2020

A Microlongitudinal Study of Menopause Symptoms and Problematic Eating in Midlife Women

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A MICROLONGITUDINAL STUDY OF MENOPAUSE SYMPTOMS AND PROBLEMATIC EATING IN MIDLIFE WOMEN

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

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May 2020

Acknowledgements

First, I want to thank my advisor and dissertation director, Natalie Dautovich, for her continual support and guidance over the past five years. I thank you for always encouraging me and fostering my skills as a researcher and future psychologist. I am truly grateful for our time together and look forward to continuing our collaboration in the future. I would also like to thank my committee for their support, feedback, and assistance with the project. I wish to thank my husband, Jon for his unwavering love, support, and patience, as well as my family and friends including my sisters, Lindsay and Sami, who were always willing to provide encouragement when needed. I also wish to thank my mom, who has always encouraged me to follow my dreams and "never settle." I lastly wish to thank my dad, who although was not here to witness me complete this project, taught me the importance of hard work and always fostered my inquisitive nature. Special thanks goes to my Lulu, who was always willing to keep me company during long hours of writing and analyses and is always an excellent reminder to be grateful for the simple pleasures of life.

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Abstract

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Women in midlife are at risk for engagement in problematic eating behavior which is associated with negative mental and physical health outcomes. Despite this risk, little is known about precipitating factors that may increase risk in this population. One specific, yet unstudied, factor that may increase risk for problematic eating in midlife women is menopause, which is characterized by distinct symptomatology (e.g., vasomotor symptoms, negative mood, sleep). The purpose of the current study was to investigate the associations among psychological, behavioral, and social symptoms of menopause and problematic eating behavior in midlife women using both retrospective and prospective methodologies. As menopause is a dynamic process that involves daily fluctuations of symptoms that may covary over time, the current study aimed to understand how menopause symptoms are globally *and* temporally associated with problematic eating behaviors. First, the study investigated how a comprehensive range of menopause symptoms (i.e., sleep, depressive symptoms, anxiety, pain, vasomotor symptoms, cognitive complaints, and sexual behavior) mapped onto problematic eating behaviors using

retrospective, self-report questionnaires. Next, the study investigated how daily menopause symptoms (i.e., sleep, negative mood, vasomotor symptoms) temporally related to daily engagement in problematic eating behaviors both between-person (mean-level), and within-person (day-to-day level) using a seven-day, daily diary study. Overall, the study found that greater endorsement of menopause symptoms including worse mood, sleep, pain, cognitive complaints, and vasomotor symptoms, was associated with greater endorsement of problematic eating behavior. Additionally, across seven days, worse negative mood, more bothersome vasomotor symptoms, and worse sleep quality was associated with greater endorsement of daily problematic eating. On a day-to-day basis, worse mood was associated with daily problematic eating. These findings support the association between menopause symptoms and problematic eating in midlife women highlight the need for continued examination of this association.

A Microlongitudinal Study of Menopause Symptoms and Problematic Eating in Midlife Women

The goal of this project is to increase understanding of eating behavior in midlife, specifically how menopause may promote problematic eating behavior in midlife women. Problematic eating behavior is a broad domain that is defined as eating behaviors and attitudes that increase risk for weight-related health outcomes and eating disorder prognosis, yet do not meet the threshold for eating disorder diagnosis (Yoon et al., 2018). Problematic eating can include behaviors which restrict energy intake (e.g., consciously limiting food intake to prevent weight gain or to promote weight loss), behaviors that lead to disinhibition (e.g., uncontrolled eating in the presence of palatable foods; Fairburn & Beglin, 1994), and also include attitudes concerning shape and weight (e.g., feeling "fat," dissatisfaction with weight or shape; Slevec & Tiggemann, 2011). Although individual problematic eating behaviors, such as limiting food intake or overconsuming food on occasion, do not constitute concern, a repeated tendency to engage in these specific eating behaviors can lead to adverse health outcomes including eating disorders and weight-related diseases (Marcus, Bromberger, Wei, Brown, & Kravitz, 2007).

Emerging research demonstrates that women in midlife are at risk for engagement in problematic eating behavior (Micali et al., 2017). Furthermore, engagement in problematic eating behavior in midlife is associated with an increased risk for negative health outcomes related to excess weight (e.g., metabolic syndrome, diabetes), eating disorder prognosis, and poor mental health symptomatology (Yoon & Jacobs, 2017). Despite this risk, limited work has investigated precipitating factors that may increase risk of engagement in problematic eating behaviors in this population (Marcus et al., 2007). As such, identifying precipitants to

problematic eating is important for both prognosis and treatment of negative health outcomes in midlife women.

One specific factor that increases risk of eating pathology and negative weight-related health outcomes in midlife is menopause (Micali et al., 2017). Menopause, or the cessation of menstruation in midlife, is characterized by distinct symptomatology such as vasomotor symptoms (i.e., hot flashes, night sweats), cognitive complaints, sleep disturbances, negative mood (i.e., depressive symptoms, anxiety), changes in sexual desire, and pain (Greene, 2008; Nelson et al., 2005). Despite the many psychological, behavioral, and social symptoms associated with menopause, most research investigating menopause as a precipitant to problematic eating behavior has focused on hormonal and biological mechanisms (Baker et al., 2017). Although many of the behavioral and psychosocial factors (i.e., depressive symptoms, sleep) have been implicated as independent risk factors for problematic eating behavior in general adult samples (Chaput, Despres, Bouchard, & Tremblay, 2011), limited work to date has examined how these factors precipitate engagement in problematic eating behavior during menopause. The small body of work investigating menopause symptoms and problematic eating has investigated how depressive symptoms in midlife are associated with single construct eating behaviors (e.g., fast food consumption, stress eating). However, the extent to which a comprehensive range of menopause symptoms are associated with a variety of problematic eating constructs has yet to be investigated (Crawford, Khedkar, Flaws, Sorkin, & Gallicchio, 2011; Schreiber & Dautovich, 2017). A more comprehensive understanding of how menopause symptoms may increase risk for engagement in problematic eating is necessary, as midlife women are at risk for negative health outcomes that result from problematic eating. In addition, existing research has primarily focused on eating disorders in midlife rather than sub-threshold

problematic eating behaviors (Drobnjak, Atsiz, Ditzen, Tuschen-Caffier, & Ehlert, 2014; Gagne et al., 2012; Marcus et al., 2007). Although eating disorders are serious problems which lead to a host of deterimental outcomes, subthreshold eating behaviors are more prevalent than eating disorders in this population (Mangweth-Matzek, Hoek, & Pope, 2014). Subthreshold eating disorders are also problematic in their own right and are associated with many poor health outcomes (Crow, Agras, Halmi, Mitchell, & Kraemer, 2002; Striegel-Moore et al., 2000). As such, a more thorough examination of subthreshold problematic eating behaviors, rather than eating disorder diagnoses, is warranted. Lastly, most research investigating precipitating factors that influence problematic eating behavior in midlife has used retrospective and/or cross-sectional self-report indices of problematic eating behaviors. As menopause is a dynamic process that involves daily fluctuations of symptoms that may covary over time, single-time, retrospective designs often obscure these nuances. As such, understanding how menopause symptoms are temporally associated with problematic eating behaviors in daily life is important in order to understand risk, promote healthy outcomes, and prevent negative health consequences in this population. Therefore, the current study investigated the associations among psychological, behavioral, and social symptoms of menopause and problematic eating behavior in midlife women using both retrospective and prospective methodologies.

