An expansion of a model of depression in multiple sclerosis: emotion regulation and coping as moderators of the relationship between functional disability and adjustment to disease

Elizabeth W. Raffanello

University at Albany, State University of New York, eraffanello@gmail.com

The University at Albany community has made this article openly available. Please share how this access benefits you.

Follow this and additional works at: https://scholarsarchive.library.albany.edu/legacy-etd

Part of the Psychology Commons

Recommended Citation


This Dissertation is brought to you for free and open access by the The Graduate School at Scholars Archive. It has been accepted for inclusion in Legacy Theses & Dissertations (2009 - 2024) by an authorized administrator of Scholars Archive. Please see Terms of Use. For more information, please contact scholarsarchive@albany.edu.
An expansion of a model of depression in multiple sclerosis: Emotion regulation and coping as moderators of the relationship between functional disability and adjustment to disease

by

Elizabeth Raffanello

A Dissertation

Submitted to the University at Albany, State University of New York

In Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Arts and Sciences

Department of Psychology

August 2019
ABSTRACT

Multiple sclerosis (MS) is an immune-mediated disease affecting the central nervous system (CNS), producing a range of physical and emotional symptoms. Psychological disorders, particularly depression and anxiety, are common in MS, but only partially accounted for by MS symptoms. The associations between common MS sequelae (e.g., fatigue, pain, disability) and mental health indicators are weak and inconsistent, suggesting the presence of moderators. This research study examined two possible moderators of the association between MS sequelae and adjustment to disease: emotion regulation and coping. Emotion regulation refers to the processes used to modulate emotional experiences. It is closely related to coping, which refers to the strategies used to respond to stressful situations. Emotion dysregulation has been consistently linked to mood and anxiety disorders in the general population but has not been extensively studied in MS. One hundred and ninety-eight adults with MS (89.0% female, mean age = 43.42 years, SD = 12.05, 77.0% diagnosed with relapsing-remitting MS) completed an anonymous online survey that included the Performance Scales (PS), Difficulties in Emotion Regulation Scale (DERS), COPE Inventory, Center for Epidemiological Studies Depression Scale-Revised (CESD-R), and Penn State Worry Questionnaire (PSWQ). Emotion dysregulation was positively associated with transformed depression ($\beta = 0.54, p < 0.001$) and anxiety scores ($\beta = 0.56, p < 0.001$). Behavioral disengagement was positively associated with transformed depression score ($\beta = 0.32, p < 0.001$) whereas problem-focused coping was negatively associated with transformed depression score ($\beta = -0.24, p < 0.001$). Focusing on and venting of emotions ($\beta = 0.32, p < 0.001$) was positively associated with anxiety, whereas problem-focused coping was negatively associated with anxiety ($\beta = -0.20, p = 0.010$). Better emotion regulation and greater use of problem-focused coping
mitigated the effect of functional disability on depression at lower levels of disability. Findings have implications for research and interventions focused on psychological adjustment to MS. In earlier stages of disease progression, bolstering ways of regulating emotions and managing stress may be especially beneficial. Additional forms of support may be needed at later stages of disease, although future research is needed to identify what would be the most helpful to people with MS.

Keywords: multiple sclerosis, emotion regulation, depression, anxiety, adjustment to disease
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td>Psychiatric Comorbidity in Multiple Sclerosis</td>
<td>3</td>
</tr>
<tr>
<td>A Model of Depression in Multiple Sclerosis</td>
<td>5</td>
</tr>
<tr>
<td>Multiple sclerosis disease factors</td>
<td>7</td>
</tr>
<tr>
<td>Multiple sclerosis sequelae</td>
<td>8</td>
</tr>
<tr>
<td>Factors that may moderate the relationship between common multiple</td>
<td>11</td>
</tr>
<tr>
<td>sclerosis sequelae and depression</td>
<td></td>
</tr>
<tr>
<td>Stress and coping</td>
<td>12</td>
</tr>
<tr>
<td>Social support</td>
<td>15</td>
</tr>
<tr>
<td>Conceptions of self and illness</td>
<td>17</td>
</tr>
<tr>
<td>Emotion Regulation: Another Possible Moderator</td>
<td>20</td>
</tr>
<tr>
<td>Emotion regulation and psychopathology</td>
<td>21</td>
</tr>
<tr>
<td>Emotion versus coping</td>
<td>25</td>
</tr>
<tr>
<td>Emotion regulation and adjustment to multiple sclerosis</td>
<td>26</td>
</tr>
<tr>
<td>The Proposed Study</td>
<td>28</td>
</tr>
<tr>
<td>Methods</td>
<td>29</td>
</tr>
<tr>
<td>Sample</td>
<td>29</td>
</tr>
<tr>
<td>Procedure</td>
<td>30</td>
</tr>
<tr>
<td>Measures</td>
<td>31</td>
</tr>
<tr>
<td>Demographic and disease factors</td>
<td>31</td>
</tr>
</tbody>
</table>
Multiple sclerosis sequelae.............................................................. 31
Performance Scales........................................................................ 31
Possible moderators......................................................................... 32
Difficulties in Emotion Regulation Scale........................................... 32
COPE Inventory.............................................................................. 33
Psychological adjustment to multiple sclerosis................................. 34
Center for Epidemiological Studies Depression Scale Revised.......... 34
Penn State Worry Questionnaire...................................................... 34
Rand 36-Item Short Form Survey 1.0................................................ 35
Statistical Analysis.......................................................................... 35
Sample Characteristics...................................................................... 35
Primary Research Aims..................................................................... 36
Secondary Research Aim.................................................................. 37
Testing Assumptions of Linear Regression........................................ 38
Statistical Power............................................................................. 40
Results............................................................................................ 42
Demographic Characteristics............................................................ 42
Disease and Mental Health Characteristics........................................ 42
Bivariate Analyses between Demographic and Disease Characteristics and the
Dependent Variables....................................................................... 43
The relationship between demographic characteristics and depression.... 44
The relationship between disease characteristics and depression........... 44
The relationship between demographic characteristics and anxiety....... 46
The relationship between disease characteristics and anxiety

Emotion Regulation as a Moderator of the Relationship between Multiple Sclerosis Sequelae and Depression

Fitting the hierarchical linear regression model

Results of the hierarchical linear regression

Emotion Regulation as a Moderator of the Relationship between Multiple Sclerosis Sequelae and Anxiety

Fitting the hierarchical linear regression model

Results of the hierarchical linear regression

The Relationship Between Coping and Depression in Multiple Sclerosis

The Relationship between Coping and Anxiety in Multiple Sclerosis

Discussion

Multiple Sclerosis Sequelae and Psychological Adjustment to Disease

Emotion Regulation and Psychological Adjustment to Multiple Sclerosis

Emotion Regulation as a Moderator of the Relationship Between Multiple Sclerosis Sequelae and Psychological Adjustment to Disease

Coping and Psychological Adjustment to Multiple Sclerosis

Problem-focused and emotion-focused coping

Avoidance coping

Problem-Focused Coping as a Moderator of the Relationship between Multiple Sclerosis Sequelae and Psychological Adjustment to Disease

Additional Findings of Interest
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengths and Limitations</td>
<td>79</td>
</tr>
<tr>
<td>Implications and Future Research</td>
<td>86</td>
</tr>
<tr>
<td>References</td>
<td>89</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. Demographic Characteristics of Participants.................................................. 122
Table 2. Disease and Mental Health Characteristics of Participants.............................. 123
Table 3. The Relationship Between Total Center for Epidemiological Studies Depression-Revised (CESD-R) Scale Scores and Demographic Characteristics of Participants................................................................. 124
Table 4. The Relationship Between CESD-R Scores and Disease Characteristics of Participants.............................................................................................................. 126
Table 5. The Relationship Between Penn State Worry Questionnaire (PSWQ) Scores and Demographic Characteristics of Participants.................................................. 127
Table 6. The Relationship Between PSWQ Scores and Disease Characteristics of Participants.............................................................................................................. 129
Table 7. Hierarchical Multiple Linear Regression Predicting Natural-Log Transformed CESD-R Scores from MS Sequelae and Emotion Dysregulation............................. 130
Table 8. Hierarchical Multiple Linear Regression Predicting PSWQ Scores from MS Sequelae and Emotion Dysregulation.............................................................. 131
Table 9. Hierarchical Multiple Linear Regression Predicting Natural-Log Transformed CESD-R Scores from MS Sequelae and Coping............................................... 132
Table 10. Hierarchical Multiple Linear Regression Predicting PSWQ Scores from MS Sequelae and Coping........................................................ 133
LIST OF FIGURES

Figure 1. A model of depression in multiple sclerosis proposed by Arnett et al. (2008)… 134

Figure 2. Emotion dysregulation moderates the association between functional disability and depressive symptoms………………………………………………………… 135

Figure 3. Problem-focused coping moderates the association between functional disability and depressive symptoms……………………………………………… 136
Introduction

Background

Multiple sclerosis (MS) is an immune-mediated or inflammatory demyelinating disease that attacks the central nervous system (CNS) (Trapp & Nave, 2008). Common symptoms include fatigue, weakness, spasticity, tingling, numbness, pain, vision problems, gait difficulties, emotional symptoms, and cognitive changes. Early in the disease course, inflammatory demyelination damages axons, but compensation of the central nervous system (CNS) may mask the clinical effects of this damage (Dutta & Trapp, 2007). For most people with MS, a threshold is reached at which point the damage exceeds the compensatory abilities of the CNS and neurological decline becomes evident. Ultimately, loss of axons, dendrites, and neurons results in irreversible neurological decline, which is commonly observed in advanced MS (Dutta & Trapp, 2007). Treatment, typically with anti-inflammatory agents, is most effective early in the disease course to help prevent damage to the CNS and subsequent disability (Dutta & Trapp, 2007).

Multiple sclerosis is a leading cause of non-traumatic neurological disability among young and middle-aged adults living in the developed world (Koch-Henriksen & Sorensen, 2010). Research estimates the prevalence of MS in the United States ranges from 58 to 95 per 100,000 persons (Williamson et al., 2010), or approximately 250,000 to 350,000 people in the United States currently living with this disease (Noonan, Kathman, & White, 2002; Anderson et al., 1992). The wide range in prevalence estimates likely reflects methodological differences in the identification of individuals with MS as well as differences in the prevalence of MS across populations. There is evidence to suggest that the incidence and prevalence of MS may be increasing over time (e.g., Grytten, Torkildsen, & Myhr, 2015; Koch-Henriksen & Sorensen, 2010) and varies according to gender, race/ethnicity, environment, and other factors (e.g.,
Noonan et al., 2002; Rosati, 2001; Sellner et al., 2011). Multiple sclerosis disproportionately affects women relative to men, with women approximately twice as likely to develop the disease (Noonan et al., 2002; Anderson et al., 1992).

The exact cause of MS is unknown; however, variation in the incidence and prevalence of the disease across populations and over time points to multiple and interacting risk factors for the disease. Koch-Henriksen and Sorensen (2010) attribute the uneven distribution of MS worldwide to population genetics, the interplay between genetics and the environment, and socioeconomic structure including access to medical care. Although the sex ratio of MS initially led researchers to examine gonadal hormones and sex differences in the immune system and CNS, the increasing prevalence of MS among women appears to be attributable primarily to changes in women’s lifestyle and environmental influences as opposed to biological causes (Koch-Henriksen & Sorensen, 2010; Olsson, Barcellos, & Alfredsson, 2017). Smoking, shift work, and obesity are several lifestyle factors that are associated with increased risk for MS. Environmental factors that are known to increase risk for MS include low vitamin D exposure, either due to insufficient sun exposure or insufficient dietary intake, and exposure to organic solvents, which are a type of chemical commonly used in certain industries (Olsson et al., 2017).

The development of MS appears to depend upon the interaction of risk factors present at birth (e.g., genetic anomalies) and environmental risk factors present in childhood, adolescence, and adulthood (Ramagopalan, Dobson, Meier, & Giovannoni, 2010). Multiple sclerosis tends to strike in early to middle adulthood, with the peak age of onset at 30 years (Confavreux & Vukusic, 2006). People with MS generally survive for decades with the disease, albeit with increasing levels of functional impairment (Confavreux & Vukusic, 2006; Hirst, Swingler, Compston, Ben-Schlomo, & Robertson, 2008). Cigarette smoking and stress, risk factors for MS
development, may also contribute to progression of the disease and to symptom severity (Manouchehrinia et al., 2013). The life expectancy of people with MS is approximately 10 years shorter than the life expectancy of the general population (Hirst et al., 2008; Brønnum-Hanssen, Koch-Henriksen, & Stenager, 2004). The clinical course, symptom presentation, and progression of disability are highly variable in MS. MS is characterized by two clinical phenomena: (1) relapses or exacerbations of acute neurological symptoms, which remit either partially or completely, and (2) progression involving chronic and irreversible worsening of signs and symptoms (Confavreux & Vukusic, 2006; Leray et al, 2010).

Multiple courses of MS have been identified and are classified according to disease activity and progression. In the early phase of MS, most people with MS (85%) are diagnosed with a relapsing-remitting course, meaning they experience relapses without disease progression. As duration of illness increases, most people will transition to a secondary progressive phase of the disease during which neurological functioning steadily declines. Cigarette smoking may speed the change from relapsing-remitting to secondary progressive MS (Healy et al., 2009). A minority of MS patients (15%) are diagnosed with a progressive and typically more aggressive disease course without an initial relapsing-remitting phase. It is common for patients to also experience relapses or flare-ups during the progressive phase of MS (Confavreux & Vukusic, 2006; Confavreux, Vukusic, Moreau, & Adeleine, 2000).

Psychiatric Comorbidity in Multiple Sclerosis

Psychiatric comorbidity is common in MS at the time of diagnosis and increases over the course of the illness (Marrie et al., 2015; Beal, Stuifbergen, Sands, & Brown, 2007), likely due to the chronic and debilitating nature of the disease. Although there is considerable heterogeneity in prevalence estimates across studies, depression and anxiety are thought to be especially
prevalent, with each disorder affecting greater than 20% of people with MS. Furthermore, depression and anxiety are more prevalent among people with MS than in the general population (Marrie et al., 2015; Boeschoten et al., 2017). Of the anxiety disorders, generalized anxiety disorder (GAD) is the most common among people with MS, followed by panic disorder and obsessive-compulsive disorder. As in the general population, there is considerable overlap between depression and anxiety symptoms among people with MS (Korostil & Feinstein, 2007). Few studies have examined other psychological disorders, such as bipolar disorder, substance use disorders, and psychotic disorders, in people with MS (Marrie et al., 2015); however, bipolar disorder appears also to be more prevalent among people with MS than in the general population (Marrie et al., 2015).

Research suggests that psychiatric comorbidity is underdiagnosed and undertreated in MS patients, particularly among those of low socioeconomic status, resulting in significant burden and substantially lowered quality of life (Marrie et al., 2009; Korostil & Feinstein, 2007; Beiske et al., 2008; Fruewald et al., 2001; Janssens et al., 2003; Carta et al., 2014). Depression and anxiety have been linked to greater social dysfunction, perceived stress, alcohol abuse, and suicidality among MS patients (Feinstein, O’Connor, Gray, & Feinstein, 1999; Korostil & Feinstein, 2007; Feinstein, 2002; Turner, Williams, Bowen, Kivlahan, & Haselkorn, 2006). Moreover, depression is associated with poorer adherence to disease-modifying treatments for MS (Mohr et al., 1997b).

Of note, there is research to suggest that the prevalence of depression (and perhaps other psychiatric disorders) decreases in older people with MS, despite higher disability ratings (Patten, Beck, Williams, Barbui, & Metz, 2003). It has been hypothesized that people who live with MS for many years develop effective strategies for coping with their illness, resulting in a
decrease in depressive symptoms over time (Patten et al., 2003). The exact nature of these coping strategies, and the extent to which they could be actively targeted in preventive interventions remains to be examined.

**A Model of Depression in Multiple Sclerosis**

Researchers postulate that the link between MS and psychiatric disorders may be explained by multiple factors including: (1) the direct effects of the disease on brain structures involved in emotion regulation; (2) immune dysfunction; (3) mood-related side effects of certain treatments for MS; and (4) the psychosocial effects of MS. (Wallen, Wilken, Turner, Williams, & Kane, 2006; Arnett, Barwick, & Beeney, 2008). Arnett and colleagues (2008) propose a comprehensive theoretical model of depression in MS integrating these various biopsychosocial factors and focusing on potential moderators of the association between common MS sequelae and psychological adjustment to disease. Their model focuses on depression, but may be applied to anxiety and other psychological indicators of adjustment to disease. The relationships between MS sequelae and adjustment to disease tend to be weak and inconsistent in the literature, and Arnett and colleagues (2008) believe moderating influences on these relationships may help explain the mixed findings. Arnett and colleagues (2008) selected the moderators for their model on the basis of empirical support, but note that research on this topic is lacking and other moderators likely exist.

The model proposed by Arnett and colleagues (2008) is depicted in Figure 1. As summarized in the triangle at the left side of the figure, the risk for psychiatric disorders develops after the onset of MS with disease-related changes in the CNS. Disease-related changes in the CNS have been directly associated with depression and with Common MS Sequelae. According to Arnett and colleagues (2008) these neurobiological changes play a central role in
the model but are distal risk factors for the development of depression; they account for some but not all of the variance in depression, necessitating the other components of the model. Similarly, the risk and moderating factors identified by Arnett and colleagues may contribute to a greater prevalence of psychiatric disorders other than depression in patients with MS.

As represented by the arrows leading from Disease-Related Changes to MS Sequelae, disease-related processes in the CNS result in the development of a variety of MS symptoms, including fatigue, pain, cognitive impairment, and functional limitations/physical disability. Arnett and colleagues (2008) arrange the Common MS Sequelae around a circle because research suggests they are related to one another, as well as to Possible Moderators.

Possible Moderators are represented by an overlapping circle at the right side of the figure. The Possible Moderators included in the model, as presented by Arnett and colleagues (2008), are social support, stress, coping, and conceptions of self and illness. They were selected because they have the most empirical support, either as a moderator of the association between MS sequelae and depression or as a correlate of depression that is theorized to moderate the association between MS sequelae and depression. Possible Moderators are also arranged in a circle because they are theorized to be related to one another, as well as to the Common MS Sequelae with which they overlap. Of note, these Possible Moderators have been linked to other psychiatric disorders but the extent to which they may be involved in the etiology of anxiety and other common psychiatric comorbidities in MS remains to be examined.

Arnett et al. (2008) point out that although depression is at the intersection of Common MS Sequelae and Possible Moderator in this figure, depression could be replaced by any Common MS Sequelae or other indicators of adjustment disease in order to investigate their associations with MS Disease Factors and Possible Moderators. The model does not imply
directionality as the researchers posit that “dynamic and complex relationships among the variables are likely” (p. 692). Moreover, much of the research examining these variables in relation to adjustment to MS is correlational, limiting our ability to make causal inferences. A summary of each component of the model put forth by Arnett and colleagues (2008) follows below.

**Multiple sclerosis disease factors.** Disease-related factors may directly, and indirectly by way of MS Sequelae, increase risk for depression and other psychiatric disorders in MS. Although emotion regulation is not a represented in the model, it is implicated in Disease-Related Factors, particularly the CNS effects of MS that directly increase risk for psychiatric co-morbidity. Research suggests that psychiatric symptoms, particularly depression and anxiety, are elevated even before people are formally diagnosed with MS, and these symptoms may be an early symptom of the disease itself (Hoang, Laursen, Stenager, & Stenager, 2015).

Research on the neurobiological basis of psychiatric disorders in MS have focused on depression. Depression has been associated with greater MS lesion volume and atrophy in regions of the brain involved with emotion processing and mood regulation, such as the frontal and temporal regions (e.g., Gobbi et al., 2014; Feinstein et al., 2010; Feinstein et al., 2004). More subtle changes in these regions, as well as the hippocampus, resulting from demyelination and inflammation have also been linked to depression in MS (Gold et al., 2014; Feinstein et al., 2010). Together, structural brain changes detected by MRI explain a large proportion of the variance (up to 50%) in depression among MS patients (Feinstein et al., 2010; Feinstein et al., 2004). Abnormal communication within key limbic circuits responsible for emotion processing and at the interface between limbic and motor systems that translate emotions into survival-
oriented behaviors have also been identified in MS patients with depression (Nigro et al., 2014; Riccelli et al., 2016; Rossi et al., 2017).

Disease-related factors that indirectly increase risk for depression and other psychiatric disorders by way of MS Sequelae include brain changes associated with wide-ranging MS symptoms, such as pain, fatigue (DeLuca, Genova, Hillary, & Wylie, 2008), cognitive dysfunction (Paul, 2016), and disability (Fisniku et al., 2008). In addition, there is a growing body of literature that supports the role of inflammatory cytokines in the development and maintenance of depression among people with inflammatory disorders like MS and other populations, including those receiving cytokine treatment (e.g., interferon beta-1b for MS) (Koutsouraki et al., 2011; Dantzer et al., 2008; Gold & Irwin, 2006). New research suggests inflammatory cytokines may also contribute to the development of anxiety (Rossi et al., 2017; Vogelzangs, Beekman, de Jonge, & Penninx, 2013; Vogelzangs, de Jonge, Smit, Bahn, & Penninx, 2016; Hou et al., 2017).

