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A Cross-Sectional Examination of the Associations Between Symptoms, Community Integration, and Mental Health in Multiple Sclerosis

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Abstract

Objective—To determine the frequency and severity of eight symptoms in persons with multiple sclerosis (MS) and to examine the association between these symptoms and community integration and mental health.

Design—A cross-sectional survey that assessed eight symptoms (pain, fatigue, imbalance, numbness, weakness, shortness of breath, vision loss, and memory loss), disease progression (the self-report version of the Expanded Disability Status Scale; EDSS), community integration, and mental health.

Setting—Community.

Participants—180 adults with self-reported MS who responded to a mailed survey.

Interventions—Not applicable.

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Main Outcome Measures—The presence and intensity of symptoms were measured with a symptoms checklist. Community integration was assessed with the Community Integration Questionnaire and mental health was measured by the Mental Health Index of the Short Form Health Survey-36.

Results—The average number of symptoms reported was 5.07 (SD = 2.18). The most common symptoms - fatigue, weakness, and imbalance - were also rated as most severe. Not all symptoms were associated with level of disease progression or with MS subtype. Symptoms related to mobility were more likely to be associated with these variables. The eight symptoms as a whole accounted for significant amounts of variance (ranging from 13% to 21%) in measures of community integration and mental health, with specific symptoms made differential independent contributions to these measures.

Conclusions—This study demonstrates that most individuals with MS report a number of bothersome symptoms. Type of MS or level of progression does not tell the whole story regarding the impact of symptoms.

INTRODUCTION

Multiple sclerosis (MS) is a chronic neurologic disease associated with a constellation of symptoms, including impaired ambulation, cognitive dysfunction, depressed mood, weakness, pain, and fatigue. The impact of some of these symptoms on mental health, physical functioning, participation, and quality of life in general has been well documented. For example, fatigue is recognized as a highly disabling symptom of MS, limiting physical exertion and the ability to participate in work, leisure activities, and social roles.[1–6] Similarly, it has been shown that many persons with MS experience chronic pain,[7–9] and that for roughly 25%, pain is severe and negatively impacts daily activities and functioning over and above the effects of MS itself.[8–10] The burden of cognitive dysfunction,[11–13] depression[12, 14, 15] and impaired mobility[16–18] on functional ability (e.g., activities of daily living) and quality of life has also been described extensively in the literature.[19–22]

To date, most studies of MS symptoms have focused on the impact of a single symptom or small collection of symptoms (e.g., pain, fatigue and depression). Consequently, the severity and impact of any given symptom relative to others is not well understood. Only a few studies have examined the relative prevalence and severity of a broad range of MS symptoms.[22] One study of an MS sample with severe disability found that the most common symptoms were problems using arms and legs, fatigue, spasms, pain, and sleepiness, and that only some of these symptoms were significantly correlated with measures of disability; however the association of symptoms with community integration or mental health was not assessed in this study.[23] An early study in a community sample of 656 individuals with MS found that fatigue, balance problems, weakness or paralysis, and numbness or other sensory disturbance were the most common symptoms and that fatigue, balance problems, and weakness were related to "difficulty" in activities of daily living, but the type of difficulty

was not reported and, again, the association of symptoms to community integration and mental health were not examined.[24]

Knowledge about the frequency and severity of a broader range of symptoms and their impact on community integration and mental health is needed to inform symptom management, including self-management. Such information may guide decisions about the specific symptoms targeted, skills taught, and/or goals set within a self-management intervention. It may also inform the degree to [25] which self-management interventions should focus on teaching skills to manage a specific symptom, as is most commonly done,[25] or multiple co-occurring symptoms.[26] Given that rehabilitation interventions often target symptom management, community integration, and mental health, knowing how different symptoms relate to these outcomes may help patients and rehabilitation providers prioritize symptoms and care.[1,3,7,9,10]