Problematic Eating Behavior in Midlife Women

Women in midlife are at risk for problematic eating behaviors (Marcus et al., 2007). Although the definition of problematic eating behavior can be broad, current conceptualizations include dieting or restrained eating for a specific proportion of time, binge eating (i.e., eating a large amount of food in a short time period that is larger than what most people would eat in a similar time period), sensing a loss of control with eating, compensatory behaviors to avoid

weight gain (e.g., exercise, vomiting, laxative use), feeling upset or anxious over overeating and/or loss of control when eating, and endorsing shape and/or weight concerns (Yoon & Jacobs, 2017).

The current study used this conceptualization in order to identify eating behaviors and attitudes that are associated with risk for weight-related disease and eating disorder diagnosis, but may not meet the threshold or fulfill Diagnostic and Statistical Manual 5 (DSM 5; American Psychiatric Association, 2013) criteria for an eating disorder diagnosis (Yoon et al., 2018). This includes restrained eating, disinhibited eating, as well as weight and shape concerns. Previous research has found these eating behaviors to be problematic and associated with poor outcomes in adult populations (Levitan & Davis, 2010; Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016). Dietary restraint, the conscious restriction of food intake in order to control body weight or to promote weight loss, is associated with excessive food intake, body dissatisfaction and weight gain (Karlsson, Persson, Sjöström, & Sullivan, 2000; Polivy & Herman, 1985; Stice, Cameron, Killen, Hayward, & Taylor, 1999; van Strien, 1989). Although restraint is often utilized as a treatment for obesity with short-term weight loss benefits, there is conflicting evidence surrounding the sustainability and usefulness of this strategy as it often does not lead to long-term weight loss, and rather, is associated with increased risk of negative health outcomes (Schaumberg et al., 2016). Additionally, disinhibited eating, defined as a tendency to eat more than usual due to a loss of control over intake or emotional distress, is a problematic eating behavior as it is associated with binge eating, mood dysregulation, and eating in the absence of hunger, all symptoms which are themselves risk factors for eating disorder pathology and negative weight-related health outcomes (Karlsson et al., 2000; Levitan & Davis, 2010; Schaumberg et al., 2016; van Strien, van der Zwaluw, & Engels, 2010). Lastly, weight and shape

concerns, which include feeling dissatisfied with weight and/or shape, having the desire to lose weight or fear of weight gain, and feeling "fat" (Fairburn & Beglin, 1994), can influence engagement in problematic eating behavior, and increase risk of both poor weight outcomes and disordered eating (Slevec & Tiggemann, 2011).

Problematic eating behaviors are also a concern for women in midlife (Yoon & Jacobs, 2017). In a recent evaluation of a multiethnic sample of women in midlife, many respondents endorsed multiple problematic eating behaviors including regular binge eating, dissatisfaction with eating patterns, and fear of weight gain, with estimates of 3-11%, 29.3% and 9.2%, respectively (Gagne et al., 2012; Marcus et al., 2007). An additional investigation indicated that problematic eating behaviors are four times as likely in women compared with men, and peak during midlife (i.e., 45-55 years of age; Hilbert, de Zwaan, & Braehler, 2012). Women in midlife were also more likely to report disordered eating behaviors and concerns compared with older women (Gravener, Haedt, Heatherton, & Keel, 2008; Lewis & Cachelin, 2001). Emerging research also indicates that subthreshold eating behaviors (i.e., individual problematic behaviors that do not meet diagnostic criteria for eating disorder diagnosis) are more common compared with threshold diagnosis of eating disorders in midlife women (Mangweth-Matzek, Hoek, & Pope, 2014). These subthreshold eating disordered behaviors include restrictive and disinhibited eating (Mangweth-Matzek, Hoek, & Pope, 2014). Although eating disorders and weight-related health concerns are typically viewed as separate, distinct conditions, emerging research demonstrates that these conditions exist along a continuum with problematic eating behaviors increasing the risk for both eating pathology and obesity (Marcus et al., 2007). As such, there is a need to further understand sub-threshold, problematic eating behaviors given their impact on health and potential disease outcomes.

Weight-Related Health Outcomes in Midlife Women

Engagement in problematic eating behavior is important to investigate as it can increase risk for weight gain and obesity in midlife women. Weight gain and weight-related health outcomes are pertinent to understand in midlife as women in this age group are at particular risk for weight gain, with 42% of women between the ages of 40-60 reported as obese as indicated by a BMI equal to or above 30 (Ogden, Carroll, Fryar, & Flegal, 2015). Although weight gain and obesity status are not an indicator of poor health independently, weight gain during this time period is associated with increased risk for negative health outcomes including type II diabetes, metabolic syndrome, breast cancer, and higher rates of mortality (de Wit et al., 2010; Flegal, Kit, Orpana, & Graubard, 2013; Gariepy, Nitka, & Schmitz, 2010; Grundy et al., 2005). As such, weight gain in midlife is pertinent to understand. Additionally, although weight gain and obesity are complex in origin, with influence from biological, social, and psychological factors, eating behavior is a strong predictor of weight gain and negative weight-related outcomes in this population (Hays et al., 2002). In particular, increased and/or excessive caloric intake (e.g., disinhibition) are risk factors for negative weight and health outcomes in midlife (Yoon et al., 2018).

Eating Disorders in Midlife Women

In addition to weight gain and related health outcomes, problematic eating behaviors also increase risk for eating disorders in midlife women. The *DSM 5* provides criteria for diagnosis of eating disorders including Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder (American Psychiatric Association, 2013). Many of the aforementioned problematic eating behaviors (i.e., binge eating, restriction of food intake) serve as criteria for particular diagnoses (Marcus et al., 2007). For example, diagnosis of anorexia nervosa requires persistent restriction

of energy intake, fear of weight gain, and shape/weight concerns. Binge Eating Disorder, conversely, includes criteria such as recurrent episodic overeating episodes, lack of control over eating, and feeling upset over overeating (American Psychiatric Association, 2013). As such, persistent engagement in particular problematic eating behaviors increases risk for diagnosis of an eating disorder (Gagne et al., 2012).