Cytokines are small proteins which are involved in cell signaling and are produced during an immune response. They signal to the brain that the body is sick, thereby inducing “sickness behavior” or symptoms such as fatigue, pain, sleep problems, and altered mood and cognition (Dantzer, 2009). These symptoms overlap substantially with MS symptoms. Prolonged exposure to cytokines can lead to depression, anxiety, and cognitive dysfunction (Dantzer, 2009; Dantzer et al., 2008). In inflammatory conditions like MS, cytokines promote breakdown of the blood-brain barrier, which allows them to enter the brain and cause neurological damage, which is thought to be responsible for both the physical and psychological sequelae of MS (Gold & Irwin, 2006).
**Multiple sclerosis sequelae.** The association between MS sequelae and depression in the empirical literature is fairly inconsistent, which could signify weak effects and/or moderation by other factors (i.e., Possible Moderators) that have not been assessed or examined (Arnett et al., 2008). Of the MS sequelae described in the model, fatigue is among the most frequently reported by people living with MS (Hadjimichael, Vollmer, & Oleen-Burkey, 2008; Wood et al., 2013; Ziemssen, 2009), and unlike the other sequelae, its relationship to depression has considerable empirical support (e.g., Bakshi et al., 2000; Flachenecker et al., 2002; Kroencke, Lynch, & Denney, 2000). Fatigue has consistently been linked to anxiety and multiple dimensions of quality of life, as well (Beiske et al., 2008; Mills & Young, 2011; Wood et al., 2012; Janardhan & Bakshi, 2002). Although there are concerns regarding overlap in the measurement of depression and fatigue, this association persists even when measures of depression de-emphasizing somatic symptoms are utilized (e.g., Wood et al., 2012).

Pain, in addition to fatigue, is highly prevalent among people with MS. Approximately half of patients with MS report pain at any given point in their disease, and up to three-quarters of patients report with pain in the past month (O’Connor, Schwid, Herrmann, Markman, & Dworkin, 2008). Pain poses a threat to both physical and emotional health-related quality of life among people with MS (Kalia & O’Connor, 2005; Amtmann et al., 2015). When examining specific psychological outcomes, persistent and bothersome pain has been linked to higher levels of depression (Ehde et al., 2003) and anxiety, particularly among women (Kalia & O’Connor, 2005; Amtmann et al., 2015). Pain-related interference with daily activities has been linked to mood symptoms including depression (Ehde et al., 2014; Hadjimichael, Kerns, Rizzo, Cutter, & Vollmer, 2007). Despite these links between pain and adjustment to disease, other studies find
only weak or no association between symptoms of depression and pain intensity among people with MS (Beiske et al., 2008; Hadjimichael et al., 2007; Stenager, Knudsen, & Jensen, 1991).

Cognitive dysfunction affects an estimated 40% to 65% of people with MS depending on the research setting (e.g., clinic versus community), study sample, and method of measurement (Amato, Zipoli, & Portaccio, 2006; Chwastiak et al., 2002). Male patients with MS may be especially vulnerable to cognitive impairments (Beatty & Aupperle, 2010). Younger age of onset and more severe disease course have also been linked to greater cognitive impairment (Smestad, Sandvik, Landro, & Celius, 2010). Overall, evidence suggests that subjective cognitive functioning and, to a lesser extent, objective cognitive functioning are related to depression, anxiety, and mental health quality of life in patients with MS (Maor, Olmer, & Mozes, 2001; Lester, Stepleman, & Hughes, 2007; Goretti et al., 2014; Benito-Leon, Morales, & Rivera-Navarro, 2002). Research suggests higher levels of depression can lead to cognitive impairment, although there is evidence that even mild symptoms of depression are associated with cognitive impairment (Sundgren, Maurex, Wahlin, Piehl, & Brismar, 2013). Conversely, some studies find no relationship between cognitive impairment and adjustment to disease (Grech et al., 2015, Patti et al., 2009; Benedict et al., 2005).

Findings regarding relationship between disability and psychological adjustment to MS are more mixed, warranting an examination of potential moderators of this association. Some studies find that MS patients experiencing greater disability are more likely to report depression and/or anxiety (Chwastiak et al., 2002; Lynch, Kroencke, & Denney, 2001; McIvor, Riklan, & Reznikoff, 1984; Tsivgoulis et al., 2007), while others fail to replicate these findings (e.g., McGuigan & Hutchinson, 2006; Janssens et al., 2013) despite large sample sizes (e.g., Patten et al., 2003). In fact, Beiske and colleagues (2008) found that lower levels of disability were
associated with anxiety. Likewise, many studies examining health-related quality of life among people with MS find that disability status is related to physical but not psychological or mental quality of life scores (Janssens et al., 2003; Amato et al., 2001; Lobentanz et al., 2004; Pittion-Vouyovitch et al., 2006). Furthermore, studies often fail to detect an association between psychological distress in MS and increasing age or duration of illness, both of which coincide with worsening disability (Beiske et al., 2008; Marrie et al., 2009; Patten et al., 2003).

Factors that may moderate the relationship between common multiple sclerosis sequelae and depression.

The model put forth by Arnett and colleagues (2008) focuses on a handful of variables that may interact with MS Sequelae to increase or decrease the risk of depression. This model could readily be extended to other psychiatric comorbidities such as anxiety in MS. Arnett and colleagues (2008) explain, “when the influence of these moderator variables is in the adaptive direction, then the common MS sequelae are less likely to lead to depression” (p. 718). Possible moderators such as greater use of problem-focused coping, good social support, and more positive views of self and illness are theorized to buffer the negative impact of MS sequelae on psychiatric comorbidities in MS. Conversely, “when the influence of these variables is in the maladaptive direction, the common MS sequelae are more likely to lead to depression” (Arnett et al., 2008, p. 718). Avoidance coping, poor social support, and negative views of self and illness may exacerbate the negative impact of MS sequelae on adjustment to disease. While many of the proposed moderation effects have not been formally tested, Arnett and colleagues (2008) believe that interaction effects are likely the cause of the mixed findings with respect to the associations between common MS sequelae and adjustment to disease. Some of the proposed moderators have some empirical support (e.g., stress and coping), and those that do not were selected by
Arnett and colleagues (2008) due to their consistent relationship with depression in MS and/or theoretical potential to magnify the relationship between MS symptomatology and psychological functioning.

Although Arnett and colleagues (2008) view their model as predominantly moderational, they admit that a mediational model “may be possible in some instances” (p. 706). Arnett and colleagues refer to Baron and Kenny (1986) when making the argument for a moderational model. According to Baron and Kenny (1986), “moderator variables are typically introduced when there is an unexpectedly weak or inconsistent relation between a predictor and criterion variable” (p. 1174), whereas mediation is “best done in the case of a strong relation between the predictor and criterion variable” (p. 1178). Strong relationships between predictor and criterion variables are an anomaly in the context of research on depression in MS, thus favoring the moderational model. Moreover, the literature already lends support to significant interactions between several of the identified moderator variables and the common MS sequelae, suggesting other moderational relationships are possible (Arnett et al., 2008). Possible moderators of the relationship between MS sequelae and psychological adjustment are described below, with an emphasis on depression because this is the most extensively studied indicator of adjustment to MS.

**Stress and coping.** The transactional theory of stress and coping, proposed over thirty years ago by Lazarus and Folkman (1984), is the foundation of psychological stress and coping research across multiple disciplines including psychological adjustment to disease. According to Folkman et al. (1986b), “stress is conceptualized as a relationship between the person and the environment that is appraised by the person as taxing or as exceeding his or her resources and as endangering well-being” (p. 572). The transactional theory of stress and coping identifies
appraisal and coping as important mediators of the person-environment transaction as well as the outcomes of that transaction (Folkman, Lazarus, Gruen, & DeLongis, 1986). Cognitive appraisal as “the process in which a person evaluates whether a particular encounter with the environment is relevant to his or her well-being, and if so, in what ways” (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986, p. 992). There are two types of cognitive appraisal: primary and secondary. In primary appraisal, the person determines whether he or she “has anything at stake” in the encounter (Folkman et al., 1986b, p. 572). For example, does the encounter have the potential to compromise someone’s health or well-being in some way? In secondary appraisal, the person evaluates whether he or she can do anything to minimize harm and/or maximize benefit in the encounter. In other words, what potential strategies can the person to use to manage the internal and/or external demands of the stressful encounter.

According to the transactional theory of stress and coping, coping refers to the cognitive and behavioral strategies a person uses to manage the demands of a stressful encounter (Folkman et al., 1986a). Generally, these strategies fall into two categories: emotion-focused coping and problem focused coping. Emotion-focused coping aims to regulate the emotions arising from a stressful encounter. Problem-focused coping strives to change or deal with the stressful encounter (Folkman et al., 1986a). Research demonstrates that both forms of coping are used in most stressful encounters, and the relative proportion of problem-focused versus emotion-focused strategies used depends largely on the context of the encounter and how the encounter is appraised (Folkman & Lazarus, 1980). Earlier conceptualizations of stress and coping, stemming from developmental-psychoanalytic theory, viewed coping as a style or trait that was relatively fixed. Furthermore, certain styles or defenses were regarded as inherently more adaptive or maladaptive than others. The transactional theory of stress and coping treats coping as a process
which varies over time depending on the context. Coping strategies are separated from their outcome because they are context-dependent, and thus there are no preconceived notions as to the healthiness or adaptiveness of particular strategies (Lazarus, 1993).

High levels of perceived stress have been linked to poorer psychological adjustment to MS. This relationship is consistent across multiple sources of stress, including MS-related stress (Kirchner & Lara, 2011), life stress (Aikens et al., 1997), social stress (Gilchrist & Creed, 1994), as well as across multiple indicators of psychological adjustment, such as depression (Patten, Metz, & Reimer, 2000), anxiety (Korostil & Feinstein, 2007), and psychological distress (Jean, Beatty, Paul, & Mullins, 1997). The effects of stress in MS are not limited to psychosocial outcomes. Results of meta-analytic studies suggest that stress is a risk factor for exacerbation of MS symptoms (Mohr, Hart, Julian, Cox, & Pelletier, 2004; Artemiadis, Anagnostouli, & Alexopoulos, 2011). With respect to coping, greater use of problem-focused strategies has been associated with lower levels of distress in people with MS (McCabe, McKern, & McDonald, 2004; Goretti et al., 2009). However, some studies find only weak or limited support for this association (Jean, Paul, & Beatty, 1999; McCabe, 2005; Pakenham, 1999). Conversely, emotion-focused coping strategies have been associated with higher levels of distress in people with MS across studies (Dennison, Moss-Morris, & Chalder, 2009; Pakenham, 1999). Generally, research on coping in MS examines coping strategies as fixed as opposed to context-dependent, which is at odds with Folkman & Lazarus’ (1980) transactional theory of stress and coping.

Several studies have examined coping as a moderator of psychological adjustment or depression in people with MS; however, research on this topic is limited. Consistent with the theory of depression in MS they proposed, Arnett et al. (2002) examined coping as a moderator of the relationship between cognitive dysfunction and depression in MS. They found that
cognitive dysfunction was more likely to lead to depression in MS when people with MS used high levels of avoidance coping or low levels of active coping. Additional research is needed to determine if coping moderates the relationship between other common MS sequelae and psychological adjustment to this disease. Pakenham (1999; 2005) examined another theory, the stress-buffering hypothesis, in the context of adjustment to MS. The stress-buffering hypothesis posits that coping moderates the effects of stress on adjustment when stress appraisals are high (Folkman & Lazarus, 1980). Pakenham (1999; 2005) found some support for this hypothesis in people with MS. Specifically, he found that MS patients with high levels of stress and greater use of problem-focused coping strategies reported better social adjustment than peers with high levels of stress and lower use of problem-focused coping. On the other hand, patients with high levels of stress and greater use of “passive” (i.e., wishful thinking, self-blame, avoidance) emotion-focused coping strategies reported significantly greater subjective distress than participants with high levels of stress and less frequent use of emotion-focused coping strategies.

**Social support.** Social support has been extensively examined in relation to health and well-being with research primarily centering on the (1) the direct effect of social support on wellbeing (main effects model), and (2) the moderating effect of social support on the relationship between negative life events and health and well-being (buffering effects model). The main effects model states that social support has an overall beneficial effect on health and well-being, irrespective of negative or stressful life events (Cohen & Wills, 1985). Alternatively, the buffering effects model, which is consistent with the model of depression in MS put forth by Arnett et al. (2008), proposes that social support protects individuals against the negative effects of stressful life events (Cohen & Wills, 1985). Support has been found for both models, suggesting that social support has physical and mental health benefits regardless of the presence
of a stressor, but social support may be especially beneficial during times of stress (Holt-Lunstad, Smith, & Layton, 2010; Wang, Wu, & Lui, 2003; Wang, Cai, Qian, & Peng, 2014; Olstad, Sexton, & Søgaard, 2001; Takizawa et al., 2006; Cohen & Wills, 1985).

Generally, research on social support and adjustment to MS provides support for the main effects model. Krokavcova et al. (2008) found multiple links between social support and mental health and well-being among people with MS. In their study, greater social support from family was associated with better social and emotional functioning, greater support from friends was associated with better mental functioning, and greater support from individuals other than family and friends (e.g., co-workers, health care professionals, other MS patients) was associated with better general health status (Krockova et al., 2008). Hwang, Cvitanovich, Doroski, and Vajarakitipongse (2011) likewise found a positive association between perceived level of social support and overall quality of life among people with MS. Furthermore, a number of studies have demonstrated that low levels of perceived social support from family and friends, or failure to seek out social support from family and friends, is associated with poorer psychological adjustment to MS, including higher levels of depressive and anxiety symptoms (McIvor et al., 1984; Chwastiak et al., 2002; Korostil & Feinstein, 2007; McCabe et al., 2004). Other research has focused on the function of support as opposed to the source of social support. Bambara, Turner, Williams, and Haselkorn (2011) found that greater positive social interaction, greater emotional and informational support, and greater affective support were linked to lower levels of depression in a sample of male veterans with MS.

Findings from the MS literature are largely consistent with the results of a recent meta-analysis of social support and mental health and well-being in people with physical disabilities, which found consistent positive associations between social support and overall mental health.
functioning (Tough, Siegrist, & Fekete, 2017). However, relationships between social support and specific domains of mental health, including depression, anxiety, and well-being, were less robust as a number of studies reported non-significant associations. Tough and colleagues explain that the inverse relationship between social support and depression appears to be stronger in the general population than among people with disabilities, which may be due to potentially adverse consequences of unwanted or unnecessary social support in this specific population (Tough et al., 2017). They also note that certain types of social support may have indirect or moderating effects on depression accounting for heterogenous across mental health indicators.

With respect to the indirect or buffering effects of social support on stress and mental health, some studies have found limited support for this model in patients with MS (e.g., Pakenham, 1999; Vargas & Arnett, 2010). However, research on the buffering effects of social support on mental health and wellbeing in MS is scarce. Likewise, there has been mixed support for this model in other patient populations, such as patients with rheumatoid arthritis (e.g., Doeglas et al., 2004; Strating, Suurmeijer, & van Schuur, 2006; Affleck, Pfeiffer, Tennen, & Fitfield, 1988). Vargas and Arnett (2010) examined social support as a moderator of the relationship between daily uplifts and hassles and depression in MS. While hassles and its interaction with social support failed to predict depression in this sample, social support protected MS patients from the negative effects of absence of uplifts and positive experiences (Vargas & Arnett, 2010).

**Conceptions of self and illness.** While research on psychosocial predictors of adjustment to MS has focused on stress and coping, there is some evidence to suggest that perceptions of illness may be a stronger predictor of adjustment than coping (Wineman, Schwetz, Goodkin, & Rudick, 1996). For example, Wineman and colleagues (1996) found illness uncertainty, but not
coping effectiveness and ambulation status, accounted for a significant proportion of the variance in mood state among patients with MS enrolled in a clinical trial. Other researchers have also documented a relationship between illness uncertainty and psychosocial adjustment to MS (Lynch et al., 2001; Kroencke, Denny, & Lynch, 2001; McNulty, Hanoch, & Wilson, 2003). According to Leventhal, Nerenz, and Steele (1984), uncertainty is just one aspect of the representations patients form about their illness. The self-regulation model of Leventhal and colleagues (1984) states that patients develop their own perceptions of the identity, timeline, cause, consequences, and curability/controllability of their illness, which in turn, determines coping.

A number of studies have investigated the self-regulation model of illness perceptions in patients with MS. In their research on this topic, Jopson and Moss-Morris (2003) found that while illness severity explained most of the variance in physical and role dysfunction, illness perceptions played a significant role in psychosocial dysfunction, emotional dysfunction, and fatigue levels. Illness identity, in particular, was strongly related to social disability, anxiety, and fatigue. Jopson and Moss-Morris (2003) explain that patients with MS may misattribute harmless, everyday symptoms (e.g., headaches, sore throats) to their illness because they are eager to find a label that fits their symptoms. Patients may also interpret symptoms, even if they are harmless, as signals that their illness is active or progressing, leading to anxiety, fatigue, and/or social isolation (Jopson & Moss-Morris, 2003). Skerrett and Moss-Morris (2006) likewise found that patients’ negative interpretation of their symptoms (e.g., tendency to misattribute symptoms to MS, catastrophize about symptom consequences, view symptoms as a sign of physical damage) was related to fatigue and anxiety. Additionally, researchers have documented that patients who have more negative views about the impact of their symptoms report greater
psychological distress even after controlling for symptom severity (Lester et al., 2007; Mullins et al., 2001).

Patients’ self-concept, or how they view themselves and how others respond to them, also impacts their adaptation to disease. Self-efficacy and self-esteem are two components of self-concept which have been studied in MS. Bandura (1994) defined self-efficacy as, “people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (p. 71). Greater self-efficacy has been linked to better psychosocial adjustment and self-management of disease, as well as to improved self-esteem and self-worth among people with MS (Wilski & Tasiemski, 2016; Barnwell & Kavanagh, 1997; Airlie, Baker, Smith, & Young, 2001). Self-esteem refers to the way people feel about themselves and is determined in part by people’s interactions with their environment (Kernis, 2003). Mikula et al. (2017) detected a positive association between high self-esteem and the mental component of QoL among people with MS. In a longitudinal study of people with MS, Berzins and colleagues (2017) found that low levels of self-esteem and self-efficacy significantly predicted the development of major depression six months later. The association between self-esteem and self-efficacy and major depression was bidirectional such that baseline depression symptoms predicted low levels of self-esteem and self-efficacy at follow-up (Berzins, Bulloch, Burton, Dobson, Fick, & Patten, 2017).

While there is some research examining perceptions of illness and self in relation to adjustment to MS, few studies have examined these constructs as potential moderators of the association between common MS sequelae and psychosocial adaption to MS. Moreover, there has been a tendency to examine self-concept as an outcome of rather than a predictor of psychosocial functioning in MS (e.g., Lorio et al., 2010; McCabe, 2005; Shnek et al., 1997;
Uccelli, Traversa, & Ponzi, 2016). To date, qualitative studies exploring MS patients’ reaction to their diagnosis and experience living with this illness appear to provide the richest data on how patients’ views of their illness and themselves impact their mood. Quantitative research is needed to formally test associations and the interactions between views of self and illness, and depression proposed by Arnett et al. (2008).

**Emotion Regulation: Another Possible Moderator**

Arnett and colleagues (2008) acknowledge that many of the interactions they propose in their model have not been empirically tested and other possible moderators are likely. Another possible moderator of the relationship between MS symptomatology and psychological functioning is emotion regulation. According to Gross (1998), “emotion regulation refers to the processes by which individuals influence which emotions they have, when they have them, and how they experience these emotions” (p. 275). Although Arnett and colleagues (2008) do not explicitly describe emotion regulation in their model, it is implied in their summary of disease-related changes that directly and indirectly influence adjustment to disease. As previously noted, the neurobiological effects of MS have been shown to impact regions of the brain that are responsible for emotion processing and mood regulation. Furthermore, emotion dysregulation has been implicated in a range of psychiatric symptoms and disorders, including those that are more highly prevalent among people with MS (e.g., depression, anxiety, bipolar disorder). Thus, a closer examination of the role of emotion regulation in adjustment to disease is warranted. Furthermore, findings from the general population indicate that emotion regulation may be associated with resilience to stress (Carlson, Dikecligil, Greenberg, & Mujica-Parodi, 2012; Boyes, Hasking, & Martin, 2015). Although research on this topic among people with MS is lacking, it is likely that these findings generalize to this patient population and emotion
regulation could function as a buffer of the negative effects of MS sequelae on adjustment to disease.

