ^a	41.8 ^a	41.5 ^a	43.8 ^b	20.5 ^b	21.8 ^a	19.3 ^b
Standard deviation	121.059	22.4	9.1	9.1	16.7	8.0	8.0	4.8

All correlations are statistically significant ($p < 0.05$)

GLTEQ Godin Leisure-Time Exercise Questionnaire, SF-12 Short Form-12 Health Survey, MSIS-29 Multiple Sclerosis Impact Scale, SWLS Satisfaction With Life Scale, LMSQOL Leeds Multiple Sclerosis Quality of Life Scale

^aHigher scores are better

^bLower scores are better