Facilitators and Barriers and Self-management in Adults With Multiple Sclerosis

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Research article

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Abstract

Background: An estimated 2.3 million individuals affected worldwide are affected by multiple sclerosis. Due to advancements in treatment and earlier diagnosis, there are higher numbers of people living with MS than ever before. There is evidence linking optimal self-management to better outcomes among patients with chronic illnesses; however, regarding adults with MS specifically, the results are inconclusive. The purpose of this study was to determine whether self-management mediates the relationship between facilitators and barriers (comorbidity, condition severity, pain, fatigue, and cognitive deficits) and quality of life.

Methods: To complete this cross-sectional correlational quantitative study, the researcher recruited a sample of 196 U.S. adults diagnosed with MS and administered a survey consisting of the Comorbidity Questionnaire for MS, the Patient-Determined Disease Steps, the Numeric Pain Intensity Scale, the Fatigue Severity Scale, the Multiple Sclerosis Neuropsychological Screening Questionnaire, the Multiple Sclerosis Self-Management Scale-Revised, the Multiple Sclerosis International Quality of Life, and a demographic questionnaire. The results were analyzed using multiple linear regression analysis.

Results: The studied facilitators and barrier had statistically significant relationship(s) with the

dependent variable of QoL; however, the relationship between fatigue, pain, and QoL was not

supported. A relationship exists between comorbidity, condition severity, and symptomatology and self-management. Finally, there is a significant relationship between self-management and QoL; however, self-management did not mediate the relationship between the comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and QoL.

Conclusions: By providing an understanding of the factors that hinder or facilitate MS self-management, the findings can inform the development of interventions and the improvement of health outcomes for adults with MS.

Background

There has been a steady rise in the prevalence of multiple sclerosis (MS) over the past 5 decades (Wallin, 2019). Due to the high variability and unpredictable course of MS, incidence and prevalence vary considerably around the world (Evans et al., 2013). Global estimates have indicated an increase from 30 individuals per 100,000 in 2008 to 33 per 100,000 in 2013, with counts exceeding 400,000 citizens in the United States, representing approximately one in 85 individuals (Multiple Sclerosis International Federation, 2013; National Multiple Sclerosis Society, 2016). As of 2013, an estimated 2.3 million individuals affected worldwide are affected by the disease (Evans et al., 2013).

With advancements in disease-modifying treatment, earlier diagnosis, and improved comprehensive care, MS is changing, resulting in a higher number of people living with MS, greater numbers of older

individuals living with MS, and longer survival rates (Solaro et al., 2015). Although MS may develop in infancy or well after the age of 60 years, diagnosis for 90% of people occurs between the second and fourth decades of life, which usually are the individuals' most productive years for working and childbearing (National Multiple Sclerosis Society, 2016).

The Costs and Burden of Multiple Sclerosis

MS is a chronic, inflammatory disease characterized by diffuse effects on the central nervous system (CNS) due to demyelination (Ferreira et al., 2013). MS may result in visual impairment, movement disorders, sensory and motor loss, tremor, ataxia, and balance and coordination issues. The effects of MS are substantial, placing a significant burden on patients, caregivers, employers, and the healthcare system (Campbell et al., 2014). When considering direct and indirect costs, MS expenditures in the United States are approximately $12 billion annually. The estimated total healthcare cost for MS is $8,528 to $54,244 per patient each year (Adelman, Rane, & Villa, 2013). As a result, MS ranks second highest in healthcare costs related to direct healthcare expenses for the management of chronic diseases (Adelman et al., 2013).

Self-Management of Multiple Sclerosis

Individuals with MS must manage the day-to-day effects of the disease on their lives. Self-management encompasses not only the ability to care for themselves, but also the management of symptoms and existing comorbidities as well as the psychosocial, cultural, and spiritual consequences of this health condition (Grey, Knafl, & McCorkle, 2006). People with MS can now live longer and need to manage their health status over lengthier lifespans than they did in the past (Solaro et al., 2015). Historically, symptomatic management was the focus of MS care. The current practice in MS, however, emphasizes a comprehensive care model and promotes a patient-centered approach, which includes a multidisciplinary team coordinating services and continuity of care for individuals with MS and their families. As such, self-management becomes a critical factor in the comprehensive care model. The practice of patient-centered care fosters the perfect environment for creating shared responsibility for the management of the self (Pulvirenti, McMillian, & Lawn, 2014). With effective self-management, adults with MS are able to deal with all aspects of their chronic illness, including its symptoms, the physical and social consequences of the disease, and the necessary lifestyle changes needed to maintain a satisfactory QoL (Coleman & Newton, 2005).

Much of the research conducted on MS involves interventions that often focus on education and not key components such as problem-solving, skill building, and other factors, including facilitators and barriers established in another chronic disease's self-management research (Fraser et al., 2013). At present, the relative efficacy of these different intervention components is debatable, given the lack of high-quality research about MS and self-management.

Factors Related to Self-Management

Several factors may influence self-management in MS. Despite evidence for improved clinical outcomes with the effective medical treatment (e.g., better medications) of chronic conditions such as diabetes and asthma, suboptimal self-management and health outcomes continue among many chronic illnesses, including MS (Abubakari, Cousins, Thomas, Sharma, & Naderali, 2016; Fraser et al., 2013; Mackey, Doody, Werner, & Fullen, 2016). As a result, there is a clear need to understand what factors may influence self-management.

Comorbidity, condition severity, and symptomatology (pain, fatigue, and cognition) may affect one's ability to self-manage chronic disease, increasing the complexity of care needed for individuals to successfully achieve self-management and improve health outcomes (Grey et al., 2015). Regarding other chronic conditions, researchers have found self-management connects to comorbidity, condition severity, and symptoms (Grey et al., 2015; Schulman-Green, Jaser, Park, & Whittemore, 2015). More experts are recognizing self-management as a key component in improving the overall health of populations with multiple chronic conditions and comorbidities (Liddy, 2014). The compelling evidence, therefore, favors self-management as an effective strategy for the management of MS.

Self-Management and Health Outcomes

Evidence shows a positive relationship between the self-management of MS and improvements in clinical outcomes, including improved QoL, reduced disability, and lower treatment costs. Additionally, experts recognize self-management as an effective strategy that facilitates the achievement of high-quality, long-term care, improved outcomes, and the appropriate utilization of services while ensuring increased patient confidence, reduced anxiety and unplanned admissions, and improved adherence to treatment and medication regimens (Reidy et al., 2016).

According to the self- and family management model, disease severity, symptoms (pain, fatigue, and cognition), and comorbidities influence self-management needs (Grey et al., 2006). Comorbidities in MS, the severity of the disease, and the associated symptomatology (pain, fatigue, and cognitive problems) are potential factors (facilitators and barriers) affecting the transition to the process of self-management (Grey et al., 2015).

Gap in the Literature

Throughout the literature, optimal self-management appears connected to better outcomes among patients with chronic illnesses, including reported QoL (Bosworth, Powers, & Oddone, 2010; Fraser et al., 2013; Gao & Yuan, 2011; Warwick et al., 2010). Self-management increases perceived control over one's illness and other aspects of life, resulting in a positive effect on individuals' health overall and ultimately their perceived QoL (Rae-Grant et al., 2011). Despite the compelling emerging evidence, the evidence

regarding self-management in adults with MS is still inconclusive. It is not possible to conclude that the process of self-management directly affects health outcomes (e.g., QoL) when self-management undergoes influence presumably by other factors (e.g., condition severity, comorbidity, and symptomatology). Although the self-management of pain, fatigue, and cognition is necessary with other chronic diseases, and the emerging literature on MS shows the relationships between such factors, there are remaining knowledge gaps regarding self-management's mediating effects on distal health outcomes (Bosworth et al., 2010; Fraser et al., 2013; Gao & Yuan, 2011).

Current researchers in self-management have not clearly demonstrated the links among MS symptoms, condition severity and comorbidities, self-management abilities, and QoL. Despite emerging studies on self-management in MS, experts know little about how disease-specific factors predict self-management ability in adults with MS, and subsequently how self-management ability predicts QoL. Elucidating these issues is critical for improving overall QoL, and previous researchers indicated that critical factors affect self-management in individuals with other types of chronic conditions, subsequently affecting QoL. Thus, there is a need for further research on the associations among these factors in adults with MS.