People engage in many different emotion regulatory activities (Parkinson & Totterdell, 2010), which may be effortful or automatic, conscious or unconscious, and intrinsic or extrinsic (Gross, 1998; Gross, 1999). Gross (1998) classifies these activities in terms of where their impact lies in the emotion generative process. At the broadest level, these activities are classified as antecedent-focused strategies or response-focused strategies. Antecedent-focused strategies are attempts to change the production of emotion before it is generated, whereas response-focused strategies are attempts to change the response to an emotion after it has been produced (Liverant, Brown, Barlow, & Roemer, 2008). Gross (1998) describes a process model of emotion regulation that delineates five points in the emotion generative process at which an individual may intervene to manage or respond to his/her emotional experience. Each point constitutes an emotion regulation strategy. The points are: situation selection, situation modification, attentional deployment (e.g., distraction), cognitive change (e.g., reappraisal, distancing), and response modulation (e.g., suppression) (Gross, 1998). Situation selection, situation modification, attentional deployment, and cognitive change are all regarded as antecedent-focused strategies, whereas response modulation is a response-focused strategy.

**Emotion regulation and psychopathology.** Emotion dysregulation, or the inability to achieve an emotion-regulated goal despite regulatory attempts has been linked to psychopathology, particularly mood and anxiety disorders, and may be a common cause of affective disturbance (Jazaieri, Urry, & Gross, 2013; Cole, Michel, & Teti, 1994). Jazaieri and colleagues (2013) define affective disturbance as, “a disruption in the multi-system response (subjective experience, expressive behavior, physiology) of emotions, moods, and stress
responses” (p. 587). Affective disturbance refers to negative emotional states (e.g., depression, anxiety) or positive emotional states (e.g., mania, euphoria) that are problematic or disruptive to the individual or their loved ones and serve as the basis for many psychiatric disorders (Jazaieri et al., 2013). In their review of the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR), Jazaieri and colleagues found that that affective disturbance is "likely present" in a large proportion (40%) of DSM-IV-TR diagnoses and “definitely present” in 19% of them. Additionally, they found that problems with emotion regulation are directly described or suggested in 22% of DSM-IV-TR diagnoses (Jazaieri et al., 2013).

Although emotion regulation theorists emphasize context in determining whether specific regulatory strategies are “good” or “bad,” researchers have tended to assume a “fallacy of uniform efficacy” in their examination of emotion regulation in relation to mental health. In other words, researchers have tagged specific emotion regulation strategies as generally adaptive or maladaptive. Emotion regulation theory and research focusing on "dispositional emotion regulation," or those emotion regulation strategies that individuals gravitate towards over time and across contexts, generally agree that emotion regulation strategies such as reappraisal, problem-solving, and acceptance are protective against psychopathology. Conversely, suppression and avoidance are largely regarded as detrimental to mental health (Aldao, Nolen-Hoeksema, & Schweizer, 2010).

According to Gross (1998) reappraisal is a form of cognitive change and an antecedent-focused emotion regulation strategy. It has gained attention in both the emotion regulation and stress and coping literature. Reappraisal involves interpreting a stressful or emotional situation in a neutral or positive way (Gross, 2001; Aldao, Nolen-Hoeksema, & Schweizer, 2010). Problem-
solving, another emotion regulation strategy that has been studied extensively within the stress
and coping framework, is a form of situation modification and an antecedent-focused emotion
regulation strategy. Problem-solving encompasses efforts to change a distressing situation or
minimize its negative consequence (Gross, 1998). Lastly, acceptance is an emotion regulation
strategy that has antecedent- and response-focused elements. It entails fully experiencing one's
emotional response, including thoughts, feelings, and bodily sensations, without trying to
change, control, or avoid the response (Hayes, Strosahl, & Wilson, 1999). Aldao and colleagues
(2010) conducted a meta-analysis examining the relationship between widely used emotion
regulation strategies and psychopathology. They found that problem-solving was the most
strongly associated with lower levels of overall psychopathology, followed by reappraisal and
acceptance. The relationship between acceptance and psychopathology did not reach statistical
significance, but there were fewer studies focused on acceptance included in the meta-analysis.
While problem-solving was linked to lower levels of a range of psychiatric symptoms, the
benefits of reappraisal were more specific to depression and, to a lesser extent anxiety (Aldao et
al., 2010).

Conversely, suppression and avoidance strategies have been thought to increase risk for
psychopathology. Gross (1998) emphasizes the suppression of emotional expression, whereas
other researchers focus on the suppression of unwanted thoughts (e.g., Wegner et al., 1987). As
conceptualized by Gross and Levenson (1993), suppression is a form of response modulation that
involves purposefully inhibiting one's emotional expression while remaining emotionally
aroused. In laboratory experiments, suppression has been shown to be effective at diminishing
expressive behavior (Gross, 1998), with minimal or paradoxical effects on subjective
experiences of negative emotion (Campbell-Sills, Barlow, Brown, & Hofmann, 2006a),
measurable increases in physiological arousal (Gross, 1998), and slowed recovery from negative affect (Campbell-Sills, Barlow, Brown, & Hofmann, 2006b). Cognitive or thought suppression refers to attempts to stop thinking unwanted thoughts associated with unpleasant emotions (Wenzlaff & Wegner, 2000). While this may be successful in the short-term, it often leads to a resurgence in the suppressed thoughts over time (Abramowitz, Tolin, & Street, 2001); the negative subjective reaction to this rebound effect may contribute to psychopathology (Magee, Harden, & Teachman, 2012).

Experiential avoidance is an umbrella term that encompasses response-modulating emotion regulation strategies to suppress inner experiences associated with negative emotions. Furthermore, it comprises situation selection and modification strategies aimed at preventing contact with triggers of the negative emotions. Experiential avoidance is regarded as a transdiagnostic factor contributing to the occurrence and persistence of a broad spectrum of emotional disorders (Kashdan, Barrios, Forsyth, & Steger, 2006). As summarized in the meta-analysis conducted by Aldao et al. (2010), experiential avoidance has been linked to anxiety, depression, eating disorders, and substance use disorders in multiple studies. Additionally, high levels of experiential avoidance predict onset and maintenance of mood and anxiety disorders (Spinhoven, Drost, de Rooij, van Hemert, & Penninx, 2014).

Overall, maladaptive emotion regulation strategies tend to be response-focused as opposed to antecedent-focused. This is consistent with predictions made by Gross' process model of emotion regulation (1998). Gross theorizes that response-focused strategies are less effective than antecedent-focused ones because response-focused strategies attempt to manage or change emotions that have already been produced, which requires expending greater effort (e.g., Gross, 2001). It is more difficult to change a strong emotional response once it has been generated than
it is to change an emotional response early on as it is still forming. Furthermore, maladaptive emotion regulation strategies have generally been found to be more strongly associated with psychopathology than adaptive regulatory strategies (Aldao et al., 2010; Aldao & Nolen-Hoeksema, 2010).

**Emotion regulation versus coping.** As is evidenced from the review of emotion regulation strategies above, there is considerable overlap between emotion regulation and coping. Strategies such as problem solving, reappraisal, and avoidance have been examined in both the emotion regulation and stress and coping literature. Gross (1998) explains that emotion regulation research has “borrowed heavily” from stress and coping research, and that the stress and coping tradition is an “important precursor” to the current study of emotion regulation (p. 274). However, Gross (1998) also notes several significant distinctions between the two frameworks. First, emotion regulation research tends to focus on the modulation of specific emotions, as opposed to stress more broadly, and makes more nuanced distinctions between person-environment encounters than the stress and coping tradition. Second, emotion regulation involves the regulation of negative and positive emotions, as opposed to predominantly negative emotions (i.e., stress-related emotions), which is more typical of stress and coping research. Third, emotion regulation research is concerned with the emotional experience (e.g., physiological arousal, behavioral experience), which tends to be overlooked in the stress and coping literature. An exception would be emotional approach coping, which focuses on attempts to examine and understand emotions in response to stressful events (Stanton, Danoff-Burg, Cameron, & Ellis, 1994). Fourth, emotion regulation research is generally focused on shorter time periods because emotionally-laden situations and emotional responses to those situations tend to last from seconds to minutes (Gross, 1999). Alternatively, stress and coping research may
be concerned with responses to stressors that persist for months or years, as is the case with coping with chronic illness. Moreover, Gross (1999) explains that coping is a “broader category” (p. 556) than emotion regulation, since it “includes non-emotional actions taken to achieve non-emotional goals” (p. 556). Coping encompasses parts of emotion regulation, although some aspects, like the physiological experience of emotion and regulation of positive emotions, are notably absent.

**Emotion regulation and adjustment to multiple sclerosis.** In the general population, emotion dysregulation has been closely linked to psychiatric disorders, particularly those that are more frequently observed in people with MS such as depression and anxiety. However, little is known about the regulation of emotion among people living with MS. Phillips and colleagues have conducted several studies focused on emotion regulation in this patient group. When comparing perceived difficulties in emotion regulation among people with MS to healthy controls, they found that people with MS consistently reported greater emotional dysregulation across multiple dimensions, and that these difficulties in emotion regulation were associated with higher levels of depression and poorer quality of life, but not anxiety (Phillips et al, 2014; Phillips et al, 2009). Schirda, Nicholas, and Prakash (2015) similarly found that self-rated difficulties in emotion regulation predicted poorer quality of life in people with MS patients.

Although specific maladaptive emotion regulation strategies have not been extensively studied in MS patients, research examining closely related coping strategies have found consistent and strong relationships between escape-avoidance approaches (e.g., trying to forget the whole thing) to coping with MS and poorer adjustment, as indicated by higher levels of depression, anxiety, and distress, as well as diminished quality of life, and social functioning (Dennison, Moss-Morris, & Chalder, 2009). In the coping literature, suppression strategies such
as denial are sometimes examined together with emotion-focused and/or avoidance strategies (e.g., Dennison et al., 2009, Litman, 2006). Research on expressive suppression, specifically, and adjustment to disease has yielded mixed findings. Phillips and colleagues (2009) did not find a link between suppression and quality of life in a sample of MS patients, whereas Aarstad and colleagues found suppression was a preferred coping strategy among patients with MS that was associated with lower mood (Aarstad, Lode, Larsen, Bru, & Aarstad, 2011).

With respect to “adaptive” emotion regulation strategies, findings in people with MS are generally consistent with those from the general population. Phillips and colleagues (2009) found that greater use of reappraisal as an emotion regulation strategy was associated with better psychological and environmental quality of life in this population. This has also been replicated longitudinally in a large-scale study of MS patients being treated with interferon beta-1b. More frequent use of positive reappraisal, as well as problem-solving, at baseline predicted better quality of life and lower depressive symptoms two years later (Pozzilli, Schweikert, Ecari, Oentrich, & Bugge, 2012).

Findings with respect to acceptance-based strategies are more mixed, mirroring weak or non-significant associations between acceptance and psychological well-being in the general population (e.g., Aldao et al., 2010). Pakenham and Fleming (2011) developed a measure of acceptance in MS and examined its relationship to disease adjustment cross-sectionally and longitudinally (one year later). Acceptance of MS, particularly commitment to pursuing actions consistent with one's values, was related to better disease adjustment (e.g., lower distress, higher positive affect, higher life satisfaction); however, patients with less disability and cognitive impairment endorsed higher levels of the action component of acceptance. Thus, pursuing actions consistent with personal values may be easier at lower levels of functional assessment.
Pakenham (2006) found that examined acceptance was associated with both positive outcomes and distress simultaneously.

**The Proposed Study**

The primary aims of this study are twofold. First, this study will extend the model of depression in MS proposed by Arnett and colleagues (2008) to other indicators of adjustment to disease, including anxiety and mental health-related quality of life. Depression and anxiety are the most prevalent psychiatric comorbidities in MS. While research on anxiety in MS is growing, this psychological outcome is still understudied in MS relative to depression. Second, this study will explore the relationship between emotion regulation and adjustment to disease among patients with MS. Specifically, emotion regulation will be examined as a moderator of the association between common MS sequelae and psychological adjustment to disease. Greater understanding of emotion regulation among people with MS is needed given the close relationship between emotion regulation and psychopathology and high rates of psychiatric comorbidity in this vulnerable population. We hypothesize that MS sequelae are positively, but weakly, associated with depression and anxiety, and inversely correlated with mental-health related quality of life, and that these associations are moderated by emotion dysregulation, such that MS sequelae are especially predictive of poor adjustment at higher levels of emotional dysregulation.

The secondary aims of this study are to (1) replicate and expand upon previous research examining coping as a correlate of adjustment to disease, and (2) to examine coping as moderator of the relationship between common MS sequelae and adjustment to disease. In particular, we will focus on coping domains that overlap with emotion regulation, including problem-focused coping, emotion-focused coping, avoidance coping, and positive
reinterpretation and growth. We will examine these coping strategies as correlates of depression, anxiety, and mental-health related quality of life. Furthermore, we will examine these strategies as moderators of the association between common MS sequelae and the three indicators of adjustment to disease. We hypothesize that greater use of “adaptive coping strategies: (i.e., problem-focused coping, positive reinterpretation and growth) will be weakly associated with better psychological adjustment to disease, as indicated by lower levels of depression and anxiety, and higher levels of mental-health related quality of life. Conversely, we hypothesize that greater use of “maladaptive coping strategies” (i.e., emotion-focused coping, avoidance coping) will be weakly associated with poorer psychological adjustment to disease. We hypothesize that coping will moderate the weak associations between common MS sequelae and adjustment to disease such that “adaptive” strategies will buffer against the negative effects of MS sequelae on adjustment to disease.

Methods

All methods were reviewed and approved by the University at Albany Institutional Review Board. All participants were required to review a consent form detailing the nature and purpose of the research prior to survey completion. Documentation of consent was waived for this study because it posed minimal risk to participants. Participants were notified that proceeding with the survey signified their consent to partake in the study. Consenting participants were required to click the "Next" button at the bottom of the informed consent to gain access to the survey.

Sample

A total of 247 participants with MS were recruited for the purposes of this study. Participants were eligible for the study if they were: (1) 18 years of age or older; (2) diagnosed
with MS by a health care professional; (3) able to read and write in English; and (4) lived in the United States. Eligibility was assessed at the start of the survey and participants were able to gain access to the survey only if they met all four criteria. Ineligible subjects were thanked for their interest and encouraged to visit the National MS Society Research website, where they could learn about other research for which they may be eligible.

**Procedure**

Study participation involved completion of an anonymous, online survey that was created and published with SurveyMonkey®, a secure online questionnaire tool. It took participants approximately one hour, on average, to complete the survey. Self-administration of the survey allowed participants to complete the survey at their own pace and take breaks as needed. Some participants completed the survey in multiple sessions. All efforts were made to keep the survey as brief as possible given the research questions at hand. The survey was written in large font that was easy to read to accommodate vision difficulties, which is a common symptom of MS.

Participants were recruited primarily through web-based support and resources for people with MS. For a previous study, the researcher successfully recruited participants from the “Participate in Research” page on the National MS Society website as well as postings to the websites of local chapters. The researcher also successfully recruited participants from online communities for people with MS, such as “thisisMS.com.” For the present study, we recruited participants in similar ways. Full permission from website and organization administrators was obtained before posting or otherwise disseminating recruiting materials for this study.

Recruitment materials directed prospective participants to the study’s SurveyMonkey® site and provided an e-mail address where participants could contact the researcher for additional information. The first page of the SurveyMonkey® survey introduced the study and listed the
inclusion/exclusion criteria (see above). Prospective participants were instructed to check a box indicating whether they meet these criteria. If they did, they were directed to the informed consent form for the study. The informed consent emphasized the voluntary nature of the study and encouraged participants to skip any questions they felt uncomfortable answering. Due to the sensitive nature of some questionnaires, information regarding MS and mental health resources (e.g., 1-800-LIFENET) were included in the consent form.

As an incentive to participate, participants were invited to enter a raffle to win a $50 electronic Amazon gift card. When participants finished the survey, they were presented with a hyperlink to a separate website for raffle entry. Participants wishing to enter the raffle were asked to provide an e-mail address where they could be notified if they won and for delivery of the gift card. Participants were reminded that raffle entry was optional and that contact information would not be connected to their survey responses.

**Measures**

**Demographic and disease factors.** Participants were asked to provide information regarding gender, race/ethnicity, relationship status, income level, employment status, and education level. Participants were also asked about their health insurance coverage and physical and mental health history.

**Multiple sclerosis sequelae.**

**Performance Scales (PS).** The PS is a patient-reported outcome of MS-related disability. It assesses impairment in the following eight domains: mobility, bowel/bladder, fatigue, sensory, vision, cognition, spasticity, and hand function (Schwartz, Vollmer, & Lee, 1999). Like the PDDS, the PS was developed by researchers from NARCOMS. On the PS, individuals with MS are asked to rate their current level of disability (past month) in each domain relative to their
condition before MS. Disability level is rated on a six-point Likert scale ranging from zero (“normal”) to five (“total disability”), except mobility, which is scored from zero (“normal”) to six (“total disability”). Item responses are summed to produce a total score ranging from 0 to 41. The PS correlates strongly with the Expanded Disability Status Scale (EDSS) and Multiple Sclerosis Functional Composite (MSFC), a multidimensional clinical rating instrument developed by the US National Multiple Sclerosis Society (Polman & Rudick, 2010; Marrie & Goldman, 2007). While the mobility, bladder, fatigue, vision, and hand subscales of the PS correlate with their respective criterion measures based on physician examination, the criterion validity of the sensory, cognition, and spasticity subscales is less established (Marrie & Goldman, 2007). In this sample, the PS was found to have good internal consistency, $\alpha = 0.82$.

Possible moderators.

**Difficulties in Emotion Regulation Scale (DERS).** The DERS is a 36-item, self-report questionnaire that assesses “clinically relevant difficulties” in emotion regulation (Gratz & Roemer, 2004, p. 42). On the DERS, respondents rate how often items apply to themselves on a scale of one (“almost never, 0-10%”) to five (“almost always, 91-100%”). The DERS produces six subscale scores, each of which taps a different dimension of emotion regulation: (1) lack of awareness and understanding of emotions (six items, $\alpha = 0.84$); (2) lack of clarity of emotional responses (five items, $\alpha = 0.83$); (3) limited access to emotion regulation strategies perceived as effective (eight items, $\alpha = 0.90$); (4) nonacceptance of emotional responses (six items, $\alpha = 0.93$); (5) difficulties controlling impulses when experiencing negative emotions (six items, $\alpha = 0.84$); and (6) difficulties engaging in goal-directed behavior when experiencing negative emotions (five items, $\alpha = 0.88$) (Gratz & Roemer, 2004). Additionally, the DERS yields a total score (36 items, $\alpha = 0.95$). Higher scores reflect greater emotion regulation difficulties. The DERS has
been widely used in patients with psychological disorders, and it has recently been described in research with MS patients (Phillips et al., 2014; Schirda, Nicholas, & Prakash, 2015). For the present study, the DERS total score was used. The DERS total score correlated highly with all subscales (r’s > 0.60).

**COPE Inventory.** The COPE Inventory was administered to assess adaptive and maladaptive coping responses. It contains 15 subscales, each consisting of four items that measures a distinct coping strategy (Carver, Scheier, & Weintraub, 1989). In this study, the “dispositional” format of the COPE Inventory was utilized. The dispositional format asks participants about how they usually respond to stressors. Each item describes a way of dealing with stress, and item responses range from one (“I don’t usually do this at all”) to four (“I usually do this a lot”). Subscale scores are computed by summing the scores from the four items comprising each subscale. Additionally, second-order factors may be created from the subscale scores depending on whether it is supported by the data that has been collected (Carver et al., 1989). The COPE Inventory has been commonly used to assess coping strategies among patients with MS and other chronic diseases (e.g., Arnett, Higginson, Voss, Randolph, & Grandey, 2002; Groarke, Curtis, Coughlan, & Gsel, 2004; Livneh, Lott, & Antonak, 2010).

In this study, the following subscales were examined: focus on and venting of emotions (α = 0.80); use of emotional social support; planning (α = 0.87); active coping (α = 0.81); mental disengagement (α = 0.48); behavioral disengagement (α = 0.79); denial (α = 0.77); and positive reinterpretation and growth (α = 0.82). A problem-focused coping composite was created by summing the planning and active coping subscales, which were highly correlated, r(184) = 0.82, p < 0.001. The problem-focused coping composite demonstrated excellent internal consistency, α = 0.91. Due to generally weak correlations between subscales, emotion-focused and avoidance
coping composites were not computed, and subscales representing these domains were examined independently, \( r \)'s < 0.50.

**Psychological adjustment to multiple sclerosis.**

**Center for Epidemiological Studies Depression Scale Revised (CESD-R).** The CESD-R, and its predecessor, the CESD, are screening tools for depression that are intended for use in the general population and are commonly administered in epidemiological studies (Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). The CESD-R contains 20 items and corresponds with the criteria for a major depressive episode set forth by the DSM-IV. The CESD-R assesses symptoms of depression in nine groups (e.g., sadness, loss of interest, appetite). Respondents rate how often in the “past week or so” they experienced a given symptom on a five-point Likert scale ranging from zero (“not at all or less than 1 day”) to four (“nearly every day for 2 weeks”). Total scale scores may be computed ranging from zero to 80 or zero to 60, with the latter facilitating comparison with the CESD (Eaton et al., 2004). In this study, scoring facilitating comparison with the CESD was employed. For this scoring method the two highest response categories for each item are collapsed before summing item responses to produce the total score. The CESD-R was found to have excellent internal consistency in this sample, \( \alpha = 0.94 \).