Prevalence estimates of eating disorders in midlife women are sparse, as the bulk of research has focused attention on adolescent and young adult samples. However, a growing number of researchers and clinicians assert that eating disorders occur frequently in women over 40 (Kearney-Cooke & Isaacs, 2004). A recent statistic suggests that approximately 5% of women meet criteria for eating disorders in midlife with an additional 4.8% displaying subthreshold eating disorder behaviors (Mangweth-Matzek, Hoek, & Pope, 2014). There is also an increase in inpatient admissions for eating disorder treatment for women 35 and above in comparison to adolescent and young adult cohorts (Wiseman, Sunday, Klapper, Harris, & Halmi, 2001). Despite increasing rates of prevalence, eating disorders are often underdiagnosed in midlife as presentation differences exist. For example, binge eating and bulimia are more prevalent in midlife in comparison to anorexia in young adult women (Mangweth-Matzek, Hoek, & Pope, 2014; Micali et al., 2017; Schwartz, M. B., & Brownell, 2001). Additionally, there remains an assumption that eating disorders are only found in adolescent and young women (Hall & Driscoll, 1993; Lewis & Cachelin, 2001). Therefore, although limited research exists, it appears that eating disorders are likely underdiagnosed in midlife women. With problematic eating behavior serving as risk factors and prognosis of eating disorders, investigation of etiology and precipitants leading to this behavior is warranted.

Etiology of Problematic Eating Behaviors in Midlife Women

The etiology of problematic eating behaviors in midlife is complex. Although engagement in problematic eating behaviors such as food restriction and binge eating can be related to a chronic presentation of an earlier-onset eating disorder or a relapse of a remitted eating disorder (Lester, Keel, & Lipson, 2003; Scholtz, Hill, & Lacey, 2009), emerging research suggests that approximately 69% of women in midlife endorse late onset problematic eating behaviors and symptoms, suggesting that midlife is a particularly vulnerable time period for the onset of these behaviors (Lester et al., 2003).

Potential factors leading to vulnerability for the onset of problematic eating in midlife women includes a variety of age-related factors, with one important factor being the menopause transition. Menopause is a developmental period in midlife when women transition to the post-reproductive time period. Specifically, the menopause transition is characterized by the cessation of a regular menstrual cycle (Soules et al., 2001). Menopause is characterized by distinct categories including the pre-menopause, peri-menopause, and post-menopause periods (Woods & Mitchell, 2005). Pre-menopause is defined as the time period before the onset of menstrual irregularity in midlife (Soules et al., 2001). Peri-menopause, conversely, is the period in which there is irregularity of menstrual cycles during a twelve-month time period. Lastly, post-menopause is the period in which a woman has not had a menstrual cycle in the last twelve-month time period. The distinct stages of the menopause transition have been studied empirically and have been defined through the Stages of Reproductive Workshop (STRAW) criteria (see Table 1.) which has been validated across a multitude of studies (Soules et al., 2001).

Table 1. *Menopause Stages based on the STRAW Criteria*

	Reproductive Time Period	Menopause Transition		Post menopause
Terminology	Pre-menopause	Peri-menopause (Early)	Peri-menopause (Late)	Post-menopause
Menstrual Cycle	Regular menstrual cycle	Variable cycle length (> than 7 days different from normal)	≥ 2 skipped cycles and an interval of > than 60 days of amenorrhea	No menstrual cycle for past 12 months

Menopause is associated with a multitude of symptoms with the most common and impairing symptoms including hormonal fluctuations, sleep impairment, mood concerns (i.e., depression, anxiety), cognitive complaints, pain, and decreases in sexual desire (Cray, Woods, Herting, & Mitchell, 2012; Whiteley, DiBonaventura, Wagner, Alvir, & Shah, 2013). Table 2 includes a list of the most prevalent menopause symptoms (Freeman, Sammel, Liu, & Martin, 2003). Approximately 80% of women in midlife report one or more of these symptoms during the menopause transition, with 60% experiencing three or more symptoms (Freeman et al., 2003). Menopause-related symptoms also impact quality of life with impairment related to physical, emotional, and social domains (Geukes, van Aalst, Nauta, & Oosterhof, 2012; Whiteley et al., 2013).

In addition to impacting overall functioning, menopause is also associated with problematic eating. Emerging research suggests that women undergoing the menopause transition demonstrate significantly higher rates of weight gain and problematic eating symptoms compared with premenopausal women. (Baker & Runfola, 2016; Mangweth-Matzek, Hoek, & Pope, 2014). In particular, a recent study found that peri-menopausal women engaged in greater levels of binge eating in comparison to premenopausal women (Mangweth-Matzek, Hoek, Rupp, et al., 2014). This finding was upheld after controlling for age and BMI, highlighting the unique

influence of menopause on poor weight-related outcomes in this population rather than the aging process or weight, two additional theories as to why problematic eating behavior may be prevalent in this population (Baker & Runfola, 2016; Mangweth-Matzek, Hoek, Rupp, et al., 2014). Despite evidence that menopause may increase the tendency to engage in problematic eating, only a small body of research has examined the etiology of problematic eating during menopause. There has been a recent emphasis on exploring hormonal changes in menopause as a precipitating factor leading to problematic eating, but the evidence is inconclusive (Baker et al., 2017). Furthermore, pathways leading to problematic eating are complex, with hormonal changes accounting for only one pathway by which menopause may lead to problematic eating in this population (Baker et al., 2017).

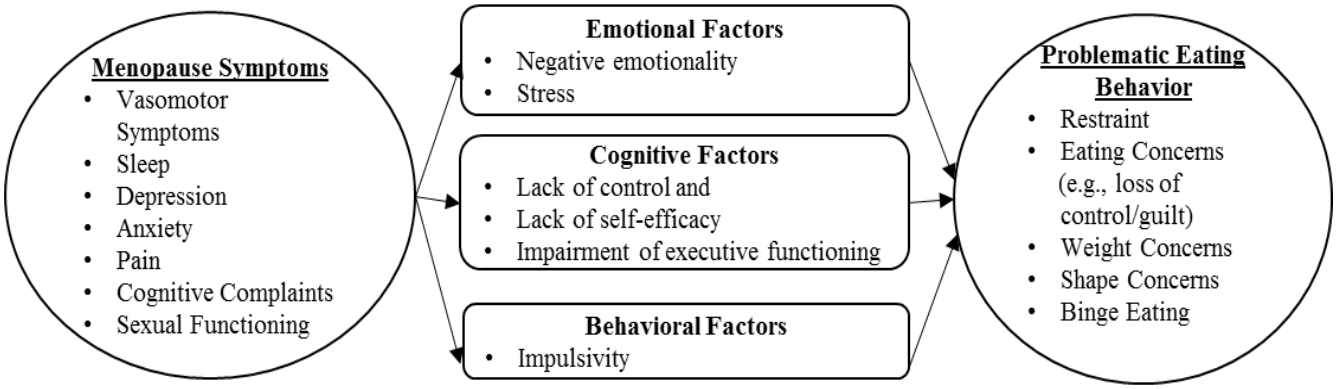

Figure 1. Theoretical model of the association between menopause symptoms and problematic eating via emotional, cognitive and behavioral factors.