This study aims to address gaps in our knowledge regarding the relative frequency and intensity of a broad range of symptoms in MS and to examine the association of symptoms to community integration, and mental health. Community integration can be defined as integration into multiple domains of community life, including social, self-care/independence, and productive activity/occupational participation.[27, 28] Mental health can be assessed as the absence of mental distress (e.g., depressive symptoms) or psychopathology (e.g., depression, anxiety). The specific aims were: (1) to determine the relative frequency and severity of eight symptoms in persons with MS; (2) to determine the extent to which MS subtype and disease progression relate to the frequency and severity of symptoms; and (3) to estimate the associations between symptom severity and both community integration and mental health, above and beyond the effects of relevant demographic and clinical variables.

MATERIALS AND METHODS

Participants and Procedures

Participants came from a postal survey of quality of life in persons with MS; see primary paper for more details on study methodology.[10] Questionnaires and a consent forms were mailed to 287 individuals randomly selected from a larger pool of research participants that were drawn from the membership list of the Multiple Sclerosis Association of [county masked]. Inclusion criteria were self-report of MS diagnosis and age 18 years. Participants were told the purpose of the study was to examine quality of life in MS. Respondents were compensated $25 for returning completed consent forms and surveys. The [masked] Human Subjects Review Committee approved all procedures; study participants provided informed consent.

Measures

Demographics—Participants reported age, gender, race/ethnicity, employment status, education level, and marital status.

MS-related measures—To identify MS subtype, relapsing/remitting (RR), secondary progressive (SP), primary progressive (PP), or progressive relapsing (PR), respondents were asked to select the pictorial graph accompanied by a written description of the clinical

course, that most closely corresponded to their disease course.[29] This measure has been shown to correspond well with physician diagnosis of MS disease subtype (K = 0.62) and provides a reasonable estimate of MS subtype for research.[30]

Respondents completed the self-report version[31] of the Expanded Disability Status Scale (EDSS),[32] the standard measure of disease progression and neurological impairment used in MS care and research. The self-report version of the EDSS is highly correlated ($r = 0.89$) with the physician-administered EDSS.[31] In our analyses, EDSS scores were categorized as mild (0 – 4.0), moderate (4.5 – 6.0), or severe (6.5 – 9.5) to reflect milestones in progressive loss of functioning. The survey also assessed the date of MS diagnosis to estimate disease duration.

Symptoms—Respondents were asked to rate the presence and severity of eight symptoms: pain, weakness, fatigue, numbness, imbalance, memory loss, vision loss, and shortness of breath. For each symptom, participants were asked to rate its current severity on an 11-point scale with 0 = "None" and 10 = "Very severe." This symptom list was originally designed to be utilized with a broad range disability populations for the purpose of making comparisons across conditions [33] with the expectation that some symptoms would be fairly common across conditions (e.g., fatigue), and others would be more common in specific groups (e.g., shortness of breath).

Mental health and community integration—The five-item Mental Health Index of the Short Form Health Survey-36 (SF-36)[34] was used to assess mental health. This widely used measure has demonstrated high internal consistency reliability, (0.81–0.95), test-retest stability coefficients (0.75–0.80), and convergent validity.[34] The Mental Health scale total score has a possible range of 0 to 100, with higher scores indicating better mental health.

The Community Integration Questionnaire (CIQ)[28, 35] is a 13-item measure of the ability to perform normal role functions in three domains of functioning: Home Competency (HC; participating in shopping, meal preparation, housework, child care [if applicable], personal finance management, and social planning), Social Integration (SI; participating in activities outside of the home, travel outside the home, leisure activities with others, and existence/availability of a "best friend"), and Productive Activity (PA; employment/school status). The CIQ scales have shown good reliability in the population for which it was developed, traumatic brain injury[35] and concurrent validity with other measures of functioning.[36] At the time of data collection, there were no measures of community integration specific to persons with MS, so the CIQ was selected. Higher scores on each subscale indicate greater community integration and possible ranges are 0–12 for the HC and SI subscales and 0–5 for the PA subscale.