**Penn State Worry Questionnaire (PSWQ).** The 16-item PSWQ is a self-report measure of the trait of worry (Meyer, Miller, Metzger, & Borkovec, 1990). Respondents rate items on a Likert scale of one (“not at all typical of me”) to five (“very typical of me”). Five negatively worded items are reverse scored. Item responses are summed to compute a total score, which ranges from 16 to 80. In this sample, the PSWQ demonstrated excellent internal consistency, \( \alpha = 0.95 \). The PSWQ is a useful screening tool for generalized anxiety disorder, with a cutoff score of 62 recommended for “unselected samples” (e.g., community samples; Behar, Alcaine, Zuellig,
& Borkovec, 2003). The PSWQ has been administered to patients with MS to assess pathological worry in the literature (e.g., Bruce & Arnett, 2009). It de-emphasizes somatic symptoms of anxiety, which are likely to overlap with physical symptoms of MS.

Rand 36-Item Short Form Survey 1.0 (SF-36). The SF-36 is a widely used measure of adult health status that was developed for use in the Medical Outcomes Study (Ware & Sherbourne, 1992). The SF-36 assesses health status in eight domains: physical functioning (10 items, $\alpha = 0.95$); social functioning (two items, $\alpha = 0.87$); role limitations due to physical problems (four items, $\alpha = 0.90$); role limitations due to emotional problems (three items, $\alpha = 0.88$); emotional well-being (five items, $\alpha = 0.80$); energy/fatigue (four items, $\alpha = 0.86$); bodily pain (two items, $\alpha = 0.92$); and general health perceptions (five items, 0.81). Each domain is assessed using a multi-item subscale. Item scores range from zero to 100 and represent the percentage of total possible points attained for a given item. Subscales scores are computed by averaging item scores within each domain. The subscales demonstrate good to high internal consistency in validity studies, as well as in this study, and differentiate groups based on health status (e.g., Brazier et al., 1992; McHorney, Ware, & Raczek, 1993).

Statistical Analysis

Sample Characteristics

All statistical analyses were conducted using IBM SPSS Statistics Version 25 for Mac. First, the relationship between demographic and disease characteristics and indicators of psychological adjustment (i.e., depression, anxiety, mental health-related quality of life) was evaluated. Pearson correlations, or non-parametric alternatives, if indicated, were used to examine the direction and strength of the relationships between continuous demographic and disease characteristics (e.g., age, disease duration, symptom severity rating) and the various
measures of psychological adjustment. Independent samples t-tests and one-way analyses of variance (ANOVA), or non-parametric alternatives, if indicated, were used to determine whether there were mean differences in the key variables of interest across categorical demographic and disease characteristics (e.g. race/ethnicity, marital status, and type of MS).

**Primary Research Aims**

Hierarchical linear regression was conducted to determine if emotion dysregulation moderates the association between MS sequelae and psychological adjustment to MS. We planned to fit a separate hierarchical linear regression model for each of the three dependent variables: depressive symptoms (CESD-R), anxiety symptoms (PSWQ), and mental health-related quality of life (SF-36). In the first step of each hierarchical linear regression model, demographic characteristics significantly associated with the dependent variable in bivariate analyses were entered. In the second step, any disease characteristics significantly associated with the dependent variable in bivariate analyses were entered. These first two steps allowed us to control for variables that may potentially confound the relationship between MS sequelae, emotion dysregulation, and the dependent variable.

In the third step of each hierarchical regression model, MS sequelae (functional disability and symptom severity), as measured by the Performance Scales (PS), were entered. R-squared change and the direction, strength, and significance of the regression coefficient for PS were examined to test the hypothesis that MS sequelae are weakly associated with depression, anxiety, and poorer mental well-being.

In the fourth step of each hierarchical linear regression model, emotion regulation, as measured by the total DERS score, was entered. R-squared change and the direction, strength, and significance of the regression coefficient for the DERS total score were evaluated to test the
hypothesis that self-rated emotional dysregulation is positively associated with depressive and anxiety symptoms and negatively associated with mental health-related quality of life.

In the fifth and final step of each hierarchical linear regression model, the interaction between total DERS score and PS was entered. Change in R-squared resulting from the inclusion of the interaction terms, as well as the direction, strength, and significance of the interaction terms, were interpreted to test the hypothesis that emotion dysregulation modulates the association between MS sequelae and psychological adjustment to disease. Furthermore, if an interaction term was found to be statistically significant, the interaction was graphed to aid in interpretation.

**Secondary Research Aims**

The secondary research aim was tested in a similar manner as the primary research aim. Hierarchical linear regression was performed to determine if coping moderates the relationship between MS sequelae and psychological adjustment to MS. We planned to fit three separate hierarchical linear regression models – one for each outcome of interest: depressive symptoms (CESD-R), anxiety symptoms (PSWQ), and mental health-related quality of life (SF-36).

In the first two steps of each hierarchical regression model, any demographic characteristics and then disease characteristics significantly associated with the dependent variable in bivariate analyses were entered. In the third step, MS sequelae, operationalized as total PS score, were entered. In the fourth step of each hierarchical regression model, the main effects of the coping scales were entered. For the purposes of preserving power given multiple coping scales entered into each model, we planned to only create interaction terms between total PS score and a given coping scale if the main effects of each of these independent variables was statistically significant in the reduced model. We planned to enter any interaction terms in the
fifth and final step of each hierarchical linear regression model. Change in R-squared resulting from the addition of any interaction terms to the model, as well as the direction, strength, and significance of the interaction terms, was examined to test the hypothesis that coping modulates the association between MS sequelae and psychological adjustment to disease. Additionally, we planned to graph any significant interactions to facilitate interpretation.

Testing Assumptions of Linear Regression

The assumptions of linear regression were tested for each hierarchical linear regression model fitted for the purposes of testing the primary and secondary aims. The assumptions of linear regression are: 1) linear relation between the dependent and independent variables; 2) homoscedasticity of residuals; 3) multivariate normality of residuals; 4) no auto-correlation of residuals; and 5) model specification (Osborne & Walters, 2002; Ernst & Albers, 2017). Given the study design, correlation of observations, or their residuals, is extremely unlikely. Thus, this assumption was not formally tested.

To test if the relationship between the independent and dependent variables was linear, a scatter plot of the standardized residuals versus the standardized predicted variables was generated. A Loess curve, which is a non-linear best fit line, was fitted to assist in determining if the relationship between the predicted values and standardized residuals was linear. If non-linearity was detected, transformations of the independent and/or dependent variables were performed as indicated.

A scatter plot of the standardized residuals versus standardized predicted values was utilized to test if the variance of the residuals was constant across all levels of the predictor values (homoscedasticity). If this assumption was not met, transformations of the independent and/or dependent variables were performed as indicated.
To test the normality of the residuals, a Normal Quantile-Quantile (Q-Q) plot of the standardized residuals was generated. If the assumption of normality was met, the data points on the plot approximated a straight line. Moreover, the Shapiro-Wilk Test of Normality was conducted to test if the sample was drawn from a normal distribution. If threats to normality such as skewness or kurtosis was observed, transformations of the independent variables were performed as indicated.

Lastly, model specification refers to the process by which independent variables are selected for inclusion or exclusion in the linear regression equation. Specification error occurs when important independent variables are left out of the model or unimportant variables are included in the model. Such error can produce biased estimates of the independent variables. To minimize specification error, theory and previous research governed the selection of variables to be included in each linear regression model. The presence of multicollinearity, outliers, and points of high leverage and influence were also examined as these are additional sources of specification error.

Before conducting any linear regression analyses, two-way correlations among potential independent variables were calculated to test for multicollinearity. Although a commonly used cut-off is 0.80, multicollinearity can be present when correlations between variables are below this threshold (Morrow-Howell, 1994). Any correlations greater than 0.6 triggered this researcher to examine the association between the variables more closely. For example, the researcher would consider whether one of the variables should be dropped or if a composite of the two variables should be calculated. Multicollinearity was also detected by examining tolerance values after the regression analyses were run. Tolerance values less than 0.1 were considered an indication of severe multicollinearity (Cohen, West, & Aiken, 2014). Additionally, regression
coefficients and significance levels were examined for other signs of multicollinearity. To minimize structural multicollinearity, which results from computing an interaction term from two independent variables, continuous independent variables were centered by subtracting the mean from all observed values of that variable.

For each linear regression model, steps were taken to determine if the regression model was affected by unusual and influential observations. A plot of the studentized residuals by leverage values was examined for outliers and leverage. Extreme outliers with standardized residuals three standard deviations from the mean were considered for removal. Highly influential cases, as indicated by Cook’s Distance values greater than one, were examined for removal. Additionally, this researcher examined cases with centered leverage values greater than two times the number of independent variables divided by the number of observations (Cohen et al., 2014).

**Statistical Power**

This researcher conducted power analyses using G*Power software to determine the minimal detectable effect given the sample size and estimated number of predictors. For the Primary Research Aim, this researcher estimated that the minimal detectable effect size for three predictors, including the main effects of functional disability and emotion dysregulation as well as the interaction between these two variables, was $f^2 = 0.10$ (a moderate effect). This is equivalent to 9% of variance explained by the three tested predictors. The minimal detectable effect size was estimated using an alpha level of 0.05, power of 0.80, a total of 10 predictors in the model. As described in the Introduction, the findings are mixed with respect to the association between disability and adjustment to disease, and many studies fail to detect a significant association (e.g., Janssens et al., 2003, Amato et al., 2001). The percentage of
variance explained by emotion dysregulation in a model predicting psychological quality of life in MS was 10%, which is greater than the minimal detectable effect size computed for this model (Phillips et al., 2014). Research documenting the moderating effect of emotion dysregulation on functional disability is lacking in MS and other populations; therefore, the size of the effect this researcher is attempting to detect is unknown.

For the Secondary Research Aim, which was exploratory, this researcher estimated that the minimal detectable effect size for 15 predictors, including the main effects of functional disability and the various coping subscales as well as possible interactions between these variables, was $r^2 = 0.13$ (a moderate effect). This is equivalent to 11% of variance explained by the 10 tested predictors. The minimal detectable effect size was estimated with an alpha level of 0.05, power of 0.80, and a total of 15 predictors in the model. Again, many studies fail to detect a significant association between disability and adjustment to MS. Research generally supports small effects of problem-focused and emotion-focused coping, as well as positive reappraisal, on adjustment to MS ($sr^2 = 0.10 – 0.20$) (Sullivan, Wilken, Rabin, Demorest, & Bever, 2004; Calandri, Graziano, Borghi, & Bonino, 2017). Avoidance coping may be more strongly related to adjustment to MS (e.g., $\eta^2 = 0.28$ in Mohr et al., 1997a). In the general population, the associations between problem-focused coping and psychopathology as well as avoidance coping and psychopathology are medium-to-large, whereas the association between positive reappraisal and psychopathology is small (Aldao et al., 2010). In a study examining coping as moderator of the association between disability and mental health, the only significant interaction emerged between problem-focused coping and disability. The size of this effect was small-to-moderate ($\eta^2 = 0.04$) (Mohr et al., 1997a). For the Secondary Research Aim, it is likely that the culmination of small-to-moderate effects of coping and the potential interaction between one or more of these
coping strategies and disability will exceed the minimal detectable effect size computed for this model.

**Results**

**Demographic Characteristics**

Of the 247 participants who were eligible for the survey, 198 responded to at least 80% of the items. In the consent form, we encouraged participants to skip questions they felt uncomfortable answering and to take breaks as needed. Thus, we expected participants to have missing data, especially given the nature of MS (e.g., cognitive symptoms such as inattention) and survey length. The sample was predominantly female (88%), Caucasian (83%), and middle-aged ($M = 43.42, SD = 12.05$). The sample was highly educated, with 23% of the sample holding a graduate degree, and 33% of the sample holding a Bachelor’s degree. Approximately half of participants were employed at least part-time (54%); however, 30% described themselves as disabled and unable to work. The majority of participants reported they were married or cohabitating (65%). The total annual household income of the sample ranged from less than $25,000 (20%) to greater than $100,000 (14%).

**Disease and Mental Health Characteristics**

The majority of the sample was diagnosed with relapsing-remitting MS (77%). Less than half the sample (44%) was in a period of MS symptom remission, and 17% of the sample reported experiencing an exacerbation or flare-up of MS symptoms at the time of survey completion. The number of years participated lived with an MS diagnosis ranged from 0 to 36 ($M = 8.07, SD = 7.56$). Participants reported they lived with MS symptoms on average for approximately five years before receiving a formal diagnosis from a physician, with participants...
experiencing their first MS symptoms an average of 13.18 years (SD = 11.01) before partaking in
the study.

Participants with MS on average reported high levels of depression on the CESD-R, \( M = \)
19.06, SD = 14.15. Ninety-one participants (50.6%) scored at or above 16, which is a cut-off
score that is widely used to identify individuals at risk for depression (Eaton et al, 2004).
Additionally, participants reported moderately elevated levels of worry on the PSWQ, \( M = \)
48.84, SD = 14.40. On the PSWQ, forty-three participants (24%) scored at or above the cut-off
score (62) used to identify individuals at risk for Generalized Anxiety Disorder (GAD) (Behar et
al., 2003).

Bivariate Analyses between Demographic and Disease Characteristics and the Dependent
Variables

We conducted a correlation analysis to examine the extent to which the three dependent
variables – CESD-R (depression) total score, PSWQ (anxiety) total score, and SF-36 emotional
well-being subscale – were associated and assessed overlapping constructs. There was a strong
negative association between total CESD-R score and the SF-36 emotional well-being subscale,
\( r(174) = -0.73, p < 0.001 \). Likewise, there was a strong negative association between PSWQ
total score and the SF-36 emotional well-being subscale, \( r(174) = -0.65, p < 0.001 \). Symptoms of
depression and anxiety were moderately correlated, \( r(164) = 0.47, p < 0.001 \). Due to the strong
negative associations between symptoms of depression and emotional well-being, as well as
between worry and emotional well-being, emotional well-being was dropped as a third outcome
variable in the linear regression analyses. The particularly strong association between depression
and emotional well-being suggests the two measures were tapping into the same construct
meaning it would be redundant to examine both as dependent variables. Given the emotional
well-being subscale is comprised of fewer items than the depression and anxiety measures, and it is a less specific measure of mental health, we opted to drop this dependent variable.

**The relationship between demographic characteristics and depression.** Visual inspection of the distribution of CESD-R total scores revealed that depression symptom levels were non-normally distributed with a skewness of 0.73 ($SE = 0.18$) and kurtosis of -0.31 ($SE = 0.36$). Thus, non-parametric tests were utilized in bivariate analyses for this dependent variable. A Spearman’s rank correlation failed to detect a significant association between age and symptoms of depression. A series of Mann-Whitney U tests, in lieu of independent samples t-tests, and Kruskal-Wallis $H$ tests, in lieu of one-way ANOVAs, were conducted to compare the effects of gender, relationship status, race/ethnicity, income level, education level, and employment status on symptoms of depression. Median levels of depression did not vary significantly across different categories or levels of these demographic variables (see Table 3).

**The relationship between disease characteristics and depression.** Spearman’s rank correlations were performed to examine the association between depression symptoms and years living with a diagnosis of MS, years living with MS symptoms, and MS-related disability, respectively. A weak, negative association was detected between years living with an MS diagnosis and depression, $r_s(177) = -0.21, p = 0.01$. We failed to detect a statistically significant association between years living with MS symptoms and depression. There was a moderately strong, positive correlation between Performance Scales score and depression, $r_s(168) = 0.44, p < 0.001$.

A Kruskal-Wallis H test was conducted to determine if there were differences in levels of depression symptoms between groups of participants with different types of MS. The distributions of CESD-R scores varied significantly across groups of participants with different
types of MS, $\chi^2 (4) = 10.73, p = 0.03$; however, median CESD-R scores did not differ significantly across groups. Participants who did not know their type of MS reported the highest median depression scores (32.00), followed by participants with primary progressive MS (18.00), followed by participants with relapsing-remitting MS (17.00). Participants with progressive relapsing MS had the lowest median levels of depression (8.00), as did participants with secondary progressive MS (9.00). Pairwise comparisons were formally tested using Dunn’s procedure with Bonferroni correction. The post-hoc analyses did not reveal statistically significant differences in CESD-R scores between groups after the Bonferroni correction was applied.

A second Kruskal-Wallis H test was conducted to determine if there were differences in levels of depression symptoms between participants grouped by MS exacerbation status. Median CESD-R scores were statistically different across groups of participants with different types of MS, $\chi^2 (2) = 13.58, p = 0.001$. Participants who were experiencing an exacerbation of MS symptoms had the highest median depression scores (29.00), followed by participants who were unsure if they were experiencing an MS exacerbation (17.50). Participants who were not experiencing an exacerbation of symptoms reported the lowest median levels of depression (13.00). Median scores on the CESD-R differed significantly between the participants who were experiencing an exacerbation of symptoms and participants who were not ($p = 0.001$).

A third and final Kruskal-Wallis H test was conducted to determine if there were differences in levels of depression symptoms between participants grouped by MS remission status (see Table 4). Median CESD-R scores did not differ significantly across groups, $\chi^2 (2) = 2.83, p = 0.24$; additionally, the distribution of CESD-R scores did not differ significantly across groups, $\chi^2 (2) = 5.85, p = 0.05$ but approached statistical significance. Participants who were
experiencing a remission of MS symptoms reported the lowest median levels of depression (14.00). Participants who were unsure if they were experiencing a remission of MS symptoms reported the highest median levels of depression (20.00), followed by participants who were not experiencing a remission of MS symptoms (17.50).

The relationship between demographic characteristics and anxiety. A Pearson correlation indicated a weak, negative association between age and symptoms of anxiety, \( r(175) = -0.35, p < 0.001 \). A series of one-way, between-subjects ANOVAs were conducted to compare the effects of gender, relationship status, race/ethnicity, income level, education level, and employment status on symptoms of anxiety. No significant associations between any of these categorical demographic variables and anxiety symptoms were detected (see Table 5).

The relationship between disease characteristics and anxiety. Correlational analyses were conducted in order to examine the relationship between anxiety symptoms and years living with a diagnosis of MS, years living with MS symptoms, and MS-related disability, respectively. A moderately strong, negative association was detected between years living with an MS diagnosis and symptoms of anxiety, \( r_s(177) = -0.32, p < 0.001 \). Likewise, a moderately strong, negative association was detected between years living with MS symptoms and symptoms of anxiety, \( r_s(178) = -0.29, p < 0.001 \). Years living with an MS diagnosis was non-normally distributed with a skewness of 1.07 (\( SE = 0.17 \)) and kurtosis of 0.54 (\( SE = 0.35 \)). Likewise, years living with MS symptoms was non-normally distributed with a skewness of 1.22 (\( SE = 0.17 \)) and kurtosis of 1.20 (\( SE = 0.35 \)). Therefore, we carried out Spearman’s rank correlations as opposed to Pearson correlations. We failed to detect a significant association between MS-related disability and symptoms of anxiety (see Table 6).
A one-way, between-subjects ANOVA was conducted to compare the effect of type of MS on anxiety symptoms. Mean levels of anxiety varied significantly by type of MS, $F(4, 175) = 5.47$, $p < 0.001$. Participants who were unsure of their type of MS had the highest mean anxiety scores, $M = 61.50$, $SD = 11.90$; followed by participants with relapsing-remitting MS, $M = 50.17$, $SD = 16.43$; and by patients with primary progressive MS, $M = 43.67$, $SD = 13.61$. The lowest mean anxiety scores were reported by participants with secondary progressive MS, $M = 38.31$, $SD = 17.93$, and participants with progressive-relapsing MS, $M = 26.75$, $SD = 8.69$. The Tukey-Kramer post-hoc test was utilized to examine pairwise differences in mean levels of anxiety between groups of participants with different types of MS. There were statistically significant mean differences in anxiety levels between participants who were unsure of their type of MS and participants with progressive-relapsing, as well as between participants who were unsure of their type of MS and participants with secondary progressive MS ($p < 0.05$). Additionally, there were statistically significant mean differences in anxiety levels between participants with relapsing-remitting MS and participants with progressive-relapsing MS ($p < 0.05$).

A one-way, between-subjects ANOVA was performed to examine the association between exacerbation of MS symptoms and anxiety. The test failed to detect a statistically significant difference in mean level of anxiety across participants grouped by exacerbation status, $F(2, 175) = 1.80$, $p = 0.34$. A one-way, between-subjects Welch ANOVA was conducted to compare the effect of remission of MS symptoms on anxiety levels. Likewise, mean level of anxiety symptoms did not vary significantly by remission status, Welch’s $F(2, 71.97) = 0.14$, $p = 0.87$. 
**Emotion Regulation as a Moderator of the Relationship between Multiple Sclerosis Sequelae and Depression**

**Fitting the hierarchical linear regression model.** A hierarchical linear regression analysis was conducted to predict total CESD-R score from MS symptomatology (PS), emotion dysregulation (DERS), and the interaction between these two independent variables (PS x DERS). Additionally, potential demographic and disease-related covariates identified in bivariate analyses as being significantly associated with CESD-R score at the \( p < 0.1 \) level were included in the model with one exception. Although both age and years living with MS were significantly associated with total CESD-R score at the \( p < 0.01 \) level, only years living with an MS diagnosis was included in the model due to concerns about multicollinearity. The two variables are not independent because years living with an MS diagnosis is computed from age. Number of years living with an MS diagnosis was more strongly associated with total CESD-R score than age, which is why the former was selected for inclusion in the model. In addition to omitting age from the hierarchical linear regression model, education level and MS type were dichotomized due to concerns about group size (e.g., small number of participants per group). Education level was dichotomized with Bachelor’s degree or higher as the cut-off based on mean CESD-R score. MS type was categorized as relapsing-remitting or not based on sample size per group.