Aims of the Study

The researcher's objective in conducting this cross-sectional correlational quantitative study was to determine whether self-management mediates the relationship between facilitators and barriers (comorbidity, condition severity, pain, fatigue, and cognitive deficits) and QoL in adults with MS. Specifically, the researcher designed the study to achieve know whether comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits), are negatively associated with quality of life in adults with MS are investigated. In addition, the researcher was interested in determining whether these factors are significantly associated with self-management ability in adults with MS. In addition, the researcher explored whether self-management ability can affect the quality of life in adults with MS and serve as a mediator on the effects of comorbidity, condition severity, and symptomatology on the quality of life in adults with MS.

With an improved understanding of self-management in MS, the researcher obtained much-needed knowledge to begin development of an appropriate office-based assessment tool specific to adults with MS. In addition, the findings of this investigation contributed to existing theoretical and practical understanding of self-management in MS nursing, utilizing self- and family-management theories.

Methods Design

The researcher selected a cross-sectional correlational design to examine the relationships among the variables of interest in a sample of adults with MS. In this type of design, the researcher takes measurements corresponding to the independent and dependent variables for each participant at a single point in time and performs analyses to reveal statistically significant associations.

Participants

The target population included U.S. adults with MS aged 18 to 50 years. Recruitment involved a nonprobability sampling method for a minimum of 98 participants through Qualtrics, an online platform for collecting survey data. The inclusion criteria for participants were as follows: (a) medical diagnosis of MS for a minimum of 6 months, (b) aged 18 to 50 years, (c) able to speak and write in English, and (d) access to and proficiency in the use of a computer. The exclusion criteria for the study included the following: (a) individuals with severe MS who were physically or cognitively unable to function independently, and (b) individuals with moderate to severe psychological impairments based on the initial cognitive screenings conducted by Qualtrics. This study was quantitative in nature; therefore, the researcher paid attention to minimizing threats to objectivity. This included making all efforts to follow a precise data collection plan. Once a minimum of 160 completed surveys met the criteria for completeness and underwent validation for eligibility, the researcher ended data collection.

Description of Materials

The surveys in the study included the following: (a) the Comorbidity Questionnaire for MS, (b) the PDSS (Appendix G), (c) the NPIS, (d) the FSS, (e) the MSNQ, (f) the MSSM-R, (g) the MusiQoL (Appendix L), and (h) the Demographic Questionnaire.

Demographics questionnaire. The researcher used a demographics questionnaire to collect sociodemographic data. The questionnaire required participants to indicate their age, gender, educational level, and marital status. The researcher also collected additional clinical variables, including duration of the illness and MS subtype.

Comorbidity Questionnaire for Multiple Sclerosis. Use of a portion of the Comorbidity Questionnaire for Multiple Sclerosis probed the presence of the following conditions: depression, anxiety, hypertension, hyperlipidemia, and chronic lung disease. The next step was combining the responses from this survey into a single numeric value for each participant to represent the variable comorbidity. As such, the researcher represented comorbidity as an ordinal variable with possible scores ranging from 0 (no other conditions besides MS) to 5 (participant has all five comorbid conditions).

Patient-Determined Disease Steps. This survey quantifies the severity of neurological impairment, with patients asked to rate the severity of their disease, mainly focusing on how well they walk. The PDDS is a self-report version of the physician-reported Disease Steps developed by Hohol, Oray, and Weiner (1995), modified by NARCOMS. A rating of 0 indicates mild symptoms of MS, ratings of 1 to 4 indicate moderate symptoms, where patients are still fully ambulatory, and a rating of 8 indicates that the patient is bedridden. The PDDS has well-established validity, with scores strongly correlated with EDSS scores (p = .783). PDDS and EDSS scores both strongly correlated with Pyramidal (p = .578 and p = .647, respectively) and Cerebellar (p = .501 and p = .528, respectively) Functional System (FS) scores, as well as 6-minute walk (MW) distance (p = .704 and p = .805, respectively), MSWS-12 scores (p = .801 and p =

.729, respectively), and accelerometer steps/day (p = -.740 and p = -.717, respectively; Learmonth, Motl, Sandroff, Pula, & Cadavid, 2013). For the present study, an individual's PDDS score represented the ordinal variable condition severity. Overall, a strong correlation between EDSS and PDDS scores (p = .783, 95% CI = .691, .850, p = .0001) existed (Learmonth et al., 2013).

Numeric Pain Intensity Scale. The NPIS asks participants to rate the average pain intensity experienced from their point of view in the last 24 hours (Michalski et al., 2011). Respondents indicated their pain level using a numerical scale from 0 (*no pain*) to 10 (*severe pain*). The NPIS has good sensitivity, producing data for statistical analysis and having undergone testing in various populations, including chronic pain patients, acute pain patients, older adults, and individuals with rheumatoid arthritis (Williamson & Hoggart, 2005). Experts have observed high test–retest reliability in both literate and illiterate patients with RA (r = 0.96 and 0.95, respectively) before and after medical consultation (Ferraz et al., 1990). Construct validity highly correlates with the Visual Analog Scale (a measurement instrument for individual characteristics of pain) in patients with rheumatic and other chronic pain conditions (pain > 6 months) before and after medical consultation, confirming it as an effective strategy for measuring pain (Ferraz et al., 1990). Responses to the NPIS represented the ordinal variable pain, an aspect of symptomatology.

Fatigue Severity Scale. The FSS is a 9-item, self-report summary scale designed to assess disabling fatigue in all individuals, with common use in patients with MS and systemic lupus erythematosus (Krupp, LaRocca, Muir-Nash, & Steinberg, 1989). The scale consists of nine questions, using a 7-point Likert-type scale ranging from *st* (7) to *s* (1) for each question. Items include "Exercise brings on my fatigue" and "I am easily fatigued." The FSS, studied and evaluated for psychometrics in adults with MS, is a valid tool for assessing and quantifying fatigue (Learmonth et al., 2013). The FSS demonstrates good internal consistency

(Cronbach's α = 0.95) in adults with obesity (Ottonello, Pellicciari, Giordano, & Foti, 2016). Internal consistency of the FSS in MS is moderate (Cronbach's α = 0.751; Learmonth et al., 2013). Construct validity is excellent (r = 0.754) with a correlation of FSS with the Modified Fatigue Impact Scale (Learmonth et al., 2013). For the present study, the total score variable served as a continuous score and was computed from an average of the nine survey questions. This score represented the variable fatigue, a subcomponent of symptomatology.

Multiple Sclerosis Neuropsychological Screening Questionnaire. The MSNQ is a 15item self-report inventory that measures cognitive function (Benedict & Cox, 2004). Patients rate themselves from 0 (*ne*) to 4 (*v*) regarding 15 specific cognitive and behavioral problems that may arise in daily life, such as "Are you easily distracted?" The higher the score, the greater amount and severity of cognitive problems. Cronbach's alpha coefficients were 0.93 and 0.94 upon analyses for the reliability of the MSNQ and correlations between both patient- and informant-report forms, respectively (Benedict et al., 2003). The MSNQ is a reliable self-administered screening test yielding a sensitivity of 0.83 and a specificity of 0.97 (Benedict et al., 2003). The researcher calculates a total score for each participant by taking the average

of responses for all 15 questions; this total score corresponded to the continuous variable cognitive deficits (a subcomponent of symptomatology).

Multiple Sclerosis Self-Management Scale-Revised. The MSSM-R addresses the multidimensional nature of self-management for individuals with MS, including the self-management processes conceptualized in the self- and family management framework. Such processes comprise factors focusing on illness, the activation of resources, and living with the condition. This instrument asks participants to rate 24 statements about their ability to self-manage, like “I have a good understanding of why I take my medications and what they are supposed to do” and “I try to take a break when I feel myself getting tired” on a scale from 1 (*I*) to 5 (*I*). Psychometrics are well-established. The test-retest reliability, using the intraclass correlation coefficient (ICC) with 95% confidence interval (CI), revealed a coefficient of 0.83 between two scores over time; the overall ICC ranged from 0.64 to 0.88, suggesting satisfactory test-retest reliability (Ghahari, Khoshbin, & Forwell, 2014). Criterion validity through comparison of the MSSM-R to two generic self-management scales (Health Education Impact Questionnaire and Partners in Health) indicated moderate to high criterion validity within the subscales of the MSSM-R, $p = .01$ (Ghahari et al., 2014). For the present study, each participant had a calculated total score that the researcher derived by taking an average of responses to each question. This total score represented the continuous variable self-management.