Data Analyses

We first examined the relative prevalence and average severity of each of the eight symptoms. Average severity was calculated for the sample as a whole and for the subgroups of people who endorsed each symptom (i.e., rated the symptom severity as ≥ 1). Prior to conducting further analyses, data distribution characteristics were examined; the data were sufficiently normally distributed for use of parametric statistical procedures (skew range =

−0.06 – 1.92; kurtosis range = −0.16 – 3.03).[37, 38] Shortness of breath, demonstrated marginal but acceptable normality (skew = 1.92; kurtosis = 3.03) due to a larger proportion of "0" responses. To examine the association between symptom ratings and MS subtype, we performed t-tests to compare ratings of each symptom between those with relapsing-remitting MS versus those with a progressive subtype, including primary and secondary progressive and progressive relapsing. One-way analyses of variance (ANOVAs) were used to examine differences in symptom scores across levels of EDSS classification (mild, moderate, severe) with Scheffe post-hoc contrasts. Finally, we conducted four multivariate regression analyses to determine which of the symptoms (entered as a block, step 2) contributed independently to community integration and mental health. Sex (0 = female, 1 = male), age, and MS subtype were included as covariates in these analyses and entered in a block before the symptoms (step 1). The MS subgroup variable was dummy-coded (i.e., three dummy variables with relapsing-remitting as the reference group) for use as an independent variable in linear regression.[37]

RESULTS

Response Rate

Of the 287 surveys sent, 12 were returned due to incorrect addresses, 4 addressees were deceased, and 8 were ineligible because they did not have MS. Of the remaining 263 possible participants, 180 returned completed surveys, for a response rate of 68.4%.[10] There was no missing data for CIQ, SF-36, or symptom reports with the exception of 1 participant who was missing data on the imbalance question. Five participants were missing data for the EDSS and 4 were missing data for MS Subtype. Sample sizes/degrees of freedom for each analysis are noted in results tables.

Description of the Sample

The sample was predominantly female (78%) and Caucasian (97%), with a mean age of 50.47 (SD = 11.07, range = 24–87). The sample was relatively well-educated, with 56% reporting college graduation or beyond. The majority (69%) were either married or living with a significant other. Mean time since MS diagnosis was 13.03 years (SD = 9.95, range = 1.13 – 46.10 years) and 56% reported a relapsing-remitting course, 21% secondary progressive, 14% primary progressive, and 9% progressive relapsing. Regarding MS severity classification, 35% reported mild MS severity (EDSS < 4.5), 18% reported moderate severity (EDSS 4.5 – 6.0) and 47% reported severe disease severity (EDSS 6.5 – 9.5). The average Mental Health Scale score was 69.00 (SD =1 9.70; range = 20 – 100). The average CIQ subscales scores were 5.59 (SD =2 .52) for HC, 7.14 (SD = 2.17) for SI, and 1.79 (SD = 1.66) for PA.

Frequency and Severity of Symptoms

The sample reported a high rate of symptoms (Table 1). The average respondent endorsed 5.07 symptoms (SD = 2.18), with only 6% (n = 10) reporting no symptoms. On average, 1.65 symptoms were reported as severe (i.e., > 6/10), and only 36% (n = 68) reported no severe symptoms. The most common and severe symptoms were fatigue, imbalance, and

weakness. Numbness, pain, memory loss, and vision loss were less common but still highly prevalent. Shortness of breath was the least common and least severe. [39]

Associations between Disease Variables and Symptom Severity

T-tests examining the associations between relapsing-remitting and progressive subtypes of MS and the severity ratings of symptoms indicated that the progressive subtypes reported significantly greater fatigue, imbalance, and weakness compared to relapsing-remitting (Table 2). ANOVAs examining differences across mild, moderate, and severe EDSS classification on the symptom severity ratings indicated that, in general, greater disease severity was associated with significantly higher symptom ratings for the five most commonly reported symptoms (Table 3). Only weakness demonstrated significant increases in a stepwise fashion across mild, moderate, and severe EDSS classifications. There were no differences for memory loss, vision loss, and shortness of breath across EDSS classification.