To test the assumption of linearity, a scatter plot of the standardized residuals versus the standardized predicted values was generated. A curvilinear pattern was revealed, which was remediated by applying a natural-log transformation to total CESD-R score. As noted previously, the distribution of CESD-R scores was positively skewed. Likewise, a natural-log transformation was applied to number of years living with an MS diagnosis, which was also positively skewed. Other continuous independent variables were mean-centered to minimize multicollinearity with
the introduction of the interaction term. Partial regression plots confirmed a linear relationship between the continuous independent variables (natural-log transformed years living with an MS diagnosis, mean-centered PS score, and mean-centered DERS score) and the natural-log transformed dependent variable.

After applying transformations to total CESD-R score (dependent variable) and number of years living with MS (independent variable), a scatter plot of the standardized residuals by the standardized predicted values revealed that the variance of the residuals was relatively constant across values of the predictor variables. Homoscedasticity of the residuals had not been achieved until the transformation was applied to the dependent variable. Furthermore, a Q-Q plot of the standardized residuals was generated following natural-log transformation of total CESD-R score, and the data points on the plot approximated a straight-line suggesting normality of the residuals.

After omitting redundant independent variables, tolerance values were greater than 0.1 suggesting that there was no multicollinearity. Steps were taken to identify any potential unusual and influential observations that could affect the model. Two cases with studentized deleted residuals greater than three standard deviations of the mean were deleted. There was one case with a high centered leverage value slightly larger than 0.2; this case was not highly influential so was kept in the model. All Cook’s Distance values were well below one; specifically, the largest value was 0.06.

**Results of the hierarchical linear regression model.** With all assumptions of multiple linear regression met, the final model was comprised of the following five steps: (1) demographic factors (education level), (2) MS disease factors (type of MS, symptom exacerbation status, and natural-log transformed years living with MS), (3) functional disability
(PS), (4) emotion dysregulation (DERS), and (5) the interaction between functional disability and emotion dysregulation (PS x DERS).

The results of the hierarchical multiple regression analyses indicated that education level, the demographic factor added in Step One, accounted for 3% of the variance in transformed CESD-R score, and the percentage of variance explained by this step approached statistical significance, $F_{\text{Change}}(1, 137) = 3.68, p = 0.06$ (see Table 7). MS disease factors, which were added in Step Two, accounted for an incremental 12% of the variance in natural-log transformed CESD-R score, and this change in the percentage of variance explained was statistically significant, $F_{\text{Change}}(7, 133) = 4.48, p = 0.002$. In the full model, both type of MS and symptom exacerbation status were significantly associated with the dependent variable. Specifically, participants with relapsing-remitting MS reported higher levels of depression relative to participants with other types of MS, $\beta = 0.15, p = 0.017$. Likewise, participants experiencing an exacerbation of MS symptoms reported higher levels of depression relative to participants who were not experiencing an exacerbation, $\beta = 0.14, p = 0.025$.

Functional disability, introduced to the model in Step Three, explained an additional 16% of the variance in natural-log transformed CESD-R score over and above that explained by demographic and disease factors, $F_{\text{Change}}(1, 132) = 29.99, p < 0.001$. As expected, functional disability was positively associated with transformed depression scores, $\beta = 0.34, p < 0.001$. The inclusion of emotion dysregulation in the model (Step Four) explained an additional 24% of the variance in natural-log transformed CESD-R score, $F_{\text{Change}}(1, 131) = 69.78, p < 0.001$; specifically, emotion dysregulation was positively associated with depression, $\beta = 0.54, p < 0.001$. Lastly, the interaction between functional disability and emotion dysregulation, added in Step Five, was significantly associated with transformed CESD-R score and accounted for an
additional 4% of the variance in the dependent variable, $F_{\text{Change}}(1, 130) = 11.65, p = 0.001$. A plot of the interaction revealed that at low levels of functional disability, better emotion regulation mitigated the positive association between disability and depression symptoms. At high levels of functional disability, the positive association between disability and depression was similar across emotion regulation ability (see Figure 2).

**Emotion Regulation as a Moderator of the Relationship between Multiple Sclerosis Sequelae and Anxiety**

**Fitting the hierarchical linear regression model.** A hierarchical linear regression analysis was fitted to predict total PSWQ score (anxiety) from MS-related functional disability (PS), emotion dysregulation (DERS), and the interaction between these two independent variables. Additionally, potential demographic and disease-related covariates identified in bivariate analyses were further examined for inclusion in the hierarchical linear regression model. In bivariate analyses, the following demographic and disease-related variables were significantly associated with PSWQ score: age, gender, number of years living with a diagnosis of MS, number of years living with MS symptoms, and type of MS. To prevent multicollinearity, age, but not years living an MS diagnosis or years living with MS symptoms, was included in the model. Of the three potential variables, age was the most strongly associated with PSWQ score in bivariate analyses (see Tables 5 and 6). In addition, type of MS was dichotomized as relapsing-remitting versus other types of MS due to concerns about the size of the groups.

A five-step hierarchical linear regression was run to determine if the emotion dysregulation moderated the association between functional disability and anxiety among people with MS. Age and gender were entered in the first step. Type of MS was entered in the second step. Functional disability, as assessed by the Performance Scales, was entered in the third step.
Emotion dysregulation, measured with the DERS, was entered in the fourth step. In the fifth and final step, the interaction between functional disability and emotion dysregulation was introduced.

To test the assumptions of multiple linear regression, the standardized residuals were plotted against the standardized predicted values of the model. This showed that the residuals were homoscedastic. Additionally, a Q-Q plot of the standardized residuals revealed that the residuals approximated a straight-line, signifying normality of the residuals. Tolerance values were greater than 0.1 suggesting that there was no multicollinearity. Partial regression plots confirmed a linear relationship between the dependent variable and the following continuous independent variables: age and total DERS score. A linear relationship was not established between PS scores and PSWQ scores. Lastly, steps were taken to identify any potential unusual and influential observations that could affect the model. Two of the cases had studentized deleted residuals greater than three (absolute value), and these cases were removed from the model. There was one case with a centered leverage values slightly greater than 0.2, but this case was not highly influential and thus not removed the model. All Cook’s Distance values were within an acceptable range.

**Results of the hierarchical linear regression model.** The results of the hierarchical multiple regression analyses indicated that demographic factors added in Step One accounted for 26% of the variance in anxiety symptoms, $F_{\text{Change}}(2, 140) = 24.28, p < 0.001$ (see Table 8). In the full model, female gender was associated with higher anxiety levels, $\beta = 0.27, p < 0.001$. Additionally, age was negatively associated with anxiety, $\beta = -0.18, p = 0.011$. Type of MS, which was entered in Step 2, explained an additional 1% of the variance in anxiety over and above that accounted for by demographic characteristics, and this step failed to explain a
significant proportion of the variance in the dependent variable, $F_{\text{Change}}(1, 139) = 1.63, p = 0.20$. In the third step, functional disability was added, which did not explain a significant proportion of variance in PSWQ scores over and above gender and MS-disease related factors, $F_{\text{Change}}(1, 138) = 0.01, p = 0.91)$. In the full model, however, the regression coefficient for PSWQ score reached statistical significance such that PSWQ score was negatively associated with PSWQ score, $\beta = -0.16, p = 0.02$. Emotion dysregulation was entered in the fourth step and explained an additional 26% of the variance in PSWQ score, $F_{\text{Change}}(1, 137) = 76.50, p < 0.001$. Emotion dysregulation was positively associated with anxiety levels, $\beta = 0.57, p < 0.001$. Lastly, the interaction between functional disability and emotion dysregulation was entered to the model in Step 5. No statistically significant incremental change in variance was observed with the addition of the interaction term, $F_{\text{Change}}(1, 136) = 0.03, p = 0.87$.

**The Relationship Between Coping and Depression in Multiple Sclerosis**

A five-step hierarchical linear regression analysis was conducted to predict total CESD-R score from MS-related functional disability (PS), the emotion-focused subscales of the COPE, the avoidance coping subscales of the COPE, and the problem-focused coping composite. The positive reinterpretation and growth subscale of the COPE was excluded from the linear regression analysis because it was strongly correlated with the problem-solving composite of the COPE, $r(171) = 0.61, p < 0.001$. Interaction terms were created and added to the model if: (1) the main effect of functional disability was significant, and (2) the main effect of a given coping subscale or composite was significant. In addition, the following covariates were included in the model: education level (dichotomized), number of years with MS (natural-log transformed), type of MS (dichotomized), and symptom exacerbation status. Age, which was significantly
correlated with CESD-R in bivariate analyses at the $p < 0.1$ level, was omitted from the model due to concerns about multicollinearity with number of years living with an MS diagnosis.

CESD-R was natural-log transformed to achieve a normal distribution. Continuous independent variables were mean-centered to minimize multicollinearity with the introduction of the interaction term. The assumptions of linear regression were met, including: (1) linearity as assessed by partial regression plots and a plot of the standardized residuals against the predicted values, (2) homoscedasticity as assessed by a plot of the standardized residuals by the standardized predictive values, and (3) normality of the residuals as determined by Q-Q plot. Tolerance values were within an acceptable range, suggesting multicollinearity was not present. An examination of leverage statistics and Cook’s distance values suggested there were no points with unusual leverage or influence. Five (5) cases were deleted from the analyses because the absolute values of their studentized residuals were greater than three.

Demographic and disease factors were controlled for in the first two steps of the model. Education level was entered in Step One of the hierarchical linear regression model, and it accounted for 3% of the variance in natural-log transformed CESD-R, $F_{\text{Change}}(1, 141) = 3.98, p = 0.05$ (see Table 9). Although education level was a statistically significant predictor of depression in the reduced model, it was no longer statistically significant in the full model. MS disease factors were entered in Step Two of the hierarchical linear regression model. This group of variables accounted for an additional 11% of the variance in natural-log transformed CESD-R, $F_{\text{Change}}(4, 137) = 4.13, p = 0.003$. Symptom exacerbation relative to no exacerbation was the only statistically significant predictor from this step in the reduced model, $\beta = 0.30, p = 0.001$. In the full model, natural-log transformed number of years living with an MS diagnosis was significantly and negatively associated with depression scores, $\beta = -0.22, p = 0.001$. No other
disease factors from the second step were significantly associated with depression in the full model.

Functional disability as assessed by the Performance Scales was entered in Step Three of the hierarchical linear regress model. The addition of functional disability to the model explained 19% of the variance in natural-log transformed depression, over and above that accounted for by demographic and disease factors alone, $F_{\text{Change}}(1, 136) = 38.49, p < 0.001$. Performance Scales scores were positively associated with transformed depression scores in the reduced and full models, $\beta_{\text{full}} = 0.43, p < 0.001$.

In Step Four, COPE emotion-focused and avoidant subscales, as well as the problem-focused coping composite were entered. The inclusion of these factors in the model explained an additional 25% of the variance in natural-log transformed depression scores, $F_{\text{Change}}(6, 130) = 12.49, p < 0.001$. Behavioral disengagement, an avoidant coping subscale, was positively associated with transformed depression scores, $\beta_{\text{full}} = 0.32, p < 0.001$. Additionally, problem-focused coping was negatively associated with transformed depression scores, $\beta_{\text{full}} = -0.24, p < 0.001$.

In the fifth and final step (Step Five) of the hierarchical linear regression model, the interaction between behavioral disengagement and functional disability as well as the interaction between problem-solving and functional disability were entered. The interaction terms explained an incremental 3% of the variance in natural-log transformed depression, $F_{\text{Change}}(2, 128) = 5.50, p = 0.01$. Of the two interaction terms, only the interaction between problem-focused coping and functional disability was statistically significant, $\beta = 0.18, p = 0.01$. At low levels of functional disability, greater use of problem-focused coping mitigated the association between disability and transformed depressions scores. At high levels of functional disability, the association
between disability and depression was consistent across problem-focused coping levels (see Figure 3).

**The Relationship Between Coping and Anxiety in Multiple Sclerosis**

A four-step hierarchical linear regression analysis was conducted to predict total PSWQ score from MS symptomatology (PS), the emotion-focused subscales of the COPE, avoidance coping subscales of the COPE, and the problem-focused coping composite. The positive reinterpretation and growth subscale of the COPE was excluded from the linear regression analysis because it was moderately correlated with the problem-solving composite of the COPE, \( r(171) = 0.61, p < 0.001 \). Interaction terms were created and added to the model if: (1) the main effect of PS was significant, and (2) the main effect of a given COPE subscale or composite was significant. Furthermore, the following covariates were included in the model: gender, age, and type of MS (dichotomized). Assumptions of linear regression, including linearity, homoscedasticity, and normality, were met. Tolerance values were within an acceptable range. No outliers or highly influential points were detected.

Demographic factors were entered in Step One of the linear regression model and explained 19% of the variance in PSWQ score, \( F_{\text{Change}}(2, 148) = 16.98, p < 0.001 \) (see Table 10). In the reduced and full models, female gender was positively associated with anxiety, \( \beta_{\text{full}} = 0.22, p = 0.003 \), and age was negatively associated with anxiety, \( \beta_{\text{full}} = -0.23, p = 0.01 \). Type of MS was entered in Step Two, but this independent variable failed to explain any additional variance in anxiety levels over and above demographic factors in the reduced and full models.

Performance Scales score was entered in Step Three, and it likewise did not explain a statistically significant proportion of variance in anxiety. Lastly, in the fourth and final step (Step Four), the COPE subscales and composites were entered, which explained an additional 17% of the
variance in the dependent variable, $F_{\text{Change}}(6, 140) = 6.34, p < 0.001$. Specifically, focus on and venting of emotion was significantly and positively associated anxiety, $\beta = 0.32, p < 0.001$. Conversely, problem-focused coping was negatively associated with anxiety, $\beta = -0.20, p = 0.01$. Interactions between functional disability and the two significant coping subscales are not reported because the main effect of functional disability was not statistically significant. For exploratory purposes, the interaction terms were created and added to the model; they were not statistically significant.

**Discussion**

The primary aims of this study were to: (1) extend the model of depression in MS proposed by Arnett and colleagues (2008) to other indicators of psychological adjustment to disease, and (2) to examine emotion regulation as a moderator of the association between common MS sequelae and disease adjustment. Depression and anxiety were selected as indicators of psychological adjustment disease because they are highly prevalent among people with MS, which was confirmed in the present sample. Although this researcher planned to examine mental-health related quality of life as a third indicator of adjustment to disease, it was dropped because of its strong association with depression and anxiety. Emotion regulation was examined as a possible moderator because of its close relationship with psychopathology in the general population and its potential relevance to the study of psychiatric comorbidity in MS. Furthermore, emotion regulation ability in MS may be impacted by disease-related changes in the brain.

It was hypothesized that greater severity of common MS sequelae would be positively but weakly associated with higher levels of depression and anxiety. This hypothesis was partially supported as functional disability was positively associated with depression in multivariate
analyses; however, functional disability was only significantly, and weakly, associated with anxiety in the model examining emotion regulation as a moderator. Functional disability was not a statistically significant predictor of anxiety when coping subscales were examined as correlates of anxiety.

It was also hypothesized that emotion dysregulation would moderate the relationship between common MS sequelae and psychological adjustment to disease. This hypothesis was partially supported as it held true for depression but not anxiety. Greater emotion dysregulation was associated with significantly higher levels of depression and anxiety in multivariate analyses; however, the moderating effect of emotion regulation on the association between MS sequelae and adjustment to disease was only statistically significant in the model predicting depression. Specifically, better emotion regulation abilities were associated with fewer depressive symptoms, particularly at lower levels of functional disability. In other words, emotion regulation appeared to mitigate the effects of disability on depression at lower levels of disease severity/disability, but not at higher levels of disease severity.

The secondary aims of this study were to (1) replicate and expand upon previous research examining coping as a correlate of adjustment to disease, and (2) to examine coping as moderator of the relationship between common MS sequelae and adjustment to disease. Again, depression and anxiety were selected as indicators of psychological adjustment to disease. Mental health-related quality of life was excluded due to its strong association with the other indicators, which were measured with more sensitive assessment instruments. We examined emotion-focused, problem-focused, and avoidance coping due to their overlap with emotion-regulation, and because they are commonly cited in the literature but rarely as moderators of the association between MS sequelae and adjustment to disease. Positive re-interpretation and
growth, which also overlaps with emotion regulation, was an additional coping subscale of interest; however, it was strongly correlated with problem-focused coping in the positive direction and omitted from analyses due to concerns of multicollinearity.

It was hypothesized that emotion-focused coping and avoidance coping would be associated with poorer psychological adjustment to disease, whereas problem-focused coping would be associated with better psychological adjustment. As warranted (i.e., significant main effects of functional disability and coping in the model), the moderating effect of coping on the relationship between MS sequelae and psychological adjustment was tested. Hypotheses regarding coping were partially supported for depression and anxiety. Emotion-focused coping subscales did not emerge as significant predictors of depression. However, problem-focused coping was moderately associated with depression in the negative direction, and behavioral disengagement (a form of avoidance coping) was moderately associated with depression in the positive direction. Furthermore, problem-focused coping moderated the association between functional disability and depression, such that greater use of problem-focused coping appeared to mitigate the negative effects of disability on adjustment to disease at lower levels of symptom severity.

When anxiety was examined, a different pattern of predictors emerged. Focusing on and venting of emotions was moderately associated with higher levels of anxiety, whereas problem-focused coping was moderately associated with lower levels of anxiety. Focusing on and venting of emotions, particularly negative emotions such as fear and anxiety, could contribute to higher levels of worry, or reflect higher levels of worry. Coping did not moderate the association between disability and anxiety (not reported), but the main effect of disability was not statistically significant.
Multiple Sclerosis Sequelae and Psychological Adjustment to Disease

In this study, an overall disability score generated from the Performance Scales was utilized as a measure of common MS sequelae. The Performance Scales assess disability in MS across multiple symptom domains, including mobility, fatigue, cognitive, bladder/bowel, spasticity, hand function, vision, and sensory. There are no published cut-off scores to aid in the interpretation of the Performance Scales, and few studies report mean Performance Scales scores. Visual inspection of the mean Performance Scales score in this sample relative to the possible range of scores suggests that the participants in this sample reported low-to-moderate levels of disability. In this study, we found a positive, moderate association between functional disability and depression. Functional disability was not associated with anxiety in bivariate analyses, but it was weakly associated with anxiety in the negative direction in one of the two hierarchical linear regression models predicting anxiety scores.

Other research examining overall disability as a correlate of depression in MS has likewise detected a significant positive association between these two factors. Gay, Vrignaud, Garitte, and Meunier (2010) assessed disability in 115 people with MS utilizing a clinician-rated scale, the Expanded Disability Status Scale (EDSS), that examines disability in similar domains as the Performance Scales. Gay and colleagues (2010) observed a moderate, positive association between functional disability and depression. They postulate that loss of autonomy resulting from disease progression precipitates the development or worsening of depressive symptoms. Disease-related changes in the CNS and periphery, as well as overlap in the measurement of functional disability and somatic symptoms of depression, could also contribute to the observed relationship between disability and depression (Gay et al., 2010). Although neuroimaging studies lend support to a biological basis of depression in MS, depression levels among people with MS
are similar to levels of depression in patients diagnosed with conditions other than MS, including conditions that do not involve the CNS (Baskhi et al., 2000; Zorzon et al., 2002; Dalton & Heinrichs, 2005).

As noted in the Introduction, a number of studies fail to detect an association between functional disability and depression (Patton et al., 2003), or they find that lower levels of functional disability are associated with higher levels of depression (Chwastiak et al., 2002; Lynch et al., 2001; McIvor et al., 1984). Null or mixed findings could be attributed to the restricted range in disability among people with MS participating in research. Patients with the highest levels of disability may be unable to participate in research, attenuating the association between disability and depression. Theoretically, people who are in earlier stages of MS and report lower levels of disability may exhibit poorer adjustment to disease because they have not yet developed adequate strategies for coping with their illness. In this sample, people with MS had been living with the diagnosis for an average of eight years, and we found that number of years living with an MS diagnosis was negatively associated with depression, but this was controlled for in multivariate analyses.

In this study, we detected a weak negative association between functional disability and anxiety in one, but not both, hierarchical linear regression models. In bivariate analyses, functional disability was not significantly associated with anxiety. Furthermore, when all types of MS were included in the hierarchical linear regression models, as opposed to dichotomized type of MS, the association between functional disability and anxiety was consistently non-significant (not reported). Indices of model fit were also slightly better when all types of MS were controlled for in multivariate analyses. Thus, the significant, negative association between
functional disability and anxiety in the one multivariate model may be due to residual confounding.