Conceptual support exists for emotional, cognitive, and behavioral factors underlying the emergence or increase of problematic eating in women in menopause (see Figure 1). Although it is beyond the scope of the current study to investigate underlying mechanisms tying menopause symptoms to problematic eating, there is support for these pathways (Barbee & Timmerman, 2015; Freeman, Sammel, Lin, & Nelson, 2006). Emotionally, negative emotionality (e.g., feeling depressed, anxious, tense, and sad) has been linked to problematic eating behaviors. In particular,

negative affect influences disinhibited eating (Freeman et al., 2006; Torres & Nowson, 2007). In addition to negative emotionality, there is evidence that stress, particularly stressors perceived as intense, bothersome, and emotionally disruptive are likely to precipitate problematic eating behavior (Crowther, Sanftner, Bonifazi, & Shepherd, 2001). Cognitively, feeling of a lack of control and/or a lack of self-efficacy is connected to problematic eating behaviors. Research in midlife women samples has identified an association between decreases in sense of self-control with increases in binge eating (Barbee & Timmerman, 2015). Impairment of executive functioning is an additional cognitive mechanism that can lead to binge eating (Barbee & Timmerman, 2015). Lastly, problematic eating can also be precipitated through behavioral mechanisms such as impulsivity. Increases in impulsivity are associated with increases in binge eating and feeling a lack of control when eating (Schag et al., 2013).

Although limited work has examined precipitants to problematic eating behavior in midlife women, menopause is a complex biopsychosocial process involving a multitude of psychological, somatic, and vasomotor symptoms that can influence emotional, cognitive, and behavioral mechanisms to influence problematic eating behavior. As such, it is relevant to explore how menopause-specific symptoms other than hormones may be associated with problematic eating behavior. The following sections explore how menopause-specific symptoms may influence eating behavior in midlife. In particular, the most prevalent symptoms of menopause including hormonal changes, impaired sleep, negative mood (i.e., depressive symptoms and anxiety), vasomotor symptoms (i.e., hot flashes and night sweats), cognitive complaints, and decreased sexual desire were examined.

Table 2. *Common Menopausal Symptoms*

Vasomotor	**Somatic**	**Psychological**
Hot flashes	*Muscle and joint pain and/or stiffness*	*Sleep impairment/insomnia*
Night sweats	*Decreased sexual desire*	*Cognitive complaints*
	Vaginal dryness	*Depressive symptoms*
	Urinary incontinence	*Anxiety*

Note. Symptoms in italics are often cited as the most bothersome and impairing symptoms of menopause (Freeman et al., 2003) and are the focus of the remainder of the literature review.

Hormonal changes. When investigating menopause and problematic eating, attention is often paid to the association between reproductive hormones and eating behavior. During other developmental transitions (e.g., menstruation), reproductive hormones play a role in eating behavior. For example, reproductive hormone changes during puberty influence the risk of eating disorder symptomology in adolescent females (Klump et al., 2013). In particular, decreased levels of estrogen during the menstrual cycle are associated with emotional eating, weight preoccupation, and body image dissatisfaction (Carr-Nangle, Johnson, Bergeron, & Nangle, 1994; Hildebrandt et al., 2015; Jappe & Gardner, 2009; Klump, Keel, Culbert, & Edler, 2008). Additionally, problematic eating behaviors such as binge eating and purging were exacerbated in women with bulimia nervosa during particular phases of the menstrual cycle when estrogen levels were low (Edler, Lipson, & Keel, 2007; Lester et al., 2003). Increases in emotional eating are also indicated during menstruation for women without eating disorder symptomatology (Carr-Nangle et al., 1994; Hildebrandt et al., 2015; Jappe & Gardner, 2009). Given that estrogen levels decrease during menopause, it is hypothesized that hormonal fluctuations may also increase risk for problematic eating behaviors in this population (Baker et al., 2017). In particular, peri-menopause involves inconsistent fluctuating levels of estrogen, whereas post-

menopause involves the cessation of menstruation as well as consistently low levels of estrogen (Santoro, Randolph, & Jr., 2011).

Recent investigations of the association between problematic eating behaviors, eating disorders, and menopause status have highlighted that peri-menopausal women have higher estimates of eating disorders compared to premenopausal women using self-report methodology (Mangweth-Matzek et al., 2013). However, studies have failed to find an association between reproductive hormones and specific eating disorder behaviors (i.e., bulimic symptomatology) in midlife women (Baker et al., 2017). As such, although hormones, specifically estrogen, might be associated with an increased prevalence of problematic eating behavior and eating disorder risk in this population, more work is needed to understand further the connection between estrogen and problematic eating behaviors. In addition, although hormones are one potential precipitating factor leading to problematic eating, it is likely that other menopause-related factors are involved in the association between problematic eating and menopause.

Sleep. An additional symptom of menopause is poor and inadequate sleep. Sleep impairment is common in midlife women and is recognized a core symptom of menopause (Lampio et al., 2017). Between 33-51% of women report sleep problems and women in the menopausal transition often rate sleep concerns as one of the most bothersome symptoms associated with menopause (Ford, Sowers, Crutchfield, Wilson, & Jannausch, 2005). In particular, menopause is associated with poor sleep efficiency, quality, duration, and timing (Appelhans et al., 2012; Choi et al., 2011; Jennings, Muldoon, Hall, Buysse, & Manuck, 2007; Taylor et al., 2016). Although inadequate sleep is a problematic menopause symptom in its own right, poor sleep is additionally linked to eating and weight-related outcomes. In menopause, sleep has largely been tied to weight outcomes rather than eating behavior. In particular, there is

support that inadequate sleep is associated with negative weight outcomes in this population which, in turn, increases risk of poor health outcomes (Appelhans et al., 2012).

Nonetheless, although limited in specific samples of midlife women, there is support that poor sleep increases risk of weight gain through problematic eating behaviors (Chaput et al., 2011). In particular, impaired sleep influences hormonal regulation of hunger and satiety, influences executive functioning such as goal-directed behavior and executive control, and alters behavioral mechanisms including impulse control, which can lead to an increase in food consumption (Anderson & Platten, 2011; Dahl, 1996; Guerrieri et al., 2007; Spiegel et al., 2004a). Impairment of executive, behavioral, and emotional functioning can lead to disinhibited eating, which includes behaviors such as eating in response to negative affect, binge eating, and not being able to resist stimulation to eat (Bryant, King, & Blundell, 2007). Although existing research primarily supports the link between poor sleep in midlife women and increased weight outcomes, there is additional support that disinhibited eating behavior increases risk of weight gain and negative weight-related outcomes in this population (Hays et al., 2002). As such, sleep is a relevant factor that may be associated with problematic eating behavior in midlife, which, in turn, could have implications for weight and weight-related health outcomes.