Associations between Symptom Severity, Community Integration, and Mental Health

After controlling for age, sex, and MS subtype, as a group, the eight symptoms accounted for a significant (all $p < 0.01$) amount of the variance in HC (14%), SI (13%), PA (16%), and in SF-36 Mental Health score (21%; Table 4). Those with PRMS reported significantly lower levels of all subtypes of community integration compared to those with RRMS and all progressive types of MS reported lower PA compared to RRMS. Sex was not related to any of the criterion variables, and age was only related to PA (negatively) and Mental Health (positively). Of the symptoms considered, only fatigue, weakness, and numbness made significant independent contributions to the HC scores. Weakness and memory loss demonstrated significant independent negative association with SI scores. Memory loss and vision loss were independently associated with PA scores. Fatigue and pain, and memory loss were each significant associated with lower mental health. For all but one of the significant associations in the multivariate analyses, greater symptom severity was associated with poorer functioning. Surprisingly, higher levels of numbness severity were associated with greater HC. However, the univariate association between numbness and HC was weak and non-significant ($r = 0.03$), suggesting the likelihood that the significant multivariate relationship was due to suppression effects, where other variables in the model "suppressed" the true (lack of) association between numbness and HC integration.[39]

DISCUSSION

This study examined the prevalence and relative severity of common MS symptoms, as well as their associations with community integration and mental health, in order to better understand which symptoms are perceived as most problematic for individuals with MS. Because nearly two-thirds of this sample's self-reported EDSS disability scores were in the moderate or severe range, the sample may reflect a more disabled segment of the MS population compared to previous national epidemiologic studies.[40, 41] This is a subgroup that is often missed in MS research and in need of further examination.[23] Our results suggest that most individuals with MS, regardless of disease subtype or progression level, report a number of bothersome symptoms that may differentially impact various areas of functioning.

On average, participants reported just over 5 symptoms and the symptoms found to be most prevalent and most frequently rated as severe were fatigue, imbalance, weakness, and numbness. This is consistent with findings from a large Canadian study where an average of just over 5 symptoms were reported, the most common being fatigue, weakness, and imbalance.[4] Although different symptom labels were used, these results are consistent with an earlier study of individuals severely affected by MS that found fatigue and limb mobility-related symptoms to be most prevalent and severe.[23] These results were also consistent with an earlier study, conducted before disease modifying therapies were introduced, which also found fatigue, balance problems, weakness, and numbness or other sensory disturbance to be the four most common symptoms.[24]

Increasing levels of disease progression, as defined by EDSS, were associated with significant worsening of some symptoms, including fatigue, imbalance, weakness, numbness, and pain. However, only weakness increased significantly with each category of EDSS disability, consistent with the fact that the EDSS is weighted heavily towards mobility; imbalance, which is also relevant to mobility, increased significantly in the moderate and severe EDSS categories compared to the mild EDSS category. The other symptoms demonstrated significant differences between the mild and moderate or severe groups, rather than increasing in a stepwise manner. The less frequently reported symptoms of memory loss and vision loss did not demonstrate significant differences across EDSS groups. Results suggest that certain symptoms may not match the level of disability suggested by an increasing EDSS score, and may impact functioning even when mobility impairment is moderate and are consistent with previous research demonstrating that the EDSS does not reflect the entire spectrum of MS disability,[20] and correlates with some symptoms but not others.[23] Thus, the EDSS provides important information about MS disability, especially regarding mobility status, but does not fully capture the impact of symptoms on functioning.