Other researchers have likewise found no association between functional disability and anxiety (e.g., Korostil & Feinstein, 2007; Dahl, Stordal, Lydersen, & Midgard, 2009; Gay et al., 2010); however, some studies report positive findings even when they administer self-report measures of both anxiety and disability (e.g., Bruce & Arnett, 2009). For example, Garfield and Lincoln (2011) examined factors influencing anxiety in 157 MS patients. Anxiety was measured using the Hospital Anxiety and Depression Scale, and functional disability was assessed using Guy’s Neurological Disability Scale, a self-report rating of the severity of 12 common MS symptoms. Garfield and Lincoln (2011) found that participants with higher levels of disability were more likely to experience clinical levels of anxiety. A recent meta-analysis identified 28 studies examining the relationship between functional disability in MS and anxiety (Butler, Matcham, & Chalder, 2016). They observed that 18 of these studies detected a significant, positive relationship between anxiety and disability at either the bivariate or multivariate level of analysis. The authors noted that the effects of disability were diminished in multivariate analyses (Butler et al., 2016).

Inconsistent findings across studies with respect to the relationship between functional disability and anxiety in MS may be due to several factors. First, differences in sample characteristics (e.g., community sample versus clinic sample) may alter the influence of functional disability on anxiety. Second, differences in the measurement of anxiety could influence findings. In the present study, we assessed worry as opposed to fear or other indices of anxiety in order to minimize overlap with physical symptoms of MS. The severity of MS symptoms can bias the measurement of somatic symptoms of anxiety, particularly somatic
symptoms such as muscle tension and fatigue (Jones, Salem, & Amtmann, 2018). Third, as highlighted in the meta-analysis described above, the effects of disability on anxiety may be diluted in multivariate analyses. The influence of disability on anxiety may be weak and masked by more influential independent variables or obscured by moderators not examined in our research. Fourth, it is possible that the unpredictability and uncertainty of MS symptoms, as opposed to the severity of these symptoms, is related to anxiety. Unpredictability and uncertainty about future threats or negative events are thought to play central role in anxiety (Grupe & Nitschke, 2013), and potentially depression (Carleton et al., 2012).

**Emotion Regulation and Psychological Adjustment to Multiple Sclerosis**

In this study, emotion dysregulation was assessed using the Difficulties in Emotion Regulation Scale (DERS), which is a widely-used, comprehensive measure of emotion regulation deficits. The DERS assesses emotion dysregulation in multiple dimensions, but we used an overall emotion dysregulation score because the scores for each dimension were highly correlated. To our knowledge, there are no published cut-off scores to facilitate the interpretation of the DERS, but Becerra and colleagues (2013) reported mean DERS scores across several clinical and non-clinical samples. We found that the emotion dysregulation levels in this sample of MS patients were higher than those reported by healthy controls, but lower than those reported by patients with bipolar disorder, depression, and anxiety, in the study conducted by Becerra et al., 2013.

Consistent with findings from the general population, high levels of overall emotion dysregulation were associated with high levels of depression and anxiety in this sample of MS patients (Aldao et al., 2010). Emotion dysregulation accounted for 24% of the observed variance in depression levels (transformed), and 26% of the observed variance in anxiety. To date,
research on emotion dysregulation in people with MS is limited even though emotion
dysregulation in the general population has been linked to mood and anxiety disorders, which are
the most prevalent psychiatric comorbidities in this patient population. Phillips and colleagues
(2014) conducted a small study comparing emotion regulation in 31 people with MS and 31
healthy controls. Phillips and colleagues (2014) administered the DERS to assess emotion
dysregulation. They measured mood and anxiety with the Hospital Anxiety and Depression
Scales. As noted in the Introduction, Phillips and colleagues (2014) found that people with MS
consistently reported greater emotion dysregulation across the six dimensions of the DERS
relative to healthy controls. Additionally, they found that greater emotional dysregulation was
associated with higher levels of depression, but not anxiety. It is possible that Phillips and
colleagues were unable to detect a significant association between emotion dysregulation and
anxiety because of the small sample size and lack of sensitivity of the anxiety component of the
Hospital Anxiety and Depression Scale, as it only has seven items.

In physically healthy samples, emotion dysregulation has been consistently linked to
internalizing disorders including both depression and anxiety. As summarized in the
Introduction, Aldao and colleagues (2010) conducted a meta-analysis examining the relationship
between emotion regulation strategies and psychopathology in clinical and non-clinical samples.
They found that emotion dysregulation, in the form of strategies such as avoidance and
suppression, was consistently associated with both depression and anxiety, and that this
association may be stronger when psychological symptoms are more severe (i.e., in clinical
samples). Nolen-Hoeksema and Aldao (2011) later published research examining the association
between emotion dysregulation and depressive symptoms across different age categories of
adults from the community. Nolen-Hoeksema again found that maladaptive emotion regulation
strategies were associated with depressive symptoms, and that this association held across age groups and genders. Thus, the association between emotion dysregulation and psychiatric symptoms appears to be robust and generalizable to different subsets of the general population. The results of the present study indicate that emotion regulation has implications for psychiatric comorbidity in MS, replicating findings in the general population and warranting further research.

**Emotion Regulation as a Moderator of the Relationship Between Multiple Sclerosis Sequelae and Psychological Adjustment to Disease**

In this study, emotion regulation moderated the association between functional disability in MS and depression, but it did not moderate the association between functional disability and anxiety. As noted above, the main effects of functional disability and emotion dysregulation were statistically significant in the model predicting depression. Additionally, the interaction between functional disability and emotion dysregulation was statistically significant such that the effect of emotion regulation ability on depression was stronger at lower levels of functional disability. In the model predicting anxiety, the main effect of both emotion regulation and functional disability were statistically significant, but the strength of the association between functional disability and anxiety was weak and not present in bivariate analyses. Given the weak and inconsistent relationship between functional disability and anxiety, it is not surprising that the interaction term between emotion dysregulation and functional disability was likewise not significant.

Although we were not able to identify similar research in MS or other patient populations, research conducted with healthy participants suggests that emotion regulation ability moderates the relationship between stress and well-being. However, it appears that the
moderating effect of emotion regulation may differ depending on the population and the nature of the stress. Extremera and Rey (2015) found that emotion regulation ability moderated the influence of perceived stress on depression and happiness, but the moderation only held for men in their convenience sample of 677 adults. Specifically, higher levels of emotion dysregulation exacerbated the negative effect of high stress levels on wellbeing. At high levels of stress, males with greater emotion dysregulation experienced increased depression and decreased happiness relative to males with lower emotion dysregulation. The impact of stress on well-being was similar across emotion regulation ability at low levels of stress.

In our research, we found that the buffering effect of emotion regulation on the association between functional disability and depression was greater at low levels of functional disability, which could be considered a measure of disease-related stress. At high levels of functional disability, the positive association between functional disability and depression was fairly consistent across levels of emotion regulation ability. Our sample was predominantly female limiting our ability to examine gender differences in the moderation effect. The finding that emotion regulation mitigated the effect functional disability on depression at lower as opposed to higher levels of functional disability seems at odds with the findings of Extremera and Rey (2015). In addition to obvious differences in methods of measuring well-being and emotion regulation, it is possible that emotion regulation skills are not enough to allay the detrimental effects of disability or disease-related stress on well-being at later stages of disease progression. Additional interventions may be needed, such as in the form of instrumental support, to help address disruptions in day-to-day activities or social support to combat the isolation that typically coincides with greater disability.
Coping and Psychological Adjustment to Multiple Sclerosis

In this study, we examined emotion-focused, problem-focused, and avoidance strategies for coping with stress and their relation to adjustment to disease. We found that for both depression and anxiety, higher levels of problem-focused coping were associated with lower levels of psychological symptoms. Additional relationships emerged between other coping strategies and psychological adjustment to disease, but they differed by type of psychological symptoms. Higher levels of avoidance coping, in the form of behavioral disengagement, were associated with higher levels of depression, but not anxiety. Higher levels of focusing on and venting of emotions were associated with higher levels of anxiety, but not depression.

**Problem-focused and emotion-focused coping.** In the MS literature, greater use of problem-focused coping has generally been associated with lower levels of psychological distress. This finding has been replicated in cross-sectional (McCabe et al., 2004; Goretti et al., 2009) and longitudinal studies (Pakenham, 1999), as well as in our research. Problem-focused coping was negatively associated with both depression and anxiety in multivariate analyses. Alternatively, some studies find only weak or limited support for the association between problem-focused coping and adjustment to MS (Jean et al., 1999; McCabe, 2005; Lynch et al., 2001; Pakenham, 1999). Studies generally find that greater reliance on emotion-focused coping is linked to higher levels of distress in people with MS (Dennison, et al., 2009; Pakenham, 1999). Our study partially replicates this finding as we observed that greater reliance on focus on and venting of emotions was associated with higher levels of anxiety, but not depression.

Although not examined in this study, the goodness-of-fit model may help explain variability in findings across studies in terms of the relationship between coping and adjustment to MS. The goodness-of-fit model proposes that the adaptiveness of a coping strategy depends on
how well it matches or fits the appraisal of the stressor. To the extent that a stressor is appraised as controllable, problem-focused coping strategies would be preferable. On the other hand, stressors that are appraised as uncontrollable would be better managed using emotion-focused or meaning-focused strategies. Theoretically, employing strategies that match the appraisal of the stressor would lead to better adjustment, while utilizing strategies that mismatch the stressor would lead to more negative outcomes (Conway & Terry, 1992; Folkman & Moskowitz, 2004).

Roubinov, Turner, and Williams (2015) applied the goodness-of-fit model to their examination of problem-focused and meaning-focused coping and adjustment to MS in a sample of 113 US veterans. Roubinov et al. (2015) found that individuals with MS who relied more heavily on problem-focused coping efforts but appraised their stressors as uncontrollable were more likely to report symptoms of depression and anxiety. Although the association did not reach statistical significance, they also found that individuals with MS who relied more heavily on meaning-focused coping strategies and perceived their stressors as uncontrollable reported fewer symptoms of depression and anxiety. The findings described by Roubinov et al. (2015) underscore the importance of assessing threat appraisal when examining adjustment to disease from a stress and coping framework. Multiple factors including symptom duration, severity, duration of disease, and type of MS could impact the perceived controllability or uncontrollability of disease-related stressors and influence the adaptiveness of the coping strategies under study.

The goodness-of-fit model, as well as the intolerance of uncertainty model of anxiety may help explain the disparate findings with respect to the association between emotion-focused coping and adjustment to disease in this sample; namely, that greater reliance on focusing on and venting of emotions was associated with anxiety but not depression. According to the goodness-
of-fit model, emotion-focused coping strategies better match threats that are perceived as uncontrollable and should promote more positive mental health outcomes when utilized in these situations. Those MS patients who rely on emotion-focused strategies to manage controllable stressors (i.e., mismatch between coping and type of stressor) may be especially vulnerable to anxiety. Reliance on emotion-focused strategies, particularly when facing controllable stressors, could reflect a predisposition to worry and rumination and tendency to avoid actively dealing with the stressor. As discussed in “Strengths and Limitations,” the emotion-focused subscales of the COPE are conflated by psychological distress. Therefore, focus on and venting of emotions may be tapping into preoccupation with negative emotion as opposed to more adaptive forms of emotion-focused coping.

Even when emotion-focused strategies are employed in response to uncontrollable stressors, the negative impact of the uncontrollability of the stressor could outweigh the potential benefits of coping for MS patients who are at risk for or experiencing anxiety. Intolerance of uncertainty, or heightened sensitivity to threats that are perceived as unpredictable or uncertain, is thought to play a central role in anxiety and other disorders, such as depression. Research suggests that the negative beliefs people hold about uncertainty and its possible consequences contribute to the development and maintenance of anxiety disorders, particularly GAD (Carleton et al., 2012). This may be particularly salient for people with MS given the unpredictable and uncontrollable nature of the disease.

Avoidance coping. As observed in this study, greater use of avoidance coping has been associated with higher levels of depression as well as other indicators of poor adjustment in individuals with MS (e.g., Goretti et al., 2009; Lynch et al., 2001; Pakenham, Stewart, & Rogers, 1997). Although avoidance receives greater attention in anxiety research, the observed
association between avoidance coping and depression in this sample of MS patients is consistent with theory, research, and treatment focusing on the role of avoidance and escape behaviors in depression (Cribb, Moulds, & Carter, 2006; Trew, 2011; Ottenbreit & Dobson, 2004). In this sample, the behavioral disengagement subscale of the COPE was positively associated with depression. Behavioral disengagement, which includes strategies such as “I reduce the amount of effort I’m putting into solving the problem” and “I give up the attempt to get what I want,” is consistent with the withdrawal and inactivity that characterize depression (Trew, 2011). Mental disengagement and denial were not associated with depression in this sample, although cognitive avoidance is also thought to play a central role in depression. The reason for this is unclear; it is possible these strategies are more commonly used in earlier stages of MS and among people who are newly diagnosed. Alternatively, rumination, which is another a form of cognitive avoidance but not measured by the COPE, may be more common in this patient population.

Other research on adjustment to MS has found that avoidance coping is positively associated with anxiety; however, we failed to detect an association between these two factors in this sample. Anxiety has been less well-studied than other indicators of adjustment to MS, such as depression and quality of life. Tan-Kristanto and Kiropoulos (2014) assessed coping and psychological symptoms in a sample of 129 individuals newly diagnosed with MS. In bivariate analyses, greater use of multiple avoidance coping strategies (i.e., behavioral disengagement, denial, and substance use coping) was associated with higher anxiety levels. In multivariate analyses, however, only one of these strategies – denial – was positively associated with anxiety. Likewise, in our sample of MS patients, mental disengagement, behavioral disengagement, and denial were all positively, albeit weakly, associated with anxiety in bivariate analyses. These associations were no longer significant in multivariate analyses, even when a composite of these
three avoidance strategies was formed (not reported). It is possible that the associations between avoidance coping and anxiety that emerged in the bivariate analyses were obscured in multivariate analyses due to lack of power or dissipated after controlling for potential confounding variables such as demographic or disease factors. There may be other possible moderators of the association between avoidance coping and anxiety we did not consider (e.g., gender, threat appraisal). Moreover, avoidance coping, as measured by the COPE, may be more closely associated with other types of anxiety than GAD, which is the focus of the PSWQ administered in this study. GAD is characterized by avoidance of internal experiences; however, avoidance takes the form of worry, a cognitive strategy that is not assessed by the avoidance subscales of the COPE. Rather than denying or distracting oneself with thoughts or activities unrelated to the stressor, as assessed by the COPE avoidance subscales, worry itself serves as a distraction from the stressor or negative state (Roemer, Salters, Raffa, & Orsillo, 2005).

**Problem-Focused Coping as a Moderator of the Relationship Between Multiple Sclerosis Sequelae and Depression**

Several studies have examined coping as a moderator of the association between functional disability psychological adjustment in people with MS; however, findings are mixed in the literature. In this study, we found that greater use of problem-focused coping was more strongly associated with better psychological adjustment to disease, as indicated by lower depression scores, when levels of functional disability were low. We did not establish any other moderating effects of coping on the association between functional disability and depression. The moderating effect of problem-focused coping on the relationship between functional disability and depression is consistent with the goodness-of-fit hypothesis. Disease-related stressors, such as those related to tasks of daily living or role functioning, would likely be more
controllable at lower levels of functional disability; thus, problem-focused coping would be better matched to stress appraisal at lower levels of disability, leading to lower levels of depression. Conversely, at high levels of functional disability when stressors are less controllable, problem-focused coping would be less beneficial or adaptive.

Our findings are largely in contrast with research conducted by Mohr, Goodkin, Gatto, and Van Der Wende (1997a), who found a significant interaction between planful problem-solving, depression, and functional impairment such that the negative association between planful problem-solving and depression was stronger in the high disability versus the low disability group. The cross-sectional design of both studies prevents researchers from drawing conclusions about the directionality of the complex relationship between coping, depression, and disability. Mohr et al. (1997a) propose two explanations for their findings: (1) increasing levels of disability produces depression, which compromises patients’ ability to engage in active coping strategies, and (2) increasing levels of disability reduces patients’ ability to engage in active coping strategies, which increases their vulnerability to depression. These explanations are not mutually exclusive, as the relationships between these variables could be bidirectional and transactional.

Differences in sample characteristics, measurement, and methods may explain the discrepant findings between our study and the study conducted by Mohr and colleagues (1997a). Mohr and colleagues (1997a) recruited patients from an MS clinic, and their sample had a larger proportion of males and higher levels of disability. Disability was determined using a clinician-rated rated scale of mobility as opposed to a self-report measure assessing. Additionally, disability was dichotomized in their analyses as low-to-moderate versus high impairment. Of the 91 patients with complete data, only 23 were assigned to the high impairment group, which was
defined as inability to walk, with or without assistance. Dichotomizing impairment and using such a high threshold raises concerns about statistical power and the representativeness of the subsamples, particularly those with high levels of impairment. For example, willingness to engage in problem-focused coping among those who are unable to walk, with or without assistance, may reflect unmeasured traits or characteristics such as optimism or resilience that protect against depression.

Our results regarding the moderating effect of problem-focused coping are more similar to those reported by Arnett and colleagues (2002) and Rabinowitz and Arnett (2009), who examined coping as a moderator of the relationship between cognitive dysfunction and depression in a sample of 55 MS patients. The researchers initially examined the relationship between these variables cross-sectionally and then replicated their findings longitudinally in a three-year follow-up study of same sample. Cognitive dysfunction was measured with a neuropsychological battery, coping was assessed with the COPE, and depression with the Chicago Multiscale Depression Inventory and Beck Depression Inventory. Arnett and colleagues (2002) and Rabinowitz and Arnett (2009) found that cognitive dysfunction was more likely to lead to depression when people with MS used high levels of avoidance coping or low levels of active coping. Conversely, cognitive dysfunction was less strongly associated with depression when people with MS reported high levels of active coping and low levels of avoidance coping. The negative association between active coping and depression was stronger among people with lower levels of cognitive dysfunction, which is consistent with our findings. Additionally, the positive association between avoidant coping and mood symptoms was stronger among people with lower levels of cognitive dysfunction (Rabinowitz & Arnett, 2009).
In their follow-up study, Rabinowitz and Arnett (2009) identified coping as a significant mediator, as well as moderator, of the association between cognitive dysfunction and depression. The model of depression in MS proposed by Arnett and colleagues (2008) centered on possible moderators of the association between MS sequelae and adjustment to disease, but the researchers acknowledged that these possible moderators may serve as mediators as well. In the model of depression in MS and in the literature on adjustment to chronic illness at large, coping has primarily been examined within a stress-buffering framework, with coping as a moderator of the relationship between stress and adjustment to disease. Rabinowitz and Arnett (2009) argue that disease-related stressors, such as cognitive disability, may additionally affect adjustment to disease indirectly by way of coping. Cognitive dysfunction and potentially other MS symptoms could diminish patients’ ability to employ “adaptive” (e.g., active) coping, making it more likely that they will utilize “maladaptive” (e.g., avoidant) coping strategies and ultimately increase risk for depression and other adverse mental health outcomes (Rabinowitz and Arnett, 2009). In their mediational model, Rabinowitz and Arnett (2009) operationalized coping as a “composite index” of active coping and avoidant coping, allowing them to consider how an individual utilizes both approaches within and across stressful encounters. Independently, active coping and avoidant coping did not mediate the association between cognitive dysfunction and depression, but the composite index was a significant mediator of this association. Although we did not examine coping as a mediator in our research or examine the relative contribution of different coping approaches to overall adjustment to disease, these are important directions for future research.

**Additional Findings of Interest**

In addition to addressing the primary and secondary aims, our findings shed light on demographic and disease-related correlates of MS. Many of the significant associations between
demographic and disease-related factors and MS that emerged in bivariate analyses were no longer statistically significant after controlling for functional disability. In bivariate analyses, we found a negative correlation between age and anxiety, as well as a trend toward a negative correlation between age and depression. A similar pattern was observed by Jones et al. (2012) in their large-scale study of psychological adjustment in 4,000 individuals with MS conducted via the web portal of the MS Registry in the United Kingdom. Wood and colleagues (2013) likewise observed that the prevalence of anxiety, but not depression decreased over time in their longitudinal study of 198 people with MS. This is consistent with patterns of anxiety and depression in the general population as the prevalence of these conditions generally decreases with increasing age (Byers, Yaffe, & Covinsky, 2010; Kessler et al., 2005; Kessler et al., 2010).

In our sample, number of years living with an MS diagnosis was negatively correlated with both depression and anxiety. Additionally, years living with MS symptoms was negatively correlated with anxiety. Findings from other research is mixed. For example, some studies find that longer duration of illness is associated with poorer emotional functioning (Benito-Leon, et al., 2002). Others find no association between duration of illness and psychological adjustment (Gay et al., 2010; Korostil & Feinstein, 2007). Compared to those who are newly diagnosed with MS, people who have lived with the disease for longer may have greater acceptance of their illness and developed more effective ways of coping with their illness and related stressors as their disease progresses.