Multiple Sclerosis International Quality of Life. The MusiQoL is a multidimensional scale, self-administered, 31-item questionnaire available in 14 languages, serving as a disease-specific QoL scale appropriate for international application. The MusiQoL features 31 questions in nine dimensions (subscales): activities of daily living, psychological well-being, symptoms, relationships with friends, relationships with family, relationships with healthcare system, sentimental and sexual life, coping, and rejection. The global index score is the mean of the nine subscales, linearly transformed and standardized on a scale 0-100 scale; where 0 indicates the worst possible level of QoL and 100 indicates the best level.

Processes and Interventions

The researcher entered the collected data into SPSS version 22.0 for Windows. Administered through Qualtrics, the survey required participants to provide a response to every item. The researcher also screened the data for outliers in order to ensure that extreme values were not skewing the data distribution. The researcher identified outliers as values outside of the range $z = \pm 3.29$ standard deviations away from the mean (Tabachnick & Fidell, 2012) and removed these values from further analysis.

Statistical Analyses

To determine whether comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) are inversely predictive of quality of life in adults with multiple sclerosis, the researcher conducted a multiple linear regression analysis. To determine whether comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) are significantly associated with self-management in adults with multiple sclerosis, the researcher conducted another multiple linear regression analysis.

To assess whether self-management predictive of quality of life in adults with multiple sclerosis, the researcher conducted a linear regression with self-management as the independent predictor variable and QoL as the dependent outcome variable. The researcher performed a final regression analysis to determine whether self-management acts as a mediator between the independent variables comorbidity, condition severity, pain, fatigue, and cognitive deficits and the dependent variable QoL. In this analysis, the researcher regressed QoL on self-management and the independent variables of comorbidity, condition severity, pain, fatigue, and cognitive deficits.

Results

Descriptive Statistics

Frequencies and percentages. A majority of the participants were female (*n* = 165,

84.2%). The age of participants heavily varied between 36 to 40 years (*n* = 40, 20.4%) and 41 to 45 years (*n* = 48, 24.5%). The ethnicity of the participants was predominantly White (*n* = 159, 81.1%). Most of the participants were married (*n* = 101, 51.5%). The highest level of education varied between primary/vocational education (*n* = 49, 25.0%), secondary education (*n* = 53, 27.0%), and higher education (*n* = 94, 48.0%). Many of the participants were employed (*n* = 85, 43.4%). Roughly one quarter of the sample could not work or had physical challenges (*n* = 53, 27.0%). Table 1 shows the frequencies and percentages of the demographics.

Table 1

Frequency Table for Demographic Variables

Variable	*n*	%
Gender		
Male	31	15.8
Female	165	84.2
Age		
18-25	11	5.6
26-30	21	10.7
31-35	37	18.9
36-40	40	20.4
41-45	48	24.5
46-50	39	19.9
Ethnicity		
Caucasian/White	159	81.1
African American/Black	18	9.2
Asian	4	2.0
Hispanic/Latino	5	2.6
Native American or Alaskan Native	4	2.0
More than one ethnicity	4	2.0
Other	2	1.0
Marital status		
Single	58	29.6
Married	101	51.5
Separated/divorced/widowed	37	18.9
Highest degree or level of school completed		
Primary/vocational	49	25.0
Secondary	53	27.0
Higher	94	48.0
Current employment status		
Employed	85	43.4

Self-employed	5	2.6
Unemployed but looking for work	17	8.7
Unemployed but not currently looking for work	20	10.2
Student	6	3.1
Retired	10	5.1
Unable to work or physically challenged	53	27.0

Note. Due to rounding errors, percentages may not equal 100%.

A majority of the sample had a relapsing-remitting form of MS (*n* = 155, 79.1%). Anxiety, depression, and hypertension were the most prevalent comorbidities. Many participants had one comorbidity (*n* = 53, 27.0%), two comorbidities (*n* = 54, 27.6%), or three comorbidities (*n* = 22, 11.2%). Several participants lacked any comorbidities (*n* = 60, 30.6%). In regard to condition severity, most of the participants had normal symptom severity (*n* = 43, 21.9%), mild disability (*n* = 48, 24.5%), moderate disability (*n* = 43, 21.4%), or gait disability (*n* = 38, 19.4%). The pain intensity for the participants was approximately even in distribution from 0 (no pain) to 8 (severe pain). Table 2 presents the frequencies and percentages for the nominal level variables.

Table 2

Frequency Table for Nominal Variables

Variable	*n*	%
Type of MS		
Relapsing-remitting	155	79.1
Primary progressive	9	4.6
Secondary progressive	5	2.6
Progressive-relapsing	7	3.6
Don’t know	20	10.2
Anxiety disorder diagnosis		
Yes	81	41.3
No	115	58.7
Lung trouble diagnosis		
Yes	4	2.0
No	192	98.0
High cholesterol diagnosis		
Yes	23	11.7
No	173	88.3
Diabetes mellitus diagnosis		
Yes	6	3.1
No	190	96.9
Depression diagnosis		
Yes	103	52.6
No	93	47.4
Hypertension		
Yes	41	20.9
No	155	79.1
Comorbidity frequency		
0	60	30.6
1	53	27.0
2	54	27.6

3	22	11.2
4	4	2.0
5	3	1.5
Condition severity		
Normal: I may have some mild symptoms, mostly sensory due to MS but they do not limit my activity. If I do have an attack, I return to normal when the attack has passed.	43	21.9
Mild disability: I have some noticeable symptoms from my MS but they are minor and have only a small effect on my lifestyle.	48	24.5
Moderate disability: I don't have any limitations in my walking ability. However, I do have significant problems due to MS that limit daily activities in other ways.	42	21.4
Gait disability: MS does interfere with my activities, especially my walking. I can work a full day, but athletic or physically demanding activities are more difficult than they used to be. I usually don't need a cane or other assistance to walk.	38	19.4
Early cane: I use a cane or a single crutch or some other form of support (such as touching a wall or leaning on someone's arm) for walking all the time or part of the time, especially when walking outside. I think I can walk 25 feet in 20 seconds without a cane or crutch. I always need some assistance (cane or crutch) if I want to walk as far as three blocks.	7	3.6
Late cane: To be able to walk 25 feet, I have to have a cane, crutch, or someone to hold onto. I can get around the house or other buildings by holding onto furniture or touching the walls for support. I may use a scooter or wheelchair if I want to go greater distances.	9	4.6
Bilateral support: To be able to walk as far as 25 feet, I must have two canes or crutches or a walker. I may use a scooter or wheelchair for longer distances.	5	2.6
Wheelchair/scooter: My main method of mobility is a wheelchair. I may be able to stand and/or take one or two steps, but I can't walk 25 feet, even with crutches or a walker.	4	2.0
Bedridden: Unable to sit in a wheelchair for more than one hour	0	0.0
Pain intensity		
0 (no pain)	15	7.7
1 (mild)	20	10.2
2 (mild)	18	9.2
3 (mild)	20	10.2
4 (moderate)	11	5.6
5 (moderate)	18	9.2
6 (moderate)	42	21.4
7 (severe)	21	10.7

8 (severe)	24	12.2
9 (severe)	4	2.0
10 (severe)	3	1.5

Summary statistics. Comorbidity frequency ranged from 0.00 to 5.00, with *M* = 1.32 and *SD* = 1.17. Condition severity ranged from 0.00 to 7.00, with *M* = 1.92 and *SD* = 1.67. Pain intensity ranged from 0.00 to 10.00, with *M* = 4.63 and *SD* = 2.68. Fatigue scores ranged from 1.00 to 7.00, with *M* = 5.39 and *SD* = 1.41. Cognitive deficits scores ranged from 0.07 to 3.80, with *M* = 1.94 and *SD* = 0.87. Self-management scores ranged from 2.79 to 5.00, with *M* = 3.89 and *SD* = 0.43. QoL scores ranged from 21.76 to 95.49, with *M* = 56.37 and *SD* = 16.07.