The only significant differences in symptom severity between relapsing and progressive MS subtypes were for fatigue, imbalance, and weakness, although the progressive subtypes evidenced higher scores on all symptoms. Negative findings could reflect a lack of power to detect differences. However, these results are also consistent with the clinical picture of MS, in which progressive subtypes manifest a steady increase in functional impairment, represented in the current study by higher levels of weakness and imbalance, while relapsing subtypes report less functional impairment but similar levels of other symptoms, such as fatigue and pain. These results again highlight the importance of assessing a constellation of symptoms rather than focusing on mobility and functional impairment when broadly examining health-related quality of life.

The set of symptoms accounted for a statistically significant, although modest, amount of variance in all outcomes. In addition, a number of symptoms made significant independent contributions to different outcome measures. No single symptom demonstrated significant independent associations with all functional outcomes. Fatigue and weakness both made significant independent contributions to the HC scale, which reflects an array of activities, from housework to shopping to personal finances, suggesting that this symptom may be especially problematic for activities of daily living. This is consistent with earlier findings

that fatigue and mobility were strongly related to lower levels of self-efficacy for participation in home-based activities similar to those assessed in the CIQ HC subscale.[17] Notably, numbness was also significantly positively related to HC; however, it does not seem accurate to call this an independent contribution given that numbness shows no significant relation to HC in bivariate analyses. It is only when other symptoms are included in the model that numbness shows a positive association with HC. Post hoc examination of different combinations of predictors was unsuccessful in identifying a single or subset of suppressor variables that produced this effect; these findings suggest a complex relation between numbness and HC that relies on the influence of other symptoms. Interestingly, weakness and memory loss were the only variables significantly associated with SI, suggesting that mobility and cognitive dysfunction may be some of the biggest barriers to remaining social in the community.[13] The SI scale is weighted toward socializing outside the home, and thus may miss the socializing that occurs at home, including technology-based socializing, which is assessed in the CIQ-Revised.[42] The only variables associated with PA were memory loss and vision loss, suggesting that these two symptoms represent independent factors necessary for a person's ability to work. These findings are consistent with studies showing an association between cognitive functioning and CIQ scores[13], and domestic, leisure, and outdoor participation in persons with MS;[12] however, these previous studies suggest a stronger and more consistent association between objective measures of cognitive functioning and integration and participation outcomes compared to self-reported memory in this study.

Surprisingly, sex showed no association between measures of community integration and mental health in this sample, despite previous findings that women score higher on HC and mental health measures compared to men in studies of individuals with MS or other physical impairment.[43–46] Sex does show a trend toward an association with HC, but there are a number of strong independent contributors in the model that mitigates the association between sex and HC, which can be found in a bivariate t-test ($t (178) = 2.57$, $p = 0.01$). The finding that older adults demonstrate lower PA and higher levels of mental health are consistent with previous research.[47–49]

Fatigue and pain were significantly associated with mental health in the regression analyses. Because our study is correlational, we cannot determine the direction of causality. Other studies have supported the association between depression and fatigue,[50–52] but at least one study has examined a model in which depression was found to be a predictor of fatigue.[53] The inter-relationships among these variables are complex and will be better understood with longitudinal research and experimental studies that include the concurrent measurement of objective functioning and subjective complaints in order to identify mediating variables and causal relationships.

It was surprising that pain was not significantly related to any of the community integration scales, given that significant subgroups of individuals with MS in previous studies have reported that pain interferes with their ability to work,[10, 54, 55] engage in daily activities,[7, 56] and fulfill social roles.[54, 55] It is possible that the community integration measure captures different aspects of functioning, or that individuals with MS and pain tend to continue their usual activities despite their perception that pain interferes with their lives. Another

explanation is that when examined in isolation, pain is related to functioning, but not when examined along with other more functionally consequential variables. The finding that pain was associated with mental health is consistent with previous findings that individuals with MS and pain had poorer mental health compared to those without pain.[7, 54]