Sociodemographic factors including race/ethnicity, relationship status, income, education, and employment status were not associated with depression and anxiety in our sample once other variables were added to the models. Likewise, other studies have failed to detect a significant association between a range of demographic factors and psychological adjustment to
MS (e.g., Korostil & Feinstein, 2007; Jones et al., 2012). This may be due to diminished variability with respect to sociodemographic factors in this sample and in people with MS at large, as MS predominantly affects Caucasian women of Northern European ancestry. On the other hand, in bivariate analyses, gender was associated with anxiety but not depression in this sample; specifically, women reported significantly higher levels of anxiety than men, which is consistent with findings from the general population (e.g., Kessler et al., 2010). Likewise, Korostil and Feinstein (2007) found that women with MS reported higher levels of anxiety in their sample of 130 patients recruited from an MS clinic. Given the observed association between anxiety and gender in this sample, the lack of association between depression and gender is somewhat surprising. Men are typically diagnosed with more severe forms of MS, which could directly and indirectly contribute to elevated levels of depression.

In our sample, we found that: (1) type of MS and symptom exacerbation status were associated with depression in bivariate analyses; and (2) that type of MS but not exacerbation status were associated with anxiety in bivariate analyses. Different patterns of association emerged between type of MS and psychological adjustment to disease depending on the mental health outcome examined. Participants with primary-progressive MS and patients who were unsure of their type of MS generally reported higher levels of depression than patients with relapsing remitting MS, secondary progressive MS, and progressive-relapsing MS. Although distributions of depression scores differed significantly between groups, pairwise comparisons did not reach statistical significance after adjusting for multiple comparisons. Additionally, participants who were experiencing an MS flare-up, or who were unsure if they were experiencing a flare-up at the time of survey completion, reported higher levels of depression.
Median levels of depression differed significantly between people who were experiencing an MS flare-up and people who were not.

In their large-scale online survey of depression and anxiety in MS, Jones et al. (2012) likewise found that participants with primary progressive MS reported higher levels of depression than people with other forms of MS. Primary progressive MS is generally a more severe course of MS characterized by gradual progression of disease from its onset with fewer periods of remission and relapse. Moreover, in their examination of MS relapse and depression, Moore et al. (2012) found that prevalence of depression during MS relapse was significantly higher than at two- and six-months post-relapse. This is consistent with our finding that people with MS in periods of symptom exacerbation reported higher depression levels than people with MS who were not experiencing an exacerbation. Overall, the positive associations between primary-progressive type of MS and disease exacerbation status in our sample likely reflect the significant relationship between disease severity and elevated depression.

With respect to anxiety, we found that participants who were unsure of their type of MS and participants with relapsing-remitting MS reported the highest levels of anxiety. The uncertain and unpredictable nature of a relapsing-remitting disease course or unknown disease course may exacerbate anxiety symptoms in people with MS, which is consistent with the intolerance of uncertainty model of worry. Conversely, participants with progressive forms of MS reported lower levels of anxiety in this sample despite a more severe disease course. Some of these participants may have also been living with MS for longer as relapsing-remitting MS often transitions into secondary-progressive MS. Moore et al. (2012) likewise found that participants with relapsing-remitting MS, but not secondary progressive MS, reported higher levels of anxiety.
In this sample, exacerbation and remission status were not significantly associated with anxiety. This is at odds with other studies of people with MS. For example, McCabe (2005) found that participants experiencing an MS flare-up reported higher levels of anxiety, and established this association prospectively. Likewise, Burns, Nawacki, Siddique, Pelletier, and Mohr (2014) conducted prospective research with a sample of MS participants and found that anxiety, as well as depression levels, were elevated during periods of exacerbation and pseudo-exacerbations. It is possible that differences in the measurement of anxiety between this study and other research accounts for the contradictory findings with respect to the association between anxiety and symptom status. Worry, as measured in this study, may be less sensitive to changes in symptom exacerbation and remission and more reactive to the unpredictable nature of the disease. Other types of anxiety characterized by more overt forms of behavioral avoidance, such as panic disorder or social anxiety disorder, may be more closely linked to MS symptom severity. Worsening MS symptom severity could exacerbate avoidance behaviors, such as social isolation and withdrawal from activities. Moreover, as noted earlier, the measurement of other types of anxiety may be biased among people with more severe MS symptoms due to the overlap of somatic symptoms of anxiety and physical symptoms of MS.

We included “uncertain” as a response category when assessing MS type and exacerbation and remission status. Participants selecting this category as a response to questions asking about MS type and exacerbation status reported elevated depression scores, although pairwise comparisons did not reach statistical significance after adjusting for multiple comparisons. Participants reporting an “uncertain” type of MS reported significantly higher levels of anxiety than participants with progressive forms of MS (i.e., progressive-relapsing, secondary progressive). Other research examining illness uncertainty more closely has likewise
found an association between this factor and poor psychosocial adjustment to disease. In a small sample of 50 patients with MS, McNulty et al. (2004) observed a negative association between perceived illness uncertainty and successful psychosocial adjustment to disease that persisted even after controlling for potential confounders including demographic, social, and disease variables. Additionally, Kroencke et al. (2001) found that MS patients experiencing an exacerbation reported higher levels of uncertainty about their disease and higher levels of depression. Higher levels of uncertainty mediated the association between an MS flare-up of symptoms and higher levels of depression reported during this period (Kroencke et al., 2001). In adjustment to chronic disease, psychological distress resulting from illness uncertainty is thought to stem from the negative interpretations, assumptions, and predictions individuals hold surrounding the unpredictable and ambiguous nature of their disease (Mullins et al., 2001). This concept is closely related to intolerance of uncertainty, which is thought to be central to anxiety and has been explored as a transdiagnostic factors contributing to other conditions, such as depression (Boswell, Thomspon-Hollands, Farchione, & Barlow, 2013).

Strengths and Limitations

The primary strength of this study is its focus on an understudied yet important construct, emotion regulation, in individuals with MS. To date, few research studies have examined emotion regulation and its relation to adjustment to disease in a sample of patients with MS. The MS literature has largely focused on coping as opposed to emotion regulation. Although these constructs are overlapping, there are notable distinctions. Emotion regulation refers to the automatic or effortful strategies people use to monitor, evaluate, and modify their emotional experiences, which may be positive or negative (Gross, 1999; Thompson & Calkins, 1996). Coping, on the other hand, refers to effortful cognitive or behavioral strategies used to manage
stressful encounters. Emotion regulation, by definition, is more closely related to emotional states than coping. It warrants special attention in the literature on adjustment to MS due to the high prevalence of mood and anxiety disorders in this patient population. Deficits in emotion regulation have been linked to the onset and maintenance of a wide range of these and other psychiatric disorders, and deficits in emotion regulation serve as important targets for mental health treatment (Berking & Wupperman, 2012). While coping strategies are integral components of evidence-based psychological treatments, such as traditional cognitive-behavioral therapy, emotion regulation strategies play a central role in third-wave therapies, including dialectical behavioral therapy, mindfulness-based cognitive therapy, and acceptance and commitment therapy. In the context of psychotherapy, helping individuals with MS better regulate their emotions would theoretically increase their ability to engage in goal-directed behavior and access effective emotion regulation strategies, including adaptive ways of coping with disease-related stressors.

A secondary strength of this study is its theory-based approach to the examination of adjustment to MS. As previously noted, stress and coping have long dominated the published research on adjustment to MS. With the exception of the transactional theory of stress and coping, theory-driven approaches to the study of adjustment to MS are notably absent from the literature. Research on adjustment to MS is mainly descriptive or exploratory in nature. Arnett and colleagues’ (2008) model of depression in MS, which is the one guiding this research, provides a comprehensive framework for the examination of mental health outcomes in MS. Their model integrates previous findings from disparate areas of MS research and allows for flexibility when considering various moderators that may explain inconsistent or weak relationships between common sequelae of MS and depression. In this study, we expanded the
model to include emotion regulation as a potential moderator and to include anxiety as a mental health outcome of interest.

Another strength of this research is that its examination of mental health in MS was not restricted to depression. Research on adjustment to MS has primarily examined depression and quality of life, whereas other mental health outcomes, such as anxiety have largely been ignored. In recent years, a growing number of studies have begun to focus on anxiety in MS. In this study, as well as other research, both anxiety and depression were found to be highly prevalent among people with MS (Boeschoten et al., 2017), underscoring the importance of continued research on a range of mental health indicators in MS. Although we intended to examine mental health-related quality of life, along with depression and anxiety, mental-health related quality of life was strongly correlated with both depression and anxiety. Therefore, it was dropped from analyses. The findings of this research suggest that different correlates of depression and anxiety emerge in people with MS, so there may be a benefit to examining more specific as opposed to broad indicators of mental health in this population, particularly as quality of life has already been extensively studied in MS.

In this study, we strived to utilize sensitive, valid, and reliable measures of mental health, emotion regulation, and coping. We believe this is an improvement on prior research conducted by this researcher as well as some other research on coping in MS. When conducting research in patient populations, researchers may elect to employ brief measures to minimize burden to participants and improve response rates; however, a drawback to utilizing brief measures is that sensitivity, specificity, and reliability could be compromised. For example, in previous research, this writer administered the Brief COPE as opposed to the full COPE to minimize burden to participants; however, this presented a challenge when examining individual coping subscales.
because each subscale of the Brief COPE only contains two-items versus four in the full COPE. 

Alternatively, when measuring mental health outcomes, researchers may administer assessments that are contaminated by somatic symptoms, which overlap with symptoms of physical illnesses.

For the purposes of this study, we limited the scope of our research so we could measure fewer psychological constructs more comprehensively. Moreover, we selected measures of mental health outcomes previously utilized in MS patients and ones that de-emphasized somatic symptoms. For example, the measures of depression and anxiety selected for this study featured a larger number of items than other mental health screening measures and generally demonstrated good psychometric properties in validation studies. Moreover, the items in these measures minimized overlap with physical symptoms of MS and had been utilized in people with MS before. Hind et al. (2016) conducted a systematic review of psychometric validation studies of depression measures in MS patients. They found the CES-D, the predecessor to the CESD-R, to be “uncontaminated” by somatic symptoms of MS (Hind et al, 2016). However, they also noted that relevant validation studies of mental health measures in MS were scarce, and that published studies were plagued by “poor quality reporting” (Hind et al., 2016, p. 278). Moreover, we selected the Penn State Worry Questionnaire as our measure of anxiety because of its emphasis on worry as opposed to other dimensions of anxiety, such as fear or somatic symptoms, which could overlap with MS symptoms.

Another strength of this study is its relatively large sample size of close to 200 participants with MS. In recent years, there have been a growing number of studies on adjustment to MS with large sample sizes; however, historically, research on adjustment to MS has employed small samples. Studies involving detailed assessment of mental health outcomes and their correlates tend to have smaller samples, even those studies published recently.
Research conducted with large samples, such as the North American Research Committee on MS (NARCOMS), are generally more focused on the physical aspects of the disease and quality of life. However, NARCOMS and other patient registries present opportunities for researchers to conduct large-scale research on adjustment to MS in the future.

Although the present research has several strengths, it is not without limitations. First and foremost, a major shortcoming of this research is its cross-sectional design. Cross-sectional designs abound in research on adjustment to MS. There is a need for cross-sectional findings to be replicated prospectively. This is particularly important when examining mental health and correlates such as coping and emotion regulation. Coping and emotion regulation can influence mental health status and vice versa, although the potential bidirectional or transactional associations between these two variables have not been thoroughly addressed in research on adjustment to MS. Longitudinal research by Arnett and Randolph (2006) on depression in MS revealed that mood and coping co-varied such that increases in depression coincided with decreases in active coping, and decreases in depression coincided with increases in active coping. Establishing the temporal relationship between these variables is challenging, particularly in a field where cross-sectional study designs abound. Furthermore, mental health status can influence participants’ physical health and potentially their subjective rating of MS symptoms. Somatic symptoms of depression include fatigue, sleep disruptions, cognitive complaints, and changes in appetite. These symptoms may mimic MS symptoms, elevating subjective ratings of functional disability. Likewise, somatic symptoms of anxiety may overlap with MS symptoms, making it difficult to disentangle disease-related versus psychiatric effects. In addition, it is possible that mental health status influences patients’ perceptions of their disease-related symptoms. Longitudinal research exploring the relationship between depression,
fatigue, and cognitive problems in people with MS found that treatment for depression and fatigue led to reductions in subjective ratings of cognitive complaints, even though performance on objective measures remained unchanged (Kinsinger, Lattie, & Mohr, 2010).

A second limitation of this research, which was alluded to previously, is that the survey was self-administered online and thus all measures were self-reported. This poses less of a concern when measuring mood and anxiety symptoms, although a diagnostic interview would be the gold standard for diagnosing psychological disorders. For functional disability and other disease-related variables, clinician ratings would be preferable to self-report. Research suggests that patient-reported disability generally correlates highly with clinician-rated disability in MS, except when assessing the following symptom areas: cognitive, sensory, and spasticity (Learmonth et al., 2013; Marrie & Goldman, 2007). When measuring coping and emotion-regulation, a potential limitation of self-report is that individuals with limited insight into their emotions and behavior may not accurately report the strategies they use to manage their stress or emotions, as they are unaware of them. Moreover, there is the potential for response bias, whereby participants answer survey items in a manner that is misleading. For example, participants may respond in a way that exaggerates adaptive strategies for managing stress and emotions and minimizes maladaptive strategies. Hopefully, the anonymous nature of the survey encouraged more honest responding from participants.

A third limitation of this research, specific to the secondary aims, is that emotion-focused coping was measured using the COPE as opposed to the emotional approach coping scales developed by Stanton et al. (1994). Stanton et al. (1994) pointed out that widely used measures of coping in the health psychology field fail to distinguish between emotional avoidance and emotional approach coping strategies, or omit emotional approach items altogether. Furthermore,
many emotion-focused coping items in popular measures such as the COPE are contaminated by psychological distress or psychopathology. Therefore, findings between emotion-focused coping and psychopathology is unsurprising and potentially accounted for by measurement issues. From a clinical perspective, emotional processing and expression are an important and beneficial way of coping with stress, and may not be adequately measured by the COPE. We chose to utilize the COPE because it was popular in the MS literature, and it would allow us to compare our findings to those of other studies. Future studies should incorporate the emotional approach coping scales developed by Stanton and colleagues (1994), in addition to the COPE or other popular coping scales, as this would allow for direct comparison of both measures in this population.

Another limitation of this research is that it was conducted with a convenience sample of participants with MS. Relying on a convenience sample can introduce selection bias such that the participants who volunteered to take part in the survey differed systematically from the underlying population of people with MS. Given that the survey was administered online, participants had to be familiar with and able to access the internet to complete it. Moreover, participants needed to be physically capable of completing the online survey. MS symptoms such as visual, cognitive, or muscle-related changes could interfere with the completion of the survey. Therefore, it is possible that the participants who successfully completed the survey were less disabled than people with MS at large. Because of how the survey was advertised and access, the participants in this study may have been more connected to resources online and in their communities, which could potentially influence adjustment to disease.

There are other limitations inherent in online surveys. There is the possibility that healthy individuals without MS completed the survey, although this is unlikely given how the survey was advertised. Additionally, eligibility criteria were stated at the beginning of the survey and
participants needed to confirm eligibility to gain access to the survey. If any healthy individuals were incentivized to participate under false pretenses in order to enter the raffle for a gift card, nearly all of the survey questions were optional, so they could have skipped them and navigated to the end of the survey to the link for the raffle. It is possible that participants with MS, particularly those suffering from cognitive deficits, could have completed the survey more than once and responded differently on the psychological assessments so repeat entries could not be identified. The unique, recognizable acronym for the study’s title, “teaming up to raise awareness about life with MS (teaMS),” which was displayed clearly on all study advertisements and at the top of every survey page, likely reduced repeat survey entries.

Implications and Future Research

The findings from this research underscore the importance of ways of managing emotions and stress in psychological adjustment to MS. Emotion regulation was more strongly associated with psychological adjustment to MS than functional disability when examining both depression and anxiety as outcomes. In fact, functional disability was not linked to anxiety after controlling for other demographic and disease factors, even though functional disability was moderately associated with depression. Our findings replicate previous research linking problem-focused coping to better psychological adjustment to MS, as well as avoidant coping strategies to poorer psychological adjustment to disease. In this case, behavioral disengagement was associated with increased levels of depression, but not anxiety. Anxiety theoretically goes together with experiential avoidance, but in this study, we assessed worry, which may center on avoidance of internal states (e.g., emotions) as opposed to external states or stimuli (Newman & Llera, 2011). Emotion-focused coping strategies, namely focus on and venting of emotions, were associated with higher levels of anxiety. However, as noted above, there are some limitations in our
measurement of emotion-focused coping, and the subscales assessing these strategies are contaminated by psychological distress.

Our research revealed interesting moderating effects of emotion dysregulation and coping on the relationship between functional disability and depression, but not anxiety. The findings of this research suggest that ways of managing emotions and stress have a greater influence on psychological health at lower levels of functional disability, and that the mitigating effects of these strategies on the psychological impact of disability are diminished at higher levels of disease severity. This has important implications for psychosocial interventions for people with MS. Particularly in early stages of disease, bolstering ways of managing emotions and stress may facilitate adaptive psychological adjustment to disease. As people with MS face increasing levels of disability, interventions may need to shift or expand to include more instrumental forms of support, such as assistance carrying out day-to-day activities or adaptations of their environments to promote independence. Moreover, people with MS may benefit from psychological interventions focused on the transition to more progressive illness and ways of maintaining quality of life in the face of physical limitations.

Future research should replicate this study’s findings prospectively to elucidate the temporal relationship between emotion regulation and psychological adjustment to MS. The relationship between emotion regulation and mental health is likely bidirectional or transactional, and such complex relationships cannot be captured in cross-sectional study designs. Future research should also explore the various dimensions of emotion regulation and their relation to mental health among people with MS, as they already have been in the general population. In addition to assessing overall emotion dysregulation, we assessed rumination and suppression with strategy-specific measures, but have yet to examine their relation to adjustment to MS. With
respect to indicators of adjustment to MS, research should continue to focus on depression and anxiety as their association with emotion regulation is not well understood. There is already published research, albeit scarce, upon which future studies can build. Future research on anxiety in MS should assess multiple dimensions of anxiety, including but not limited to worry, and attempts should be made to validate measures of anxiety in MS, particularly given the close association between somatic symptoms of anxiety and symptoms of MS. Moreover, future research should strive to expand their evaluation of adjustment to MS to include other disorders, such as bipolar disorder and substance use disorder.

Coping has been studied extensively in MS, typically with depression or health-related quality of life as the dependent variable. With respect to coping in MS, research has predominantly focused on problem-focused and emotion-focused strategies, while other coping strategies are generally overlooked. There is considerable overlap between coping and emotion regulation. For example, strategies such as reappraisal, avoidance, and acceptance are common to both coping and emotion regulation, and they have not been thoroughly examined in people with MS. These strategies should be incorporated in future research on depression, anxiety, and other mental health indicators of adjustment to MS. Moreover, given the plethora of observational research on coping and adjustment to MS, future research should concentrate on the study of interventions aimed at improving ways of coping as a means of promoting psychological well-being among people with MS.
References


https://doi.org/10.1016/j.brat.2010.06.002


http://doi.org/10.1016/j.apnu.2007.02.008


Psychological Bulletin, 98(2), 310-357. http://dx.doi.org/10.1037/0033-2909.98.2.310


Dantzer, R. (2009). Cytokine, sickness behavior, and depression. Immunology and Allergy


https://doi.org/10.1191/1352458502ms839oa


http://dx.doi.org/10.2307/2136617

http://dx.doi.org/10.1037/0022-3514.50.5.992


https://doi.org/10.1034/j.1600-0404.2001.00022.x


unipolar depression: The effects of acceptance and suppression of subjective emotional experience on the intensity and duration of sadness and negative affect. *Behaviour Research and Therapy, 46*(11), 1201-1209. https://doi.org/10.1016/j.brat.2008.08.001


https://doi.org/10.1016/S1607-551X(09)70436-X


http://dx.doi.org/10.1037/0022-3514.53.1.5


Table 1.