Negative mood. Women at midlife also experience high and fluctuating rates of negative emotionality including depressive symptoms and anxiety. Cross-sectional analyses demonstrate that up to 70% of peri-menopausal women endorse depressive symptoms compared to 30% of pre-menopausal women (Freeman et al., 2006). Longitudinal studies also highlight an increased risk for depressive symptoms during the menopause transition (Bromberger, Schott, Kravitz, & Joffe, 2015; Freeman et al., 2006). Women with a history of depression are almost five times more likely to have a diagnosis of major depression during the menopausal transition compared

to their symptom-levels during pre-menopause (Freeman et al., 2006). In addition, women with no history of major depression are two to four times more likely to report depressed mood in the menopausal transition compared with those in the premenopausal stage (Cohen et al., 2006; Freeman et al., 2006)

Although less extensively explored compared with depression, anxiety is also a negative mood that is of concern in midlife women. Women in midlife are at risk for an increase in anxiety during peri-menopause, with additional support suggesting that heightened anxiety is found in midlife women who do not have a history of anxiety symptoms (Bromberger et al., 2001, 2013; Tangen & Mykletun, 2008). It is estimated that 51% of women in midlife experience anxiety symptoms including nervousness and/or irritability (Avis et al., 2001), with additional estimates suggesting that 67% of midlife women feel tense or nervous on a daily basis (Bromberger et al., 2003). As such, anxiety is prevalent with a clinically significant impact on women in this time period (Siegel & Mathews, 2015).

Eating in response to emotion is a well-known phenomenon, with chronic negative emotionality increasing appetite and desire for energy dense food (Schiffman, Graham, Sattely-Miller, & Peterson-Dancy, 2000). This association has been demonstrated in midlife women, with higher depressive symptoms linked to higher levels of emotion-driven eating (Schreiber & Dautovich, 2017). Similar to depression, anxiety can also influence eating behavior through emotion-driven mechanisms such as an increased desire for energy dense food and overconsumption of food during periods of stress (Grilo, White, & Masheb, 2009; Pollard, Steptoe, Canaan, Davies, & Wardle, 1995). Consequently, negative mood including depressive symptoms and anxiety may precipitate problematic eating behavior in midlife women by

increasing consumption of energy dense foods as well as a greater overall intake of food (Crawford et al., 2011; Konttinen et al., 2010; van Strien et al., 2016).

Vasomotor symptoms. Vasomotor symptoms, otherwise known as hot flashes and night sweats are the most common complaint of peri-menopausal and post-menopausal women and are the most common reason women seek medical care during menopause (Nelson et al., 2005). An estimated 60-80% of women experience vasomotor symptoms during the menopausal transition with a peak in prevalence and frequency during late peri-menopause and early post-menopause (Gold et al., 2006). Hot flashes are defined as recurrent, transient episodes of flushing, perspiration, and a sensation ranging from warmth to intense heat on the upper body and face, sometimes followed by chills, anxiety, palpitations, irritability, and panic (Kronenberg, 1994; Neff, 2004). Night sweats are defined as hot flashes that occur with perspiration during sleep (Neff, 2004). Hot flashes and night sweats vary in frequency and intensity but average four minutes in length with a range of a few seconds to ten minutes. Additionally, they can occur sporadically, with some women experiencing them several times or week or sometimes once every hour (Kronenberg, 1994). Vasomotor symptoms are associated with a reduced health-related quality of life and an impact on mood, sleep, and cognitive functioning (Avis et al., 2009; Gold et al., 2006).

Although the association between vasomotor symptoms and problematic eating has yet to be investigated, vasomotor symptoms influence mood, sleep, and are often appraised as bothersome and stressful (Freeman et al., 2003). As such, it is likely that these symptoms are associated with problematic eating through emotional mechanisms. In addition, there is a significant association among vasomotor symptoms and weight, whereas vasomotor symptoms are more likely in individuals who classify as obese (Thurston & Joffe, 2011). In addition,

weight is a precursor to vasomotor symptoms (Thurston & Joffe, 2011). Despite the significant association among weight and vasomotor symptoms, mechanisms linking vasomotor symptoms and weight are unclear with only a small body of research exploring if vasomotor symptoms influence subsequent weight-related behaviors (i.e., eating behavior) and outcomes as well (Thurston & Joffe, 2011). As such, the association between vasomotor symptoms and problematic eating behaviors is relevant to investigate.

Cognitive complaints. Many women report memory concerns during menopause, including concerns related to concentration and forgetfulness (Woods, Mitchell, & Adams, 2000). Subjective cognitive problems are a common feature of menopause with prevalence ratings via self-report ranging from low to between to 62% to 92% (Betti et al., 2001; Ford, Slade, & Butler, 2004). There is evidence that acute and chronic stress in midlife women influences internal and limited resources such as attention, memory, and concentration, thus influencing cognitive capacities (Baumeister, Heatherton, & Tice, 1994; Chen, Kawachi, Berkman, Trudel-Fitzgerald, & Kubzansky, 2018; Norberg et al., 2007). Additionally, there is evidence that women are likely to experience depletion of these internal resources on a daily and continual basis (Chen et al., 2018). Few studies to date, however, have objectively investigated cognitive declines during midlife. A recent meta-analysis investigating cognitive complaints in menopause indicated that verbal fluency and verbal memory declined from peri-menopause to post-menopause. However, objective cognitive declines during menopause appeared to be quite modest (Weber, Maki, & McDermott, 2014). Despite modest objective findings to date, women in midlife subjectively report bothersome and clinically significant levels of memory complaints, suggesting significant impairment to daily functioning and quality of life (Weber et al., 2014; Woods et al., 2000).

To date, the association between menopause-specific cognitive complaints and problematic eating behavior is sparse. However, there is evidence that engagement in problematic eating such as disinhibited and restraint eating behaviors may serve as coping mechanisms to manage cognitive depletion (Almeida, 2005; Araiza & Lobel, 2018).

Sexual desire. Decreases in sexuality is an additional symptom of menopause. Specifically, women in menopause experience diminished sexual desire or interest, decreased sexual receptivity, and decreased sexual responsiveness (Avis & Crawford, 2000; Dennerstein, Dudley, & Burger, 2001; Dennerstein, Smith, Morse, & Burger, 1994). Decreases in sexual desire are related to emotional and psychological distress, lower sexual and partner satisfaction, and decreases in mental and physical health (Leiblum, Koochaki, Rodenberg, Barton, & Rosen, 2006). Although no research has explored the association between decreases in sexual desire and problematic eating behavior in midlife women, there is existing literature which indicates an association between decreased sexual desire and body image concerns (Pascoal, Narciso, & Pereira, 2012). In particular, low sexual desire is correlated with low body image including self-consciousness about body and low perceived body attractiveness in midlife women (i.e., 45-60; Pujols, Meston, & Seal, 2010). Furthermore, body dissatisfaction is a predictor of problematic eating behavior, with body image concerns precipitating binge eating and restrictive-type eating behaviors (Castellini, Lo Sauro, Ricca, & Rellini, 2017). In addition, low sexual desire can also lead to negative affect including feelings of guilt, shame, and failure which can lead to problematic eating behaviors (e.g., overeating, restricting intake; Bardone-Cone et al., 2008)).