Study Limitations

In addition to the limitations associated with correlational studies and EDSS severity discussed above, this study is limited by reliance on perceived symptoms and functioning, which imparts the limitation of shared method variance. However, previous research has stressed the importance of including the patient's perspective in areas such as rehabilitation,[56, 57] clinical trials,[58, 59] and quality of life assessment,[20, 58] and recent research has found only weak associations between objective performance-based measures and self-report assessment tools.[60, 61] Because the symptom inventory used in this study was not designed to assess symptoms unique or specific to MS, not all MS-relevant symptoms (e.g. depressive symptoms, bowel and bladder problems, spasticity, tremor) were assessed. Symptom burden may have been higher in this sample had the measure been more comprehensive and future studies that seek to examine the symptom burden in MS should use a more comprehensive symptom inventory. Although this study examined independent contributions of symptoms, it is likely that symptoms interaction with each other and our understanding of the burden and impact of symptoms in MS might be advanced by examination of symptoms interactions and symptom clusters. Future research should also include observer measures of functioning (e.g., spouse or significant other reports, clinician ratings) as well as objective measures of functioning (e.g., physical performance tasks, accelerometry), when possible. In assessing community integration, we did not examine integration within the broader context of participants' lives, such as the social environment (e.g., social network, social roles), and other relevant personal (e.g., socioeconomic level) and community factors (e.g., urban/rural, built environment). This is a limitation given that these meta-factors can exert significant influence on community integration in neurological conditions.[62–65] This is supported by the fact that regression models accounted for only approximately 30% of the variance across community integration subscales, suggesting other, unmeasured consequential factors. Because the EDSS scores suggest that this sample is more disabled than national epidemiologic studies of MS, the generalizability of these findings to the broader MS population may be limited.

CONCLUSIONS

Many symptoms are common in persons with MS, and these symptoms appear to have different associations with different areas of functioning. For example, individuals who are most concerned with their employment status may need to focus on symptoms related to vision and memory, whereas individuals with mental health problems may need interventions targeting not just mental health but also pain, fatigue, and cognitive functioning. The idea of targeting specific symptoms to achieve different treatment goals, and not just targeting physical impairment, is consistent with research that has shown that patients may be less concerned than their clinicians about physical impairments (as measured by the SF-36[66] physical function and physical role limitation subscales), and may

also differ from their physicians in their assessments of the relative importance of quality of life domains.[6767] Clinicians may need to consider the relative impact of symptoms on different outcomes, and should take into consideration the priorities of each individual patient.

Abbreviations

ANOVA	analysis of variance
CI	confidence interval
CIQ	Community Integration Questionnaire
EDSS	Expanded Disability Status Scale
HC	Home Competency
HRQoL	health related quality of life
MS	multiple sclerosis
PA	Productive Activity
PP	primary progressive
PR	progressive relapsing
RR	relapsing/remitting
SF-36	Short Form Health Survey-36
SI	Social Integration
SP	secondary progressive

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Table 1

Frequency and severity of eight symptoms in a sample of individuals with multiple sclerosis.

Symptom[a]	Frequency of occurrence (% >0)	Frequency of severe symptom (% > 6)	All Participants		Participants with Severity 1	
			Mean (SD)	Median (Interquartile Range)	Mean (SD)	Median (Interquartile Range)
Fatigue	88%	34%	5.07 (2.89)	5 (3 – 7)	5.74 (2.37)	6 (4 – 7)
Imbalance	88%	35%	4.84 (3.09)	5 (2 – 7)	5.48 (2.70)	5 (3 – 8)
Weakness	86%	28%	4.51 (2.87)	5 (2 – 7)	5.24 (2.39)	5 (3 – 7)
Numbness	77%	19%	3.80 (2.97)	4 (1 – 6)	4.96 (2.39)	5 (3 – 7)
Pain	71%	13%	3.09 (2.78)	3 (0 – 5)	4.39 (2.30)	4 (3 – 6)
Memory Loss	67%	18%	3.07 (3.00)	3 (0 – 5)	4.57 (2.55)	4 (3 – 7)
Vision Loss	55%	13%	2.35 (2.91)	1 (0 – 4)	4.27 (2.68)	4 (2 – 6)
Short. of Breath	26%	4%	1.23 (2.23)	0 (0 – 2)	4.54 (2.10)	3 (2 – 5)

[a] All symptoms rated by respondents on a 0 – 10 scale, with 0 = "None" and 10 = "Very severe". Symptoms are listed in order of prevalence. All n=180, except for Imbalance n=179.