Demographic Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>43.42</td>
<td>12.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>$n$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>175</td>
<td>88.83</td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>11.17</td>
</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or Cohabitating</td>
<td>128</td>
<td>65.31</td>
</tr>
<tr>
<td>Single</td>
<td>68</td>
<td>34.69</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>165</td>
<td>84.18</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>3.06</td>
</tr>
<tr>
<td>Black/African-American</td>
<td>15</td>
<td>7.65</td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>3.06</td>
</tr>
<tr>
<td>Other Race/Ethnicity</td>
<td>4</td>
<td>2.04</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$25,000</td>
<td>40</td>
<td>21.16</td>
</tr>
<tr>
<td>$25,000-$49,999</td>
<td>46</td>
<td>24.34</td>
</tr>
<tr>
<td>$50,000-$74,999</td>
<td>29</td>
<td>15.34</td>
</tr>
<tr>
<td>$75,000-$99,999</td>
<td>31</td>
<td>16.40</td>
</tr>
<tr>
<td>$100,000+</td>
<td>43</td>
<td>22.75</td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School Degree or Equivalent</td>
<td>12</td>
<td>6.09</td>
</tr>
<tr>
<td>Some College but No Degree</td>
<td>48</td>
<td>24.37</td>
</tr>
<tr>
<td>Associate's Degree</td>
<td>26</td>
<td>13.20</td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>66</td>
<td>33.50</td>
</tr>
<tr>
<td>Graduate Degree</td>
<td>45</td>
<td>22.84</td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed Full-Time</td>
<td>70</td>
<td>35.71</td>
</tr>
<tr>
<td>Employed Part-Time</td>
<td>37</td>
<td>18.88</td>
</tr>
<tr>
<td>Unemployed or Retired</td>
<td>30</td>
<td>15.31</td>
</tr>
<tr>
<td>Disabled, Unable to Work</td>
<td>59</td>
<td>30.10</td>
</tr>
</tbody>
</table>
Table 2.

*Disease and Mental Health Characteristics of Participants*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Living with MS Diagnosis</td>
<td>8.07</td>
<td>7.56</td>
</tr>
<tr>
<td>Years Living with MS Symptoms</td>
<td>13.18</td>
<td>11.01</td>
</tr>
<tr>
<td>Performance Scales (PS) Score</td>
<td>14.4</td>
<td>7.16</td>
</tr>
<tr>
<td>CESD-R Score</td>
<td>19.06</td>
<td>14.15</td>
</tr>
<tr>
<td>Penn State Worry Questionnaire Score</td>
<td>48.84</td>
<td>14.40</td>
</tr>
<tr>
<td>SF-36 Emotional Well-being Score</td>
<td>63.73</td>
<td>21.20</td>
</tr>
<tr>
<td>SF-36 Role Functioning/Emotional Score</td>
<td>59.97</td>
<td>43.80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Multiple Sclerosis (MS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relapsing-Remitting</td>
<td>152</td>
<td>76.77</td>
</tr>
<tr>
<td>Secondary Progressive</td>
<td>18</td>
<td>9.09</td>
</tr>
<tr>
<td>Primary Progressive</td>
<td>13</td>
<td>6.57</td>
</tr>
<tr>
<td>Progressive-Relapsing</td>
<td>4</td>
<td>2.02</td>
</tr>
<tr>
<td>Unsure</td>
<td>11</td>
<td>5.56</td>
</tr>
<tr>
<td>Exacerbation of MS Symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>33</td>
<td>16.84</td>
</tr>
<tr>
<td>No</td>
<td>140</td>
<td>71.43</td>
</tr>
<tr>
<td>Unsure</td>
<td>23</td>
<td>11.73</td>
</tr>
<tr>
<td>Remission of MS Symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>87</td>
<td>43.94</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>40.91</td>
</tr>
<tr>
<td>Unsure</td>
<td>30</td>
<td>15.15</td>
</tr>
</tbody>
</table>

*Note. CESD-R = Center for Epidemiologic Studies Depression Scale-Revised; SF-36 = Rand 36-Item Health Survey.*
Table 3.

The Relationship Between Total Center for Epidemiological Studies Depression-Revised (CESD-R) Scale Scores and Demographic Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M Age</th>
<th>SD</th>
<th>r</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>176</td>
<td>43.42</td>
<td>12.05</td>
<td>-0.135</td>
<td>177</td>
<td>0.074</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M CESD-R</th>
<th>SD</th>
<th>Test Statistic&lt;sup&gt;a&lt;/sup&gt;</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>17.16</td>
<td>17.33</td>
<td>1.12</td>
<td>-</td>
<td>0.264</td>
</tr>
<tr>
<td>Female</td>
<td>161</td>
<td>19.28</td>
<td>13.77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marred or Cohabitating</td>
<td>116</td>
<td>18.62</td>
<td>13.81</td>
<td>-0.77</td>
<td>-</td>
<td>0.441</td>
</tr>
<tr>
<td>Single</td>
<td>62</td>
<td>20.39</td>
<td>14.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>150</td>
<td>18.93</td>
<td>14.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>15.50</td>
<td>13.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black/African-American</td>
<td>12</td>
<td>25.58</td>
<td>13.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>13.33</td>
<td>10.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Race/Ethnicity</td>
<td>4</td>
<td>26.00</td>
<td>21.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$25,000</td>
<td>37</td>
<td>22.41</td>
<td>14.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$25,000-$49,999</td>
<td>39</td>
<td>19.23</td>
<td>11.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$50,000-$74,999</td>
<td>28</td>
<td>20.79</td>
<td>14.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$75,000-$99,999</td>
<td>30</td>
<td>16.17</td>
<td>13.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$100,000+</td>
<td>39</td>
<td>17.77</td>
<td>14.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristic</td>
<td>N</td>
<td>M CESD-R</td>
<td>SD</td>
<td>Test Statistic</td>
<td>df</td>
<td>p</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----</td>
<td>----------</td>
<td>-----</td>
<td>----------------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School Degree or Equivalent</td>
<td>11</td>
<td>20.55</td>
<td>12.61</td>
<td>8.25</td>
<td>4</td>
<td>0.083</td>
</tr>
<tr>
<td>Some College but No Degree</td>
<td>45</td>
<td>23.36</td>
<td>14.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate's Degree</td>
<td>23</td>
<td>19.65</td>
<td>12.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>60</td>
<td>16.83</td>
<td>14.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate Degree</td>
<td>40</td>
<td>17.28</td>
<td>14.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td>4.47</td>
<td>3</td>
<td>0.215</td>
</tr>
<tr>
<td>Employed Full-Time</td>
<td>64</td>
<td>18.19</td>
<td>13.83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed Part-Time</td>
<td>36</td>
<td>17.44</td>
<td>13.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed or Retired</td>
<td>26</td>
<td>16.38</td>
<td>13.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disabled, Unable to Work</td>
<td>53</td>
<td>22.87</td>
<td>14.90</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $r_s =$ Spearman’s rho.  

*Mann-Whitney U tests were conducted to compare CESD-R scores across two groups; Kruskal-Wallis H tests were conducted to compare medians across three or more groups.*  

Due to a small number of participants in three of the five groups, a Mann-Whitney U test was conducted comparing CESD-R scores between Caucasian and non-Caucasian or minority participants.
Table 4.

The Relationship Between CESD-R Scores and Disease Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>rs</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Living with MS Diagnosis</td>
<td>197</td>
<td>8.07</td>
<td>7.56</td>
<td>-0.21</td>
<td>179</td>
<td>0.006</td>
</tr>
<tr>
<td>Years Living with MS Symptoms</td>
<td>198</td>
<td>13.18</td>
<td>11.01</td>
<td>-0.08</td>
<td>180</td>
<td>0.271</td>
</tr>
<tr>
<td>Performance Scales Score</td>
<td>186</td>
<td>14.40</td>
<td>7.16</td>
<td>0.45</td>
<td>170</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M CESD-R</th>
<th>SD</th>
<th>Test Statistic</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of MS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relapsing-Remitting</td>
<td>140</td>
<td>18.76</td>
<td>13.66</td>
<td>10.73</td>
<td>4</td>
<td>0.03</td>
</tr>
<tr>
<td>Secondary Progressive</td>
<td>14</td>
<td>14.29</td>
<td>13.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Progressive</td>
<td>11</td>
<td>23.64</td>
<td>16.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressive-Relapsing</td>
<td>4</td>
<td>7.25</td>
<td>6.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>11</td>
<td>28.55</td>
<td>15.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exacerbation of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td>13.58</td>
<td>2</td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>31</td>
<td>29.23</td>
<td>14.77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>125</td>
<td>16.02</td>
<td>12.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>22</td>
<td>22.45</td>
<td>16.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remission of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td>2.83</td>
<td>2</td>
<td>0.243</td>
</tr>
<tr>
<td>Yes</td>
<td>82</td>
<td>16.82</td>
<td>13.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>72</td>
<td>19.56</td>
<td>13.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>26</td>
<td>24.73</td>
<td>16.21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. CESD-R = Center for Epidemiological Studies Depression-Revised; rs = Spearman’s rho.

*aThe results of the Kruskal-Wallis H test run examining differences in distribution of CESD-R scores across groups.

*bThe results of the Kruskal-Wallis H test run examining differences in median CESD-R scores across groups.*
Table 5.

The Relationship Between Penn State Worry Questionnaire (PSWQ) Scores and Demographic Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M PSWQ</th>
<th>SD</th>
<th>Test Statistic</th>
<th>df₁</th>
<th>df₂</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>179</td>
<td>43.42</td>
<td>12.05</td>
<td>-0.35</td>
<td>177</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>-3.305</td>
<td>177</td>
<td>-</td>
<td>0.001</td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>37.55</td>
<td>17.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>159</td>
<td>50.43</td>
<td>16.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship Status</td>
<td>0.419</td>
<td>176</td>
<td>-</td>
<td>0.676</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or Cohabiting</td>
<td>119</td>
<td>48.76</td>
<td>16.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>59</td>
<td>49.88</td>
<td>16.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td>0.262b</td>
<td>176</td>
<td>-</td>
<td>0.524</td>
</tr>
<tr>
<td>Caucasian</td>
<td>151</td>
<td>48.79</td>
<td>17.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>48.50</td>
<td>17.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black/African-American</td>
<td>12</td>
<td>50.75</td>
<td>15.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>5</td>
<td>56.20</td>
<td>7.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Race/Ethnicity</td>
<td>4</td>
<td>49.25</td>
<td>25.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$25,000</td>
<td>37</td>
<td>52.43</td>
<td>16.59</td>
<td>1.219</td>
<td>4</td>
<td>168</td>
<td>0.305</td>
</tr>
<tr>
<td>$25,000-$49,999</td>
<td>43</td>
<td>45.47</td>
<td>19.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$50,000-$74,999</td>
<td>26</td>
<td>51.00</td>
<td>16.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$75,000-$99,999</td>
<td>29</td>
<td>50.86</td>
<td>13.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$100,000+</td>
<td>38</td>
<td>46.58</td>
<td>16.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristic</td>
<td>n</td>
<td>M PSWQ</td>
<td>SD</td>
<td>Test Statistic</td>
<td>df₁</td>
<td>df₂</td>
<td>p</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----</td>
<td>--------</td>
<td>-------</td>
<td>----------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
<td>0.977</td>
<td>4</td>
<td>174</td>
<td>0.422</td>
</tr>
<tr>
<td>High School Degree or Equivalent</td>
<td>11</td>
<td>58.27</td>
<td>15.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some College but No Degree</td>
<td>45</td>
<td>47.62</td>
<td>17.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate's Degree</td>
<td>22</td>
<td>50.05</td>
<td>14.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>59</td>
<td>48.73</td>
<td>16.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate Degree</td>
<td>42</td>
<td>47.86</td>
<td>17.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td>0.776</td>
<td>3</td>
<td>175</td>
<td>0.509</td>
</tr>
<tr>
<td>Employed Full-Time</td>
<td>67</td>
<td>48.57</td>
<td>17.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed Part-Time</td>
<td>33</td>
<td>52.94</td>
<td>14.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed or Retired</td>
<td>27</td>
<td>47.22</td>
<td>14.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disabled, Unable to Work</td>
<td>52</td>
<td>47.96</td>
<td>18.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *r* = Pearson correlation coefficient.

*Independent sample t-tests were conducted to compare mean PSWQ score between two groups; one-way ANOVAs were conducted to compare mean PSWQ scores across three or more groups.*

*Due to a small number of participants in three of the five groups, an independent samples t-test was conducted comparing CESD-R scores between Caucasian and non-Caucasian or minority participants.*
Table 6.

The Relationship Between PSWQ Scores and Disease Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>r^a</th>
<th>df_1</th>
<th>df_2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Living with MS Diagnosis</td>
<td>197</td>
<td>8.07</td>
<td>7.56</td>
<td>-0.32</td>
<td>177</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Years Living with MS Symptoms</td>
<td>198</td>
<td>13.18</td>
<td>11.01</td>
<td>-0.29</td>
<td>178</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Performance Scales Score</td>
<td>186</td>
<td>14.40</td>
<td>7.16</td>
<td>-0.05</td>
<td>168</td>
<td>-</td>
<td>0.541</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>F</th>
<th>df_1</th>
<th>df_2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of MS</td>
<td></td>
<td></td>
<td></td>
<td>5.47</td>
<td>4</td>
<td>175</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Relapsing-Remitting</td>
<td>138</td>
<td>50.17</td>
<td>16.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary Progressive</td>
<td>16</td>
<td>38.81</td>
<td>17.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Progressive</td>
<td>12</td>
<td>43.67</td>
<td>13.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressive-Relapsing</td>
<td>4</td>
<td>26.75</td>
<td>8.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>10</td>
<td>61.50</td>
<td>11.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exacerbation of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td>1.08</td>
<td>2</td>
<td>175</td>
<td>0.341</td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>52.53</td>
<td>19.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>125</td>
<td>47.73</td>
<td>16.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>21</td>
<td>50.19</td>
<td>16.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remission of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td>0.14</td>
<td>2</td>
<td>71.97</td>
<td>0.868</td>
</tr>
<tr>
<td>Yes</td>
<td>81</td>
<td>49.57</td>
<td>15.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>74</td>
<td>48.07</td>
<td>19.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>25</td>
<td>48.76</td>
<td>14.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. PSWQ = Penn State Worry Questionnaire.

^aSpearman’s rank correlation analyses were conducted to test association between years living with MS diagnosis and PSWQ score, as well as between years living with MS symptoms and PSWQ score. Pearson correlation analysis was conducted to test association between Performance Scales score and PSWQ score.

^bWelsh’s ANOVA computed to examine group differences in PSWQ score by symptom remission status.
Table 7.

**Hierarchical Multiple Linear Regression Predicting Natural-Log Transformed CESD-R Scores from MS Sequelae and Emotion Dysregulation**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>ΔR²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 Education Level&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.14</td>
<td>0.10</td>
<td>-0.09</td>
<td>0.03</td>
<td>0.057</td>
</tr>
<tr>
<td>Step 2 Type of MS&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.31</td>
<td>0.13</td>
<td>0.15</td>
<td>0.12</td>
<td>0.002</td>
</tr>
<tr>
<td>No Exacerbation of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.32</td>
<td>0.14</td>
<td>0.14</td>
<td>0.16</td>
<td>0.017</td>
</tr>
<tr>
<td>Unsure</td>
<td>0.24</td>
<td>0.16</td>
<td>0.09</td>
<td></td>
<td>0.121</td>
</tr>
<tr>
<td>Natural-Log Transformed Years Living with MS</td>
<td>-0.11</td>
<td>0.05</td>
<td>-0.12</td>
<td></td>
<td>0.051</td>
</tr>
<tr>
<td>Step 3 Performance Scales (PS)</td>
<td>0.04</td>
<td>0.01</td>
<td>0.34</td>
<td>0.16</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Step 4 Difficulties in Emotion Regulation Scale (DERS)</td>
<td>0.02</td>
<td>0.00</td>
<td>0.54</td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Step 5 PS x DERS</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.20</td>
<td></td>
<td>0.001</td>
</tr>
</tbody>
</table>

*Note. N = 139. CESD-R = Center for Epidemiological Studies Depression-Revised; B = unstandardized beta coefficients; β = standardized beta coefficients.
<sup>a</sup>Bachelor’s degree or higher
<sup>b</sup>Relapsing-remitting MS versus other type of MS
Table 8.

Hierarchical Multiple Linear Regression Predicting PSWQ Scores from MS Sequelae and Emotion Dysregulation

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>ΔR²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gendera</td>
<td>16.28</td>
<td>3.69</td>
<td>0.27</td>
<td>0.26</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Age</td>
<td>-0.25</td>
<td>0.10</td>
<td>-0.18</td>
<td>0.01</td>
<td>0.204</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of MSb</td>
<td>2.40</td>
<td>2.65</td>
<td>0.06</td>
<td>0.01</td>
<td>0.367</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance Scales (PS)</td>
<td>-0.38</td>
<td>0.16</td>
<td>-0.16</td>
<td>0.00</td>
<td>0.910</td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulties in Emotion Regulation Scale (DERS)</td>
<td>0.38</td>
<td>0.04</td>
<td>0.56</td>
<td>0.26</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Step 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS x DERS</td>
<td>0.00</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.00</td>
<td>0.874</td>
</tr>
</tbody>
</table>

Note. N = 143. PSWQ = Penn State Worry Questionnaire; B = unstandardized beta coefficients; β = standardized beta coefficients.  
*aFemale gender

*bRelapsing-remitting MS versus other type of MS
Table 9.

**Hierarchical Multiple Linear Regression Predicting Natural-Log Transformed CESD-R Scores from MS Sequelae and Coping**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>ΔR²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Level⁹</td>
<td>0.02</td>
<td>0.10</td>
<td>0.01</td>
<td>0.844</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of MS⁹</td>
<td>0.22</td>
<td>0.12</td>
<td>0.12</td>
<td>0.061</td>
<td></td>
</tr>
<tr>
<td>Exacerbation of MS Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>-</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.19</td>
<td>0.14</td>
<td>0.09</td>
<td>0.172</td>
<td></td>
</tr>
<tr>
<td>Unsure</td>
<td>0.14</td>
<td>0.16</td>
<td>0.05</td>
<td>0.397</td>
<td></td>
</tr>
<tr>
<td>Natural-Log Transformed Years with MS</td>
<td>-0.18</td>
<td>0.05</td>
<td>-0.22</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>PS Score</td>
<td>0.05</td>
<td>0.01</td>
<td>0.43</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>COPE Use of Emotional Support</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
<td>0.930</td>
<td></td>
</tr>
<tr>
<td>COPE Focus on and Venting of Emotions</td>
<td>0.03</td>
<td>0.02</td>
<td>0.10</td>
<td>0.120</td>
<td></td>
</tr>
<tr>
<td>COPE Mental Disengagement</td>
<td>0.02</td>
<td>0.02</td>
<td>0.05</td>
<td>0.410</td>
<td></td>
</tr>
<tr>
<td>COPE Behavioral Disengagement</td>
<td>0.09</td>
<td>0.02</td>
<td>0.32</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>COPE Denial</td>
<td>0.02</td>
<td>0.02</td>
<td>0.05</td>
<td>0.418</td>
<td></td>
</tr>
<tr>
<td>COPE Problem-Focused Coping</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.24</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>PS x Problem-Focused Coping</td>
<td>0.00</td>
<td>0.00</td>
<td>0.18</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>PS x Behavioral Disengagement</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.698</td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 143. CESD-R = Center for Epidemiological Studies Depression-Revised; B = unstandardized beta coefficients; β = standardized beta coefficients.*

⁹Bachelor’s degree or higher

⁹Relapsing-remitting MS versus other type of MS
Table 10.

*Hierarchical Multiple Linear Regression Predicting PSWQ Scores from MS Sequelae and Coping*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>Δ R²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender¹</td>
<td>11.39</td>
<td>3.77</td>
<td>0.22</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.32</td>
<td>0.11</td>
<td>-0.23</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of MSᵇ</td>
<td>0.19</td>
<td>2.93</td>
<td>0.01</td>
<td>0.948</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS Score</td>
<td>0.08</td>
<td>0.19</td>
<td>0.03</td>
<td>0.697</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPE Use of Emotional Support</td>
<td>0.31</td>
<td>0.44</td>
<td>0.06</td>
<td>0.480</td>
<td></td>
</tr>
<tr>
<td>COPE Focus on and Venting of Emotions</td>
<td>1.83</td>
<td>0.46</td>
<td>0.32</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>COPE Mental Disengagement</td>
<td>0.49</td>
<td>0.53</td>
<td>0.07</td>
<td>0.359</td>
<td></td>
</tr>
<tr>
<td>COPE Behavioral Disengagement</td>
<td>0.61</td>
<td>0.48</td>
<td>0.10</td>
<td>0.210</td>
<td></td>
</tr>
<tr>
<td>COPE Denial</td>
<td>-0.28</td>
<td>0.55</td>
<td>-0.04</td>
<td>0.616</td>
<td></td>
</tr>
<tr>
<td>COPE Problem-Focused Coping</td>
<td>-0.57</td>
<td>0.22</td>
<td>-0.20</td>
<td>0.010</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* N = 151. PSWQ = Penn State Worry Questionnaire; B = unstandardized beta coefficients; β = standardized beta coefficients.

¹Female gender

ᵇRelapsing-remitting MS
Figure 1. A model of depression in MS proposed by Arnett et al. (2008), reproduced with permission from the authors.
Figure 2. Emotion dysregulation moderates the association between functional disability and depressive symptoms. CESD-R = Center for Epidemiological Studies Depression-Revised. CESD-R scores were natural-log transformed to achieve a normal distribution.
Figure 3. Problem-focused coping moderates the association between functional disability and depressive symptoms. CESD-R = Center for Epidemiological Studies Depression-Revised. CESD-R scores were natural-log transformed to achieve a normal distribution.