Pain. Prevalence estimates of pain during menopause are sparse. The Melbourne Women's Midlife Health Project indicated that prevalence increases throughout the menopause transition with estimates of 41-53% of women endorsing pain during the menopause transition

with further increases at two years post-menopause (Dennerstein, Dudley, Hopper, Guthrie, & Burger, 2000). Pain in menopause varies, including joint aches, back pain, headache, and is associated with a variety of factors including both the aging process as well as menopause associated changes (Dennerstein et al., 2000; Gold et al., 2000).

To manage pain, women tend to use emotion-focused strategies including seeking emotional support or venting emotions, as well as alternative emotion-focused strategies such as catastrophizing (i.e., exaggerate the threat value of painful stimuli and negatively evaluating their ability to deal with pain) which tends to be less effective pain management (Keefe et al., 2000). Although not investigated in menopausal women, catastrophizing is linked to increased engagement in problematic eating behaviors in general adult samples with increases in binge eating (c).

Daily Menopause Symptoms and Eating Behavior

As indicated above, the investigation of menopause symptoms as precipitants to problematic eating behavior is limited, although promising. Emerging research consistently identifies a high prevalence of problematic eating behavior in this population (Slevec & Tiggemann, 2011). However, existing research has relied on retrospective, cross-sectional analyses (Gagne et al., 2012; Marcus et al., 2007). Although knowledge of the prevalence of problematic eating in menopause is valuable, there is a dearth of knowledge concerning (1) precipitants of problematic eating in menopause and (2) how menopause and problematic eating are related temporally, in daily life. As menopause is a unique time period involving both interindividual and intraindividual variability of symptom experiences among women (Woods & Mitchell, 2005), there is a need to understand both interindividual differences in symptoms as well as the unique day-to-day experiences of menopause. Interindividually, menopause is

associated with a variety of symptoms which fluctuate depending on menopausal status (Woods & Mitchell, 2005). Peri-menopause and early post-menopause, in particular, are periods in which there are higher prevalence of symptoms compared to other menopause stages. In particular, hot flashes, night sweats, sleep disturbances, and depression increase in prevalence during peri-menopause and early post-menopause (Woods & Mitchell, 2005). Although there are less data on prevalence rates on additional symptoms including cognitive and pain symptoms, menopausal women do report that these symptoms are present and bothersome (Avis, Brambilla, McKinlay, & Vass, 1994; Dennerstein et al., 2000; Woods, Mariella, & Mitchell, 2002). Consequently, research examining menopause symptoms has demonstrated interindividual, or between-person differences in symptom frequency (Moilanen et al., 2010).

In addition to interindividual differences, menopause is also a dynamic experience characterized by varying fluctuations of symptoms on a daily basis within women (i.e., intraindividually). Although research has primarily focused on differences *between* women including types of symptoms experienced throughout menopausal stages, as well as how menopause may influence future health outcomes, a very small body of research has investigated how day-to-day experiences of symptoms can fluctuate widely *within* women. Within-person fluctuations are important to examine as menopause symptoms can vary and fluctuate on a daily basis, thus differentially influencing daily behaviors. For example, a recent study found that daily menopause symptom burden had detrimental effects on daily well-being (Kishida & Elavsky, 2017). Additional daily process research has found associations between specific daily menopause symptoms (i.e., hot flashes) and negative mood (Gibson, Thurston, Bromberger, Kamarck, & Matthews, 2011). As such, the daily experience of menopause symptoms has

implications for daily psychosocial and behavioral outcomes. It remains unknown, however, how daily symptoms may predict problematic eating behaviors.

In sum, although the current literature investigating menopause and problematic eating behaviors has employed single-time, retrospective approaches and provides support that (1) problematic eating is a risk factor for negative weight and health outcomes in midlife, and (2) specific menopause symptoms (e.g., sleep, mood, and cognitive complaints) have the likelihood to influence problematic eating behaviors (Marcus et al., 2007; Woods & Mitchell, 2011), intraindividual associations between menopause symptoms and problematic eating behaviors are unknown. Single-time, retrospective designs are useful, however, they can obscure the varied daily experiences as well as the unique daily covariation of menopausal symptoms and eating behaviors. As menopause is a dynamic process and etiology of problematic eating behavior in this population is not yet understood, an intraindividual approach, such as a daily prospective design, is valuable as it provides a more granular view that enables the observation of both daily fluctuations in menopausal symptoms and eating behaviors as well as the dynamic covariation between menopausal symptoms and eating behaviors over time. This approach can provide a unique perspective for further understanding the etiology of problematic eating behavior in this population.

Purpose of the Study

Women in midlife are at risk for problematic eating behavior (Micali et al., 2017), which increases risk for weight-related disease (e.g., metabolic syndrome, diabetes), and disordered eating (Yoon & Jacobs, 2017). Limited research, however has investigated precipitating factors that may predict engagement in problematic eating behaviors in this population (Marcus et al., 2007). Although menopause has been implicated as a potential precipitating factor for

problematic eating, most research has focused on identifying hormonal and biological mechanisms rather than psychological, behavioral, and social symptoms of menopause that may influence eating behavior (Baker et al., 2017). It is important to investigate psychological, behavioral, and social symptoms of menopause as they are amenable to change and have the potential to be beneficial targets in intervention (Baker et al., 2017). In addition, work to date has primarily focused on eating disorders in midlife rather than sub-threshold problematic eating behaviors (Drobnjak et al., 2014; Gagne et al., 2012; Marcus et al., 2007). Although eating disorders are very serious conditions which lead to a host of problematic outcomes, subthreshold eating behaviors are more prevalent than threshold level eating disorders in this population (Mangweth-Matzek, Hoek, & Pope, 2014) and can serve as precursors to poor weight-related outcomes and eating disorders (Yoon et al., 2018). Lastly, previous research investigating precipitating factors of problematic eating behavior in midlife has used retrospective and/or cross-sectional indices of problematic eating behaviors. As menopause is a dynamic process that involves daily fluctuations of symptoms that vary over time, single-time, retrospective designs often obscure the nuances of daily fluctuations. The current study addressed these concerns by investigating the association of psychological, behavioral, and social symptoms of menopause (i.e., vasomotor symptoms, negative mood, sleep, cognitive complaints, sexual desire, and pain) with problematic eating behavior in midlife women undergoing the menopause transition using both retrospective and prospective methodologies.

The proposed study was the first to examine a constellation of menopause symptoms as potential precipitants of problematic eating. First, menopause symptoms and problematic eating were examined using retrospective methodology which allowed for a comprehensive and broad investigation of both constructs and provided information on the interconnectedness of multiple

menopause symptoms in association with problematic eating. Next, the menopause—problematic eating association was examined more intensively using a prospective, daily process methodology to investigate both constructs at the interindividual (between-person) and intraindividual (within-person) level. As menopause is characterized by both between-person differences in symptoms as well as within-person variations in daily symptomatology, this approach captured variation that occurs across and within individuals. Given the intensive nature of the daily process research design (e.g., seven days of repeated measures), for the daily portion of the study, a sub-set of menopause symptoms were measured (i.e., vasomotor symptoms, negative mood, sleep). These symptoms were chosen based on their rating as especially bothersome in this population and/or their association with problematic eating behaviors in general adult samples (Freeman et al., 2006; Kravitz et al., 2003; Thurston & Joffe, 2011). Based on these overall goals, the current study aimed to answer the following questions:

A. Which menopause symptoms are associated with problematic eating behavior in midlife women?
B. How variable are daily menopause symptoms both within- and in terms of differences between-individuals?
C. How variable are daily problematic eating behaviors both within- and in terms of differences-between individuals?
D. What are the between-person (mean-level) and within-person (day-to-day level) associations between daily menopause symptoms and daily problematic eating behaviors?