Reliability. The researcher examined Cronbach's alpha values for the series of items making up the FSS, the MSNQ, the MSSM-R, and the QoL scale. The results for all four scales met the acceptable threshold for internal consistency (α > .70). The other three instruments consisted of one survey item; therefore, the researcher could not conduct a reliability analysis. Table 3 presents the findings of the descriptive statistics for the variables of interest.

Table 3

Summary Statistics for Interval Variables

Variable	Min.	Max.	M	SD	Skew	Kurtosis	# of items	A
Comorbidity	0.00	5.00	1.32	1.17	0.69	0.15	1	–
Condition severity	0.00	7.00	1.92	1.67	0.99	0.77	1	–
Symptomatology Pain	0.00	10.00	4.63	2.68	-0.20	-1.08	1	
Fatigue	1.00	7.00	5.39	1.41	-1.12	0.68	9	.93
Cognitive deficits	0.07	3.80	1.94	0.87	-0.19	-0.82	15	.95
Self-management	2.79	5.00	3.89	0.43	-0.22	-0.34	24	.77
QoL	21.76	95.49	56.37	16.07	0.27	-0.65	31	.92

Normality. The researcher examined the skewness and kurtosis values to test the normality assumption. The researcher used the following criteria to assess normality: skew between -2.0 and 2.0 and kurtosis between -7.0 and 7.0 (Kline, 2010). The values for skew and kurtosis fell within the acceptable range. Further assessment of the normality assumption occurred through use of the Kolmogorov-Smirnov test and the Shapiro-Wilk test. The researcher concluded that the findings of the tests were not statistically significant for self-management and QoL; therefore, these variables met the assumption. The findings of the Kolmogorov-Smirnov test and Shapiro-Wilk test, however, were not significant for the remaining variables ($p < .05$). Comorbidity, condition severity, pain intensity, fatigue, and cognitive deficits did not meet the assumption. Stevens (2009) suggested that samples with sums of 50 or more observations often approximate to normality. With a total sample of 196 participants, the current researcher assumed that the distributions approximated toward normality. Table 4 presents the findings of the Kolmogorov-Smirnov and Shapiro-Wilk tests.

Table 4

Kolmogorov-Smirnov and Shapiro-Wilk Tests

	Kolmogorov-Smirnov test		Shapiro-Wilk test	
Variable	Statistic	*p*	Statistic	*p*
Comorbidity	0.18	<.001	0.88	<.001
Condition severity	0.17	<.001	0.89	<.001
Symptomatology Pain	0.18	<.001	0.94	<.001
Fatigue	0.14	<.001	0.89	<.001
Cognitive deficits	0.07	<.001	0.98	<.001
Self-management	0.06	.200	0.99	.227
Quality of life	0.06	.200	0.99	.258

Bivariate Analysis

The researcher performed bivariate analyses to identify which predictor variables have a statistically significant relationship with the dependent variable (see Table 5). The findings revealed that comorbidity, condition severity, symptomatology (pain, fatigue, and cognitive deficits), and self-management had

significant relationships with QoL. Comorbidity, condition severity, and symptomatology were inversely associated with QoL, while self-management was positively associated with QoL.

Table 5

Pearson Correlations for Bivariate Relationships

Source	1	2	3	4	5	6	7
1. Comorbidity	1.00						
2. Condition severity	.13	1.00					
3. Pain intensity	.33**	.41**	1.00				
4. Fatigue	.33**	.29**	.51**	1.00			
5. Cognitive defects	.39**	.20**	.42**	.54**/	1.00		
6. Self-management	-.30**	-.09	-.08	-.08	-.33*	1.00	
7. Quality of life	-.45**	-.32**	-.40**	-.42**	-.56**	.48**	1.00

*Notes. **Denotes relationship is significant at α = .05.

**Denotes relationship is significant at α = .01.

Facilitators/Barriers and Quality of Life

The researcher used a multiple linear regression to examine the predictive relationship between comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) on QoL. The predictor variables corresponded to comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits). The continuous criterion variable corresponded to QoL.

Prior to analysis, the researcher assessed the assumptions of normality, homoscedasticity, and absence of multicollinearity. The results met the assumption of normality for the residuals due to the data closely following the normality trend line (see Figure 2). The assumption of homoscedasticity underwent visual assessment through a residuals plot. The results met the assumption due to a nonrecurring pattern appearing in the plot (see Figure 3). The results met the assumption of multicollinearity due to the variance inflation factors (VIF) being below 10 (see Table 6).

The results of the overall model of the multiple linear regression were statistically significant (F[5, 190] = 27.63, p < .001, R^2 = .421). This suggests that a significant relationship exists between comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and QoL. The R^2 value suggests that approximately 42.1% of the variance in QoL can be explained by the predictors.

Comorbidity (t = -4.00, p < .001) was a significant predictor in the model, suggesting that with every one-unit increase in comorbidity scores, QoL scores decreased by approximately 3.38 units. Condition severity (t = -2.79, p = .006) was a significant predictor in the model, suggesting that with every one-unit increase in condition severity scores, QoL scores decreased by approximately 1.63 units. Cognitive deficits (t = -5.29, p < .001) was a significant predictor in the model, suggesting that with every one-unit increase in cognitive deficits scores, QoL scores decreased by approximately 6.68 units.

Table 6

Multiple Linear Regression With Comorbidity, Condition Severity, and Symptomatology (Pain, Fatigue, and Cognitive Deficits) Predicting Quality of Life

Source	*B*	*SE*	β	*t*	*p*	VIF
Comorbidity	-3.38	0.85	-.25	-4.00	<.001	1.24
Condition severity	-1.63	0.58	-.17	-2.79	.006	1.21
Pain intensity	-0.40	0.42	-.07	-0.96	.340	1.59
Fatigue	-0.72	0.81	-.06	-0.89	.373	1.66
Cognitive deficits	-6.68	1.26	-.36	-5.29	<.001	1.55

Note. F(5, 190) = 27.63, p < .001, R^2 = .421.

Facilitators/Barriers and Self-Management

The researcher conducted a multiple linear regression to examine the predictive relationship of comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) on self-management. A criterion in this regression model was the mediating variable.

Prior to analysis, the researcher assessed assumptions of normality for the residuals, homoscedasticity, and absence of multicollinearity. The assessment met assumption of normality for the residuals due to the data closely following the normality trend line (see Figure 4). This visual assessment of assumption

of homoscedasticity featured a residuals plot. The assessment met the assumption due to a nonrecurring pattern appearing in the plot (see Figure 5). The assessment met assumption of multicollinearity due to the VIF being below 10 (see Table 7).

The results of the overall model of the multiple linear regression were statistically significant, (F[5, 190] = 7.99, $p < .001$, $R^2 = .174$). This suggests that a significant relationship exists between comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and self-management. The R^2 value suggests that approximately 17.4% of the variance in self-management can be explained by the predictors.

Comorbidity (t = -3.23, $p < .001$) was a significant predictor in the model, suggesting that with every one-unit increase in comorbidity scores, self-management scores decreased by approximately 0.09 units. Cognitive deficits (t = -4.28, $p < .001$) was a significant predictor in the model, suggesting that with every one-unit increase in cognitive deficits scores, self-management scores decreased by approximately 0.17 units. Table 7 depicts the results of the multiple linear regression.

Table 7

Multiple Linear Regression with Comorbidity, Condition Severity, and Symptomatology (Pain, Fatigue, and Cognitive Deficits) Predicting Self-Management

Source	*B*	*SE*	β	*t*	*p*	VIF
Comorbidity	-0.09	0.03	-.24	-3.23	.001	1.24
Condition severity	-0.02	0.02	-.07	-0.98	.328	1.21
Pain intensity	0.02	0.01	.09	1.11	.267	1.59
Fatigue	0.05	0.03	.16	1.88	.062	1.66
Cognitive deficits	-0.17	0.04	-.35	-4.28	<.001	1.55

Note. $F(5, 190) = 7.99$, $p < .001$, $R^2 = .174$.

Self-Management and Quality of Life

The researcher conducted a linear regression to examine the predictive relationship of self-management on QoL. Prior to analysis, the researcher assessed the assumptions of normality for the residuals and

homoscedasticity. The assessment met the assumption of normality for the residuals due to the data closely following the normality trend line (see Figure 6). The assessment met the assumption of homoscedasticity with a visual assessment through a residuals plot. The assessment met assumption due to a nonrecurring pattern appearing in the plot (see Figure 7).