Table 2

Comparison of average symptom severity ratings between MS disease subtypes (relapsing-remitting versus progressive subtypes).

| | Disease Subtype | | | |
Symptom	Relapsing n = 99 Mean (SD)	Progressive n = 77 Mean (SD)	Mean Differences	95% CI
Fatigue	4.60 (2.91)	5.61(2.67)	−1.01[*]	(−1.86 to −.17)
Imbalance	3.62 (2.89)	6.38 (2.57)	−2.77[***]	(−3.60 to −1.94)
Weakness	3.58 (2.70)	5.61 (2.57)	−2.04[***]	(−2.83 to −1.24)
Numbness	3.49 (2.95)	4.19 (2.99)	−.70	(−1.59 to .19)
Pain	2.04 (3.00)	2.65 (2.85)	−.61	(−1.45 to .22)
Memory loss	1.80 (3.02)	2.47 (3.06)	−.67	(−1.69 to .05)
Vision loss	1.43 (2.96)	1.76 (3.28)	−.33	(−1.53 to .20)
Shortness of breath	.91 (2.59)	.98 (2.84)	−.07	(−.92 to .42)

[*]
$p < .05$,

[**]
$p < .01$,

[***]
$p < .001$

Table 3

Comparison of average symptom severity ratings across levels of EDSS severity (mild, moderate, and severe).

Symptom	EDSS Severity			Simple Comparisons		
	Mild $n = 61$ Mean (SD)	Moderate $n = 31$ Mean (SD)	Severe $n = 83$ Mean (SD)	Mild vs. Moderate Mean Diff. 95% CI	Mild vs. Severe Mean Diff. 95% CI	Moderate vs. Severe Mean Diff. 95% CI
Fatigue	3.62_a (2.70)	5.74_b (2.25)	5.69_b (2.85)	-2.12^* −3.59 to −.65	-2.06^* −3.19 to −.94	.06 −1.35 to 1.46
Imbalance	2.43_a (2.48)	5.23_b (2.45)	6.37_b (2.66)	-2.80^* −4.19 to −1.40	-3.94^* −5.01 to −2.87	−1.14 −2.47 to .19
Weakness	2.39_a (2.60)	4.39_b (2.33)	6.10_c (2.25)	-1.99^* −3.30 to −.69	-3.70^* −4.70 to −2.71	-1.71^* −2.95 to −.47
Numbness	2.48_a (2.54)	4.23_b (2.77)	4.39_b (2.98)	-1.75^* −3.27 to −.23	-1.91^* −3.07 to −.75	−.16 −1.61 to 1.29
Pain	1.47_a (2.84)	3.35_b (2.38)	2.73_b (2.91)	-1.88^* −3.27 to −.26	-1.26^* −1.04 to −.19	.62 −.33 to .74
Memory loss	1.68 (3.09)	2.59 (2.84)	2.33 (3.17)	−.91 −1.05 to .18	−.65 −.80 to .14	.26 −.48 to .69
Vision Loss	1.20 (2.88)	1.46 (2.94)	1.90 (3.26)	−.26 −.81 to .41	−.70 −.92 to .01	−.44 −.84 to .32
Shortness of breath	.80 (2.36)	.86 (2.49)	1.0 (2.92)	−.06 −.60 to .46	−.99 −.70 to .11	−.21 −.73 to .28

Note.

For each symptom, mean values with different subscripts are significantly different from each other at a significance level of $p < .05$.