Additionally, for each question, the role of menopause status (peri- or post-menopause) was examined as a moderating factor. Table 3 outlines the measures that were utilized to address study aims.

Table 3**.** *Outline of Retrospective and Prospective Study Measures*

	Retrospective Measures	**Prospective (Daily) Measures**
Menopause Symptoms		
Sleep	PSQI: global sleep quality	Sleep Diary: TST, WASO, SE, SQR
Negative Mood	PHQ-8, GAD-7	Rating of nine negative emotions*
Vasomotor symptoms	WHQ: vasomotor symptoms	Number/bother of daily HF & NS
Cognitive Complaints	WHQ: memory/concentration	N/A
Sexual Desire	WHQ: sexual behavior	N/A
Pain	WHQ: somatic symptoms*	N/A
Problematic Eating		
Problematic Eating	EDE-Q: total subscale score	EDE-Q total subscale score*
S1: Restraint	EDE-Q: restraint scale	N/A
S2: Eating Concerns	EDE-Q: eating concern scale	N/A
S3: Shape Concerns	EDE-Q: shape concern scale	N/A
S4: Weight Concerns	EDE-Q: weight concern scale	N/A
Binge Eating (BE)	EDE-Q: BE questions (3)	N/A

Note. PSQI = Pittsburgh Sleep Quality Index; PHQ-8 = Patient Health Questionnaire (depression); GAD-7 = Generalized Anxiety Disorder Scale (anxiety); WHQ = Women's Health Questionnaire; EDE-Q = eating Disorder Examination Questionnaire; TST = total sleep time, WASO = wake after sleep onset, SE = sleep efficiency, SQR = sleep quality rating; HF = hot flashes, NS = night sweats

*WHQ pain was be measured via a subset of questions from the somatic symptom scale.

* Nine daily negative emotions = anxious, blue/down, stressed, frustrated, nervous, hostile, ashamed, guilty, irritable.

*EDE-Q subscales was be modified for daily use for prospective portion of study.

Study Aims and Hypotheses

Aim 1: Determine which Menopause Symptoms are Associated with Components of Problematic Eating Behavior in Midlife Women

The first aim globally examined how menopausal symptoms were associated with problematic eating behaviors in midlife women. Aim 1 specifically examined: (1) how menopause symptoms "mapped onto" problematic eating behaviors, and, (2) how the "mapping" of menopause symptoms and problematic eating behavior differed by menopause status (peri-menopause, post-menopause). This aim utilized retrospective self-report instruments that examined a comprehensive range of menopause symptoms (i.e., sleep, vasomotor symptoms, negative mood, cognitive complaints, sexual desire, and pain) and problematic eating constructs (i.e. overall problematic eating, restraint, eating concerns, shape concerns, weight concerns, binge eating). Although menopause symptoms were previously discussed as independent constructs, emerging research indicates that many menopausal symptoms co-occur and are interconnected, influencing one another and their impact on daily functioning (Freeman et al., 2003). Therefore, aim 1 examined the degree to which individual menopause symptoms reflect the overall experience of menopause and subsequently relate to problematic eating constructs. Although a subsequent aim (i.e., aim 3) also examined the relation between menopause symptoms and problematic eating, aim 1 is unique in that it provided a broad overview of the connection between menopause symptoms, rather than treating individual symptoms as independent constructs. It also provided information on how specific menopause symptoms (i.e., cognitive complaints, pain, and sexual desire) were associated with problematic eating as this relation had not yet been examined. Lastly, this aim explored how menopause symptoms differentially map onto problematic eating constructs depending on menopause status. This

approach is unique in that it provided information on how symptom expression may differentially predict problematic eating based on status.

Aim 1 Hypotheses

It was hypothesized that:

a) Poor sleep and negative mood would be associated with overall problematic eating behavior and its subcomponents given previous research which has connected these symptoms to weight and eating-related constructs (Hays et al., 2002; Konttinen, Silventoinen, Sarlio-Lahteenkorva, Mannisto, & Haukkala, 2010).

b) Vasomotor symptoms would be associated with overall problematic eating behavior and its subcomponents. Although the association between vasomotor symptoms and problematic eating has not been yet been investigated, vasomotor symptoms are associated with weight, and, furthermore are often rated as the most bothersome and distressing symptom of menopause, thus potentially influencing problematic eating constructs (Freeman et al., 2006; Kravitz et al., 2003; Thurston & Joffe, 2011)

c) To our knowledge, the relation between additional menopause symptoms (i.e., cognitive complaints, sexual desire, and pain) and problematic eating behavior has not been investigated. As such, this component of aim 1 was be exploratory.

d) Additionally, it was unclear how menopause symptoms would differentially map onto problematic eating constructs in peri-menopause versus post-menopause women. This component of aim 1 was also exploratory.

Aim 2: Identify the Extent to which Daily Menopause Symptoms and Problematic Eating Behaviors Fluctuate Daily both Within- and Between-Midlife Women

The purpose of aim 2 was to establish the extent to which women in midlife vary in their expression of daily menopause symptoms (vasomotor symptoms, negative mood, and sleep) and daily problematic eating behavior. Although previous research has examined menopause status differences (e.g., pre vs. peri) in regard to frequency and prevalence of specific menopause symptoms (i.e., vasomotor symptoms, negative mood, sleep; Burleson, Todd, & Trevathan, 2010; Moilanen et al., 2010), no research has examined overall differences in daily expression of menopause symptoms either between-persons or within-persons. In addition, no research has examined variability in problematic eating behavior between individuals in midlife, with no work focused on intraindividual differences in regard to problematic eating behavior in this population. As menopause symptoms occur daily and interfere with daily functioning (Moilanen et al., 2010), and problematic eating behavior can vary on a day-to-day basis (Verstuyf, Vansteenkiste, Soenens, Boone, & Mouratidis, 2013), there is a need to examine further intraindividual variability of menopause symptoms and problematic eating behavior in this population. Additionally, differences in the amount of within- and between-person variability in menopause symptoms and eating behaviors by menopause status (peri and post) were examined.