The results of the overall model of the linear regression indicated a lack of statistical significance (F[1, 194] = 58.56, $p < .001$, $R^2 = .232$), suggesting that a significant relationship between self-management and QoL exists. The R^2 value suggests that approximately 23.2% of the variance in QoL can be explained by self-management. Self-management ($t = 7.65$, $p < .001$) was a significant predictor in the model, suggesting that with every one-unit increase in self-management, QoL scores increased by approximately 18.10 units. Table 8 presents the results of the linear regression.

Table 8

Linear Regression with Self-Management Predicting Quality of Life

Source	*B*	*SE*	β	*T*	*p*
Self-management	18.10	2.37	.48	7.65	<.001

Note. $F(1, 194) = 58.56$, $p < .001$, $R^2 = .232$.

Mediating Effects of Self-Management

The researcher conducted a Baron and Kenny mediation analysis to assess whether self-management significantly mediates the effects of comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) on QoL in adults with MS. The researcher conducted three regressions to assess for mediation. For mediation to be supported, the results were required to meet four conditions:

1. A relationship must exist between the independent variables (comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and the dependent variable (QoL).
2. A relationship must exist between the independent variables (comorbidity, condition severity, and symptomatology [pain, fatigue, and cognitive deficits]) and the mediator variable (self-management).
3. A relationship must exist between the mediator variable (self-management) and the dependent variable (QoL) while in the presence of the independent variables (comorbidity, condition severity, and symptomatology [pain, fatigue, and cognitive deficits]).

4. The independent variables (comorbidity, condition severity, and symptomatology [pain, fatigue, and cognitive deficits]) should not be significant predictors of the dependent variable (QoL) in the presence of the mediator variable (self-management).

First, the study included a regression conducted with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting QoL (dependent variable). The results of the regression were significant ($F(5, 190) = 27.63$, $p < .001$). Comorbidity, condition severity, and cognitive deficits were significant predictors in the regression model. The results partially met the first item of the Baron and Kenny method.

Second, the regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting self-management (dependent variable) occurred. The results of the regression were significant ($F(1, 190) = 7.99$, $p < .001$). Comorbidity and cognitive deficits were significant predictors in the regression model. The results partially met the second item of the Baron and Kenny method.

Finally, the multiple linear regression conducted with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and self-management (mediator) predicting QoL (dependent variable) occurred. The results of the regression were significant ($F(6, 189) = 31.98$, $p < .001$). Comorbidity, condition severity, cognitive deficits, and self-management were significant predictors in the regression model. With self-management being significant in the regression model, the results met the third item of the Baron and Kenny method. The predictor variables that were significant in the first regression model were also significant in the third regression. In addition, no drastic reduction or increase in the beta values occurred.

The results did not meet the fourth item of the Baron and Kenny method. Therefore, the results support partial mediation for self-management on the relationship between comorbidity, condition severity, and cognitive deficits on QoL. The results did not support mediation for self-management on the relationship between pain intensity and fatigue on QoL. Table 9 shows the results of the regressions.

Table 9

Regression Results with Self-Management Mediating the Relationship Between Comorbidity,

Condition Severity, and Symptomatology (Pain, Fatigue, and Cognitive Deficits) and QoL

Dependent	Independent	B	SE	β	t	p	VIF
Regression 1: QoL	Comorbidity	-3.38	0.85	-.25	-4.00	<.001	1.24
	Condition severity	-1.63	0.58	-.17	-2.79	.006	1.21
	Pain intensity	-0.40	0.42	-.07	-0.96	.340	1.59
	Fatigue	-0.72	0.81	-.06	-0.89	.373	1.66
	Cognitive deficits	-6.68	1.26	-.36	-5.29	<.001	1.55
Regression 2: Self-management	Comorbidity	-0.09	.03	-.24	-3.23	.001	1.24
	Condition severity	-0.02	.02	-.07	-0.98	.328	1.21
	Pain intensity	0.02	.01	.09	1.11	.267	1.59
	Fatigue	0.05	.03	.16	1.88	.062	1.66
	Cognitive deficits	-0.17	.04	-.35	-4.28	<.001	1.55
Regression 3: QoL	Comorbidity	-2.35	0.81	-.17	-2.92	.004	1.31
	Condition severity	-1.41	0.54	-.15	-2.60	.010	1.22
	Pain intensity	-0.58	0.39	-.10	-1.48	.141	1.60
	Fatigue	-1.30	0.76	-.11	-1.71	.089	1.69
	Cognitive deficits	-4.64	1.23	-.25	-3.78	<.001	1.70
	Self-management	11.90	2.12	.32	5.62	<.001	1.21

Notes. First regression: $F(5, 190) = 27.63$, $p < .001$, $R^2 = .421$.

Second regression: $F(5, 190) = 7.99$, $p < .001$, $R^2 = .174$.

Third regression: $F(6,189) = 31.98$, $p < .001$, $R^2 = .504$.

Discussion

The studied facilitators and barrier had statistically significant relationship(s) with the dependent variable (QoL); however, the relationship between fatigue, pain, and QoL was not supported. The findings supported the theoretical proposition that health status facilitators and barriers such as comorbidities, condition severity, and symptomatology (cognitive deficits) affect distal individual outcomes such as QoL (Grey et al., 2015). The results showed that a greater number of comorbidities, a worse condition severity, and a greater number of cognitive deficits correlated with a lower quality of life. The inverse relationship between the predictors and QoL supported the notion of the predictors functioning as barriers.

Moreover, the findings revealed that a relationship exists between comorbidity, condition severity, and symptomatology and self-management. The findings supported the theoretical proposition that health status facilitators and barriers, such as comorbidities and symptomatology (cognitive deficits), affect self-management (Grey et al., 2015). The results indicated that the greater the number of comorbidities and the greater the cognitive deficits, the lower the individual's ability to self-manage MS. The inverse relationship between the predictors and self-management supports the notion of the predictors' function as barriers.

Findings provide evidence of a significant relationship between self-management and QoL. These findings are consistent with those of Kidd et al. (2017), following a structured (PRISMA guidelines) literature review conducted for the years 2000 to 2016. The results indicated that self-management did not mediate the relationship between the comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and QoL in adults with MS.

To date, no researchers have investigated the mediation effect of self-management on the relationship between comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) and QoL for adults with MS. Researchers studying individuals with other chronic diseases such as type 2 diabetes, however, have demonstrated the mediating effects of self-management on health outcomes, both proximal and distal (i.e., self-management behaviors, cost of health services, health status, and QoL). Such scholars have contributed to filling gaps in the knowledge of what role self-management plays in the interrelations between facilitators and barriers to self-management and health outcomes, specifically QoL (Cramm et al., 2013; Whittemore et al., 2014).

The conclusions that the researcher has drawn from this study must be considered in terms of limitations related to the adequacy of the indicators of the constructs and the population under study. Although the researcher took efforts to address potential limitations with the use of an online survey related to sampling frames, response rates, participation deception, and access to the desired sample, data

collection occurred by way of self-report, which could have led to potential bias in the results. Although the researcher sought a nationally representative sample, the participants were homogeneous, with the majority being White and nearly half employed with higher education. The timing of patient-reported outcomes, although helpful in gaining insight, also has limitations.

There remains no consensus on how to define severe MS, but it is well established from observational studies that a small minority of patients with MS follow a rapidly disabling disease course (Charleson, Herbert, & Kister, 2016). The assignment of condition severity in the setting of relapses may potentially have affected study participants' responses. No gathered data were specific to whether participants felt they were currently having relapse symptoms. There is instability during relapse (Charleson et al., 2016). In view of the instability during and following relapse, the researcher recommends that in the future, severity grade determination ideally should not be made within 6 months of reported relapse and within the first year of diagnosis. Unfortunately, the researcher did not obtain or analyze data on the timing of the last relapse.

The design of this study did not allow for test–retest reliability or comparison of the FSS, NPIS, and PDDS to other comparable scales or between MS patients and health controls. This cross-sectional study lacked any basis for causality since all variables were assessed simultaneously. There are three requirements for causality: correlation, temporal precedence, and removal of confounding variables. This cross-sectional study indicated correlation, but not temporal precedence. Control of key plausible confounding variables may be considered; however, in order to better understand key influential variables that affect the process of SM and QoL, a longitudinal design may provide benefits, especially given its ability to assess change over time.