$*$
$p < .05$

Table 4

Linear regression analyses examining the association between eight symptoms (entered as a block) and either CIQ subscale scores or SF-36 Mental Health Index score, controlling for age, sex, and MS subtype.

| Symptom | Community Integration | | | | | | Mental Health | |
| | Home Competency | | Social Integration | | Productive Activity | | SF-36 Mental Health | |
	Unstandardized beta (95% CI)	β	Unstandardized beta (95% CI)	β	Unstandardized beta (95% CI)	β	Unstandardized beta (95% CI)	β
Age	−0.14 (−0.05 – 0.02)	−0.06	0.001 (−0.03 – 0.03)	0.001	−0.04 (−0.06 – −0.01)	−0.23**	0.33 (0.08 – 0.59)	0.19*
Sex	−0.78 (−1.5 – 0.03)	−0.13†	−0.37 (−1.07 – 0.33)	−0.07	0.23 (−0.28 – 0.73)	0.06	0.73 (−5.52 – 6.97)	0.02
RR vs. SP	−0.58 (−1.50 – 0.34)	−0.09	−0.52 (−1.34 – 0.30)	−0.10	−0.62 (−1.21 – −0.03)	−0.15*	0.57 (−6.70 – 7.84)	0.01
RR vs. PP	−0.76 (−1.83 – 0.31)	−0.11	−0.85 (−1.80 – 0.11)	−0.14†	−0.70 (−1.39 – −0.02)	−0.15*	−3.45 (−11.9 – 5.05)	−0.06
RR vs. PR	−2.34 (−3.58 – −1.11)	−0.27**	−1.97 (−3.06 – −0.87)	−0.26**	−1.10 (−1.80 – −0.23)	−0.17*	−9.90 (−19.7 – −0.13)	−0.15*
Fatigue	−0.22 (−0.37 – −0.06)	−0.24**	0.07 (−0.06 – 0.21)	0.10	0.03 (−0.07 – 0.13)	0.05	−1.59 (−2.80 – −0.37)	−0.23*
Imbalance	−0.04 (−0.19 – 0.11)	−0.05	0.11 (−0.02 – 0.24)	0.16	−0.03 (−0.12 – 0.07)	−0.05	0.54 (−0.63 – 1.71)	0.09
Weakness	−0.17 (−0.32 – −0.01)	−0.19*	−0.22 (−0.36 – −0.08)	−0.29**	−0.07 (−0.17 – 0.03)	−0.12	−0.56 (−1.80 – −0.68)	−0.08
Numbness	0.24 (0.12 – 0.37)	0.29**	−0.03 (−0.14 – 0.08)	−0.04	0.06 (−0.03 – 0.14)	0.10	0.23 (−0.76 – 1.22)	0.04
Pain	0.03 (−0.11 – 0.17)	0.04	−0.09 (−0.22 – 0.03)	−0.12	−0.07 (−0.16 – 0.01)	−0.12†	−1.35 (−2.45 – −0.26)	−0.20*
Memory Loss	0.01 (−0.14 – 0.15)	0.01	−0.18 (−0.31 – −0.05)	−0.24**	0.10 (−0.19 – −0.01)	−0.17*	−1.14 (−2.28 – −0.01)	−0.17*
Vision loss	−0.10 (−0.23 – 0.02)	−0.12	−0.03 (−0.14 – 0.08)	−0.04	−0.09 (−0.17 – −0.13)	−0.16*	0.83 (−0.15 – 1.81)	0.13†
Shortness of Breath	0.05 (−0.12 – 0.22)	0.04	0.07 (−0.09 – 0.22)	0.07	−0.07 (−0.174 – 0.04)	−0.09	−0.67 (−2.01 – 0.66)	−0.08

† $p < .10$,

* $p < .05$,

** $p < .01$;

β = standardized beta. N = 175, df = 174 for all tests. RR = relapsing/remitting, SP = secondary progressive, PR = primary progressive, PR = progressive relapsing