Aim 2 Hypotheses

Although research quantifying the extent of daily variability in menopause symptoms in midlife women is lacking, existing studies that have examined variability in two of these symptoms in the general population (sleep and mood) has found sizeable variations within individuals (e.g., 50% of variations in sleep due to variability within-persons and 35% of variations in affect due to variations within individuals; Dautovich, 2010; Dautovich, McCrae,

Rowe, & Dzierzewski, 2008). Additionally, previous research examining menopause symptoms has also demonstrated differences in frequency between-persons (Moilanen et al., 2010). Problematic eating behavior can also be variable between individuals (Verstuyf et al., 2013). As such, it was hypothesized that sufficient within-person variability would exist for both menopause symptoms and problematic eating behavior to warrant further multilevel analyses. Although within-person variability may be less than between person variability, It was hypothesized that the within-person value would be considerable (e.g., greater than five percent; Heck, Thomas, & Tabata, 2010). Lastly, the examination of differences in the amount of within- and between-person variability by menopause status was an exploratory aim.

Aim 3: Identify how Daily Menopause Symptoms are related to Daily Problematic Eating Behaviors

This aim investigated how daily menopause symptoms (i.e., vasomotor symptoms, negative mood, and sleep) temporally related to daily engagement in problematic eating behaviors in midlife women. This investigation was warranted as no work to date has investigated day-to-day, within-person associations between menopause symptoms and eating behavior. Although midlife women are at risk for problematic eating (Marcus et al., 2007; Micali et al., 2017), limited research has examined precipitants' engagement in problematic eating, and work that has explored this associated has utilized between-person, retrospective, and/or cross-sectional methodology. As menopause is a dynamic process that involves daily fluctuations of symptoms, single-time, retrospective designs that involve global or average estimates of symptomatology can obscure the inherent variability of the menopausal experience. As such, an examination of how daily menopause symptoms temporally associate with daily problematic eating behaviors was warranted in order to capture the daily experience of menopause over time.

This aim specifically examined: (1) between-person (mean level) associations between daily menopause symptoms (i.e., vasomotor symptoms, negative mood, and sleep) and problematic eating behavior, (2) within-person (day-to-day level) associations between daily menopause symptoms (i.e., vasomotor symptoms, negative mood, and sleep) and problematic eating behavior, and (3) how between- and within-person associations differed by menopause status (peri and post).

Aim 3 Hypotheses

It was hypothesized that:

a) Individuals who endorsed overall higher vasomotor symptoms, negative mood, and poor sleep would report greater overall problematic eating (between-persons, Level 2 Fixed Effect).

b) Within-persons, higher vasomotor symptoms over the prior 24-hour period and higher ratings of negative mood during the day would predict greater engagement in problematic eating during the day. Additionally, nights where sleep is poor, would predict greater engagement in problematic eating on the subsequent day (within-person, Level 1 Fixed Effects).

c) The examination of differences in the between- and within-person associations by menopausal status was exploratory.

Methods

Participants

Midlife women from the United States between the ages of 40-64 were recruited through Prolific, an online data collection platform, to complete the study. A final sample of 290 women (176 post-menopause, 105 peri-menopause) were included in retrospective analyses (Aim 1) and

a final sample of 226 (122 post-menopause, 93 peri-menopause) were included in the daily, prospective analyses (Aims 2 and 3). The final sample met recruitment goals with the original goal of 200-300 (100-150 peri-menopause and 100-150 post-menopause) women for Aim 1 analyses and a minimum of 100 (50 peri-menopause and 50 post-menopause) women for Aim 2 and 3 analyses. Inclusion criteria included identifying as female, being between the ages of 40-64, and classifying as peri-menopause or post-menopause. Exclusion criteria for the study included identifying as a sex other than female, being out of the specified age range, and not identifying as peri- or post-menopause. Menopause status was determined through a series of questionnaires regarding menstrual patterns and gynecologic surgery. Age and sex were determined through a demographic questionnaire.

Procedure

The study was approved by Virginia Commonwealth University's Institutional Review Board. Data was collected from adult community members on Prolific. Prolific is an online crowdsourcing tool that allows participants to complete online tasks for monetary compensation (Palan & Schitter, 2018). Data gathered from Prolific has been found to be diverse, nationally representative, and as psychometrically sound when compared to data gathered from convenience samples (Palan & Schitter, 2018). Prolific has also been found to provide data quality that is comparable to other online crowdsourcing tools such as MTurk (Palan & Schitter, 2018).

Initially, a survey invitation was posted on Prolific, inviting interested individuals to complete a brief screener assessing basic demographic and health factors. Individuals who met inclusion criteria were invited to complete baseline measures and the daily diary study. After completion of the screening questionnaire, eligible participants were sent a unique link to a

secure website hosted by Qualtrics where they completed a series of baseline psychosocial and health-related measures. During the baseline questionnaire, participants completed a validation check to ensure that they were attending to study materials and met study inclusion criteria. The check included a question to assess attention (e.g., “For the next question, please ignore the question and respond with “2012”; “What year is it?” (a) 2012, (b), 2013, (c) 2018, (d) 2019). A total of 42 women in the study did not pass the validation check and were excluded from final analyses. The final sample for the baseline measures was 290 women (176 post-menopause, 105 peri-menopause). After completion of the baseline questionnaires, a subset of women (226 total; 93 peri-menopause, 122 post-menopause) participated in the seven-day daily diary study. Women were chosen based on time of enrollment. With a recruitment goal of 200-250 women, the first 100-125 peri-menopause and first 100-125 post-menopause women were recruited for the daily diary study. The final sample included 226 women.

For the daily diary study, participants were directed to a 5-minute Qualtrics survey via Prolific every day, for a total of seven consecutive days. Each day, participants rated menopause symptoms and problematic eating behaviors that occurred within the preceding 24-hours. Participants were sent the daily surveys at 4:00 pm Eastern Standard Time (EST) each day. An email reminder was sent to participants when the daily survey was posted as previous research identified daily reminders as useful strategy to increase likelihood of compliance (Gunthert, Cohen, Butler, & Beck, 2007). Daily diary entries were open for 24 hours. Participants were compensated for completing both the screener/baseline survey ($6.00) and daily diary surveys ($.72 per day). A total of 226 women completed the daily diary study. Out of the original 226 women, 198 completed all seven days of daily diary surveys (112 post-menopause, 86 per-

menopause; 87.6% response rate). A total of 218 participants completed at least four consecutive days of daily surveys (125 post-menopause, 93 peri-menopause; 96.5% response rate).

Measures

Screening and baseline measures. Screening questions determined eligibility for the study. Participants who identified as female, were within the age range of 40-64, and who classified as peri-menopausal or post-menopausal were eligible to complete the study. After deemed eligible, participants completed a series of baseline questionnaires assessing demographics, medical history, psychosocial health, and physical health.

Menopause status. Menopausal status was determined during the screening questionnaire from answers to a series of questions about menstrual patterns and gynecologic surgery. Women who had undergone a hysterectomy and/or a bilateral oophorectomy were not excluded from the study and were defined as surgically menopausal. Women who had had no menstrual bleeding in the previous twelve months (not due to medication, pregnancy, or severe weight loss) were defined as postmenopausal (