Conclusions

Although the current researcher failed to identify any mediating effects of self-management between predictor variables (facilitators and barriers) and distal outcomes (QoL), the findings provided valuable insight. Self-management was positively associated with QoL and, as the researcher hypothesized, predictor variables (comorbidity, condition severity, and symptomatology) influence the process of self-management in adults with MS. There remains a need for ongoing biopsychosocial research incorporating physiological, psychological, and psychosocial factors in understanding the mediating effects of self-management between facilitators and barriers and QoL. While a cure remains out of reach, individuals with MS should be capable of managing the day-to-day effects of the disease on their lives. Understanding the factors that facilitate or hinder MS self-management among adults with MS is essential to improving interventions and health outcomes.

The expansion and understanding of self-management research in MS are critical to the development of —and ultimately, the translation of—evidence-based interventions to consumers in a sustainable manner. Through this study, the researcher provided additional evidence in support of the growing body of

literature regarding self-management in adults with MS, including several opportunities to improve health, advance the delivery of healthcare services, and influence policy.

Declarations

Ethics Approval and Consent to Participate: Permission was obtained to conduct the study from The Catholic University Committee for the Protection of Human Subjects. The respondents were required to indicate their informed consent to participate before they were able to complete the survey. The risk to the participants was minimal.

Consent for Publication: The participants were aware that their data would be published in aggregate and without identifiers; any further permissions were not required.

Availability of Data and Materials: The datasets generated and analyzed in the current study are available from the corresponding author upon reasonable request.

Competing Interests: The author declares that she has no competing interests.

Funding: The author did not obtain external funding to complete this research.

Authors' Contributions: The singular author was responsible for collecting, analyzing, and interpreting patient data. The author also wrote this manuscript.

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Figures

Figure 1

Conceptualization of the self- and family management framework (Grey et al., 2015).

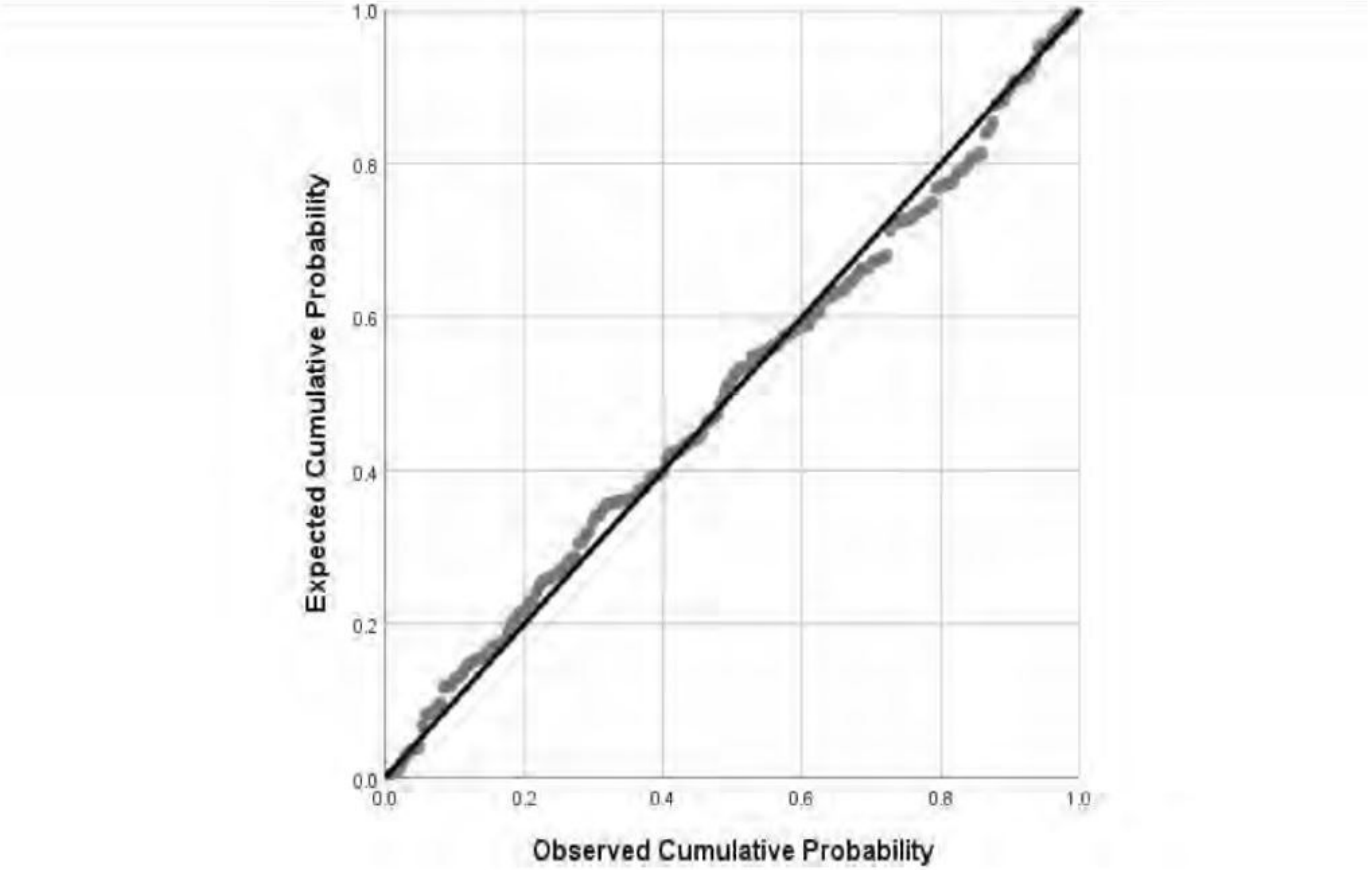

Figure 2

Normal P-P plot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting QoL.

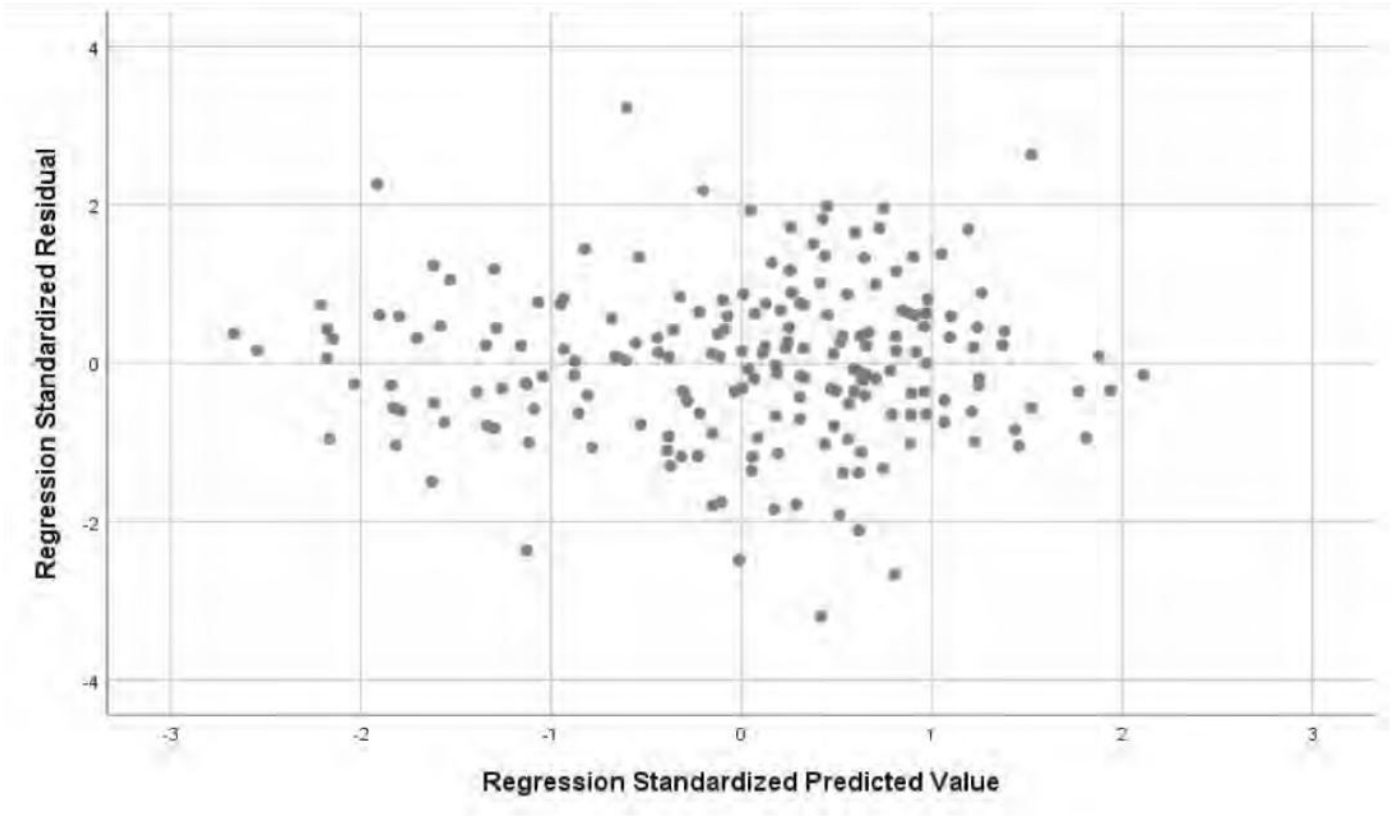

Figure 3

Residuals scatterplot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting quality of life.

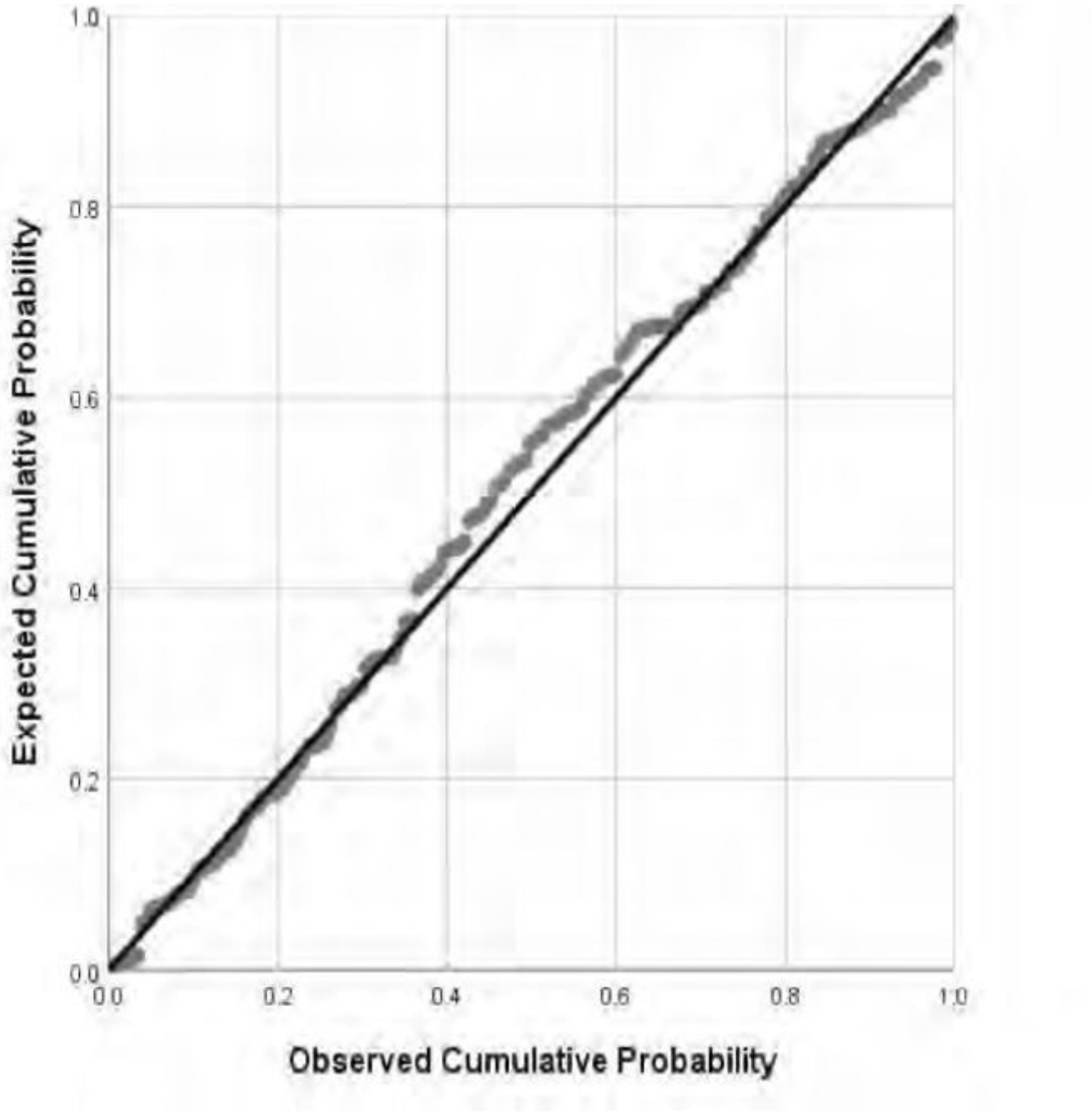

Figure 4

Normal P-P plot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting self-management.

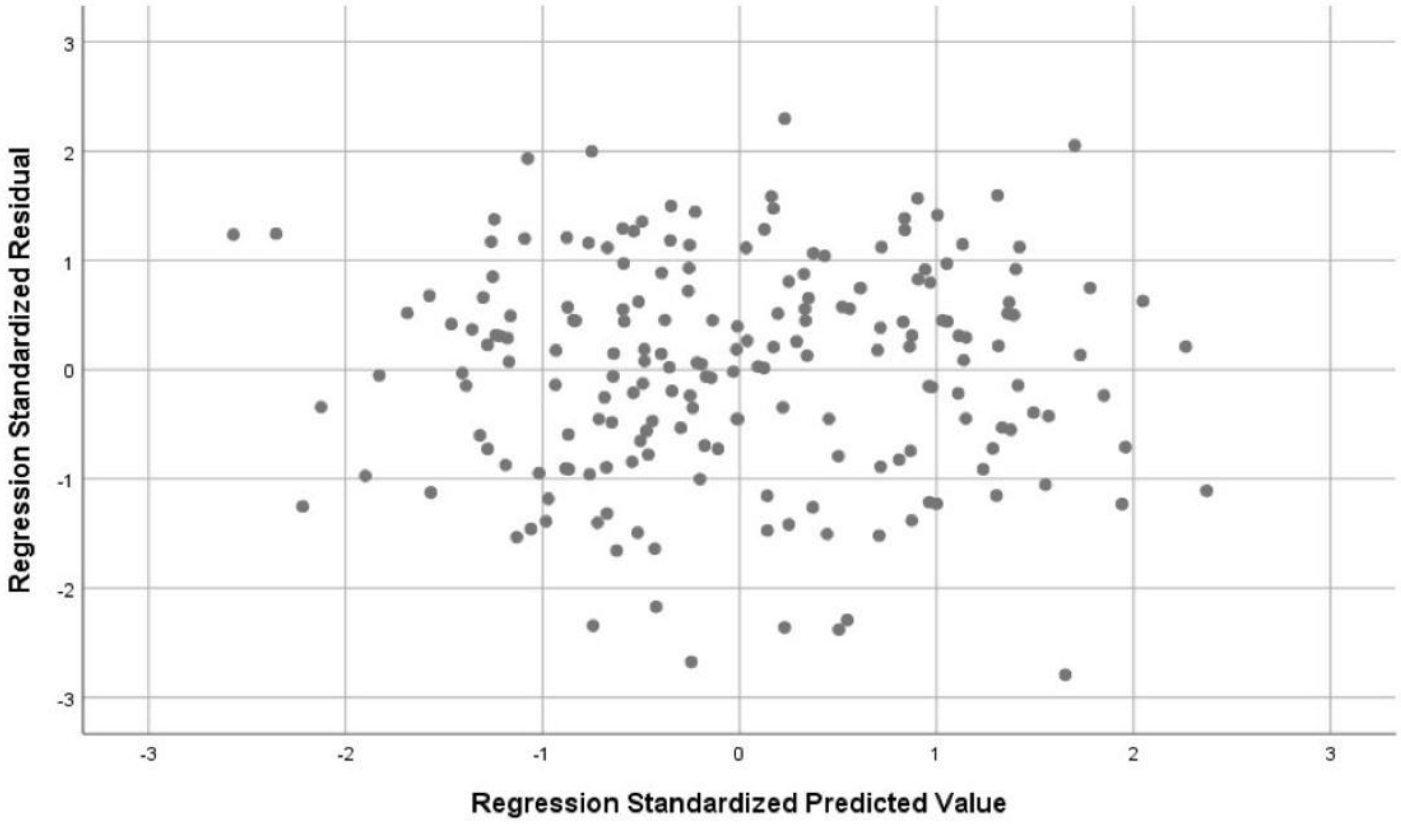

Figure 5

Residuals scatterplot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting self-management.

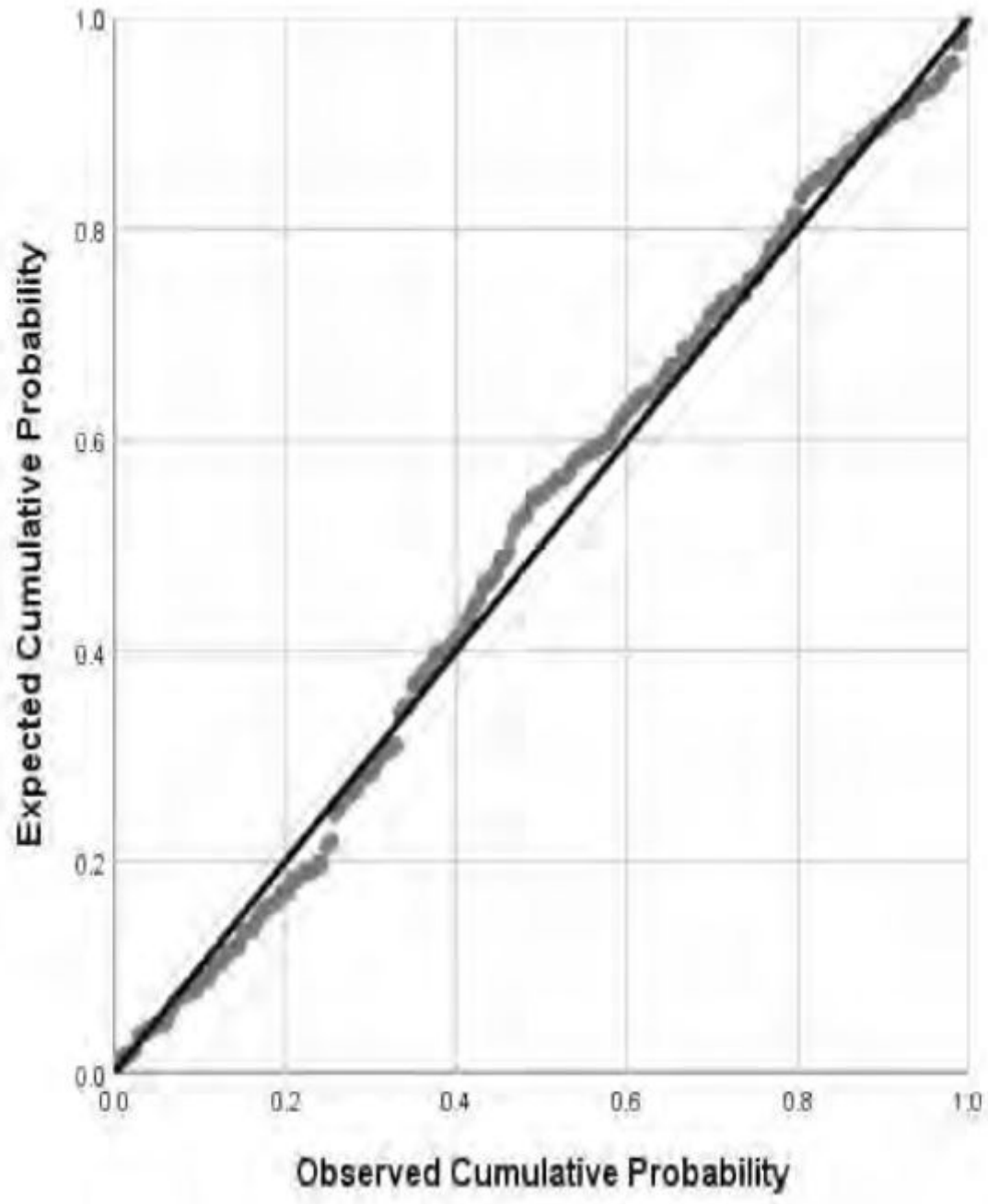

Figure 6

Normal P-P plot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting self-management.

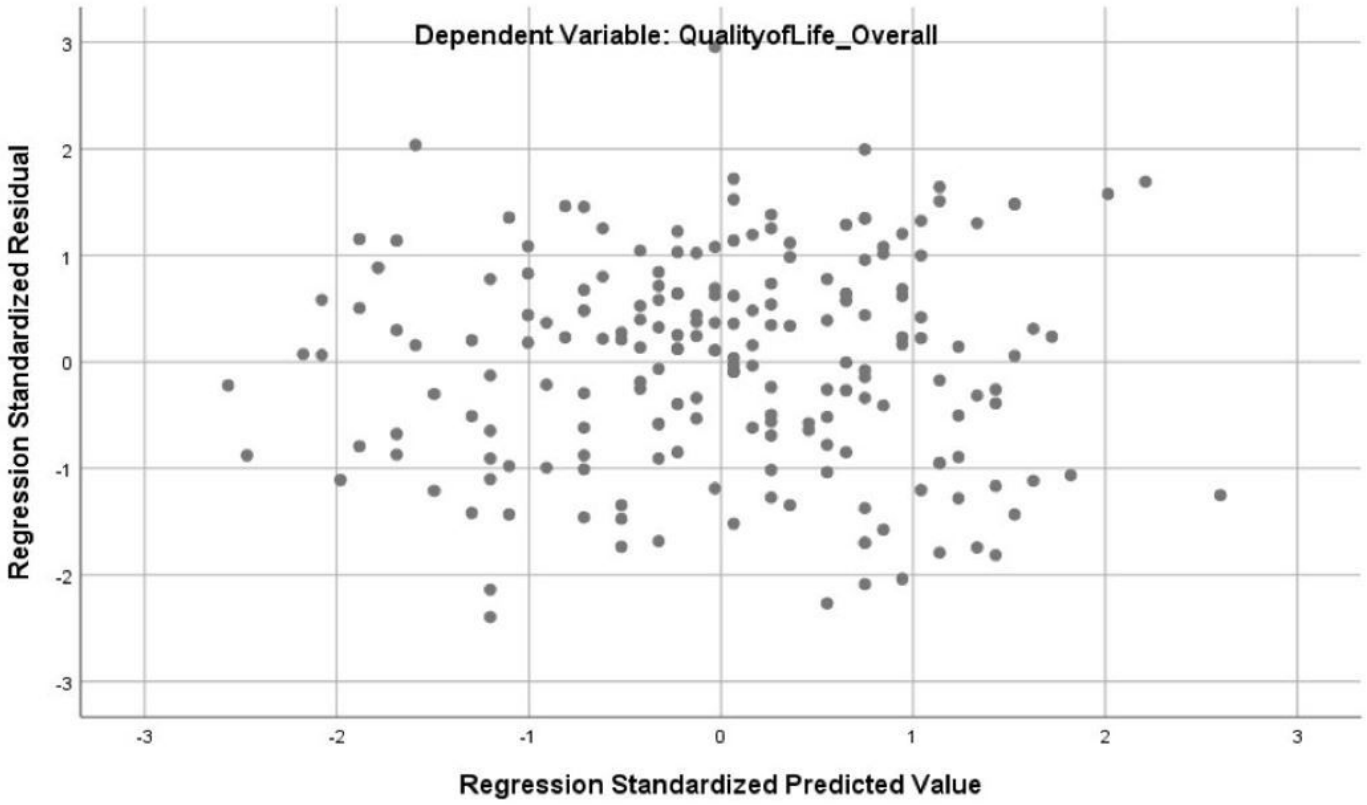

Figure 7

Residuals scatterplot for regression with comorbidity, condition severity, and symptomatology (pain, fatigue, and cognitive deficits) predicting self-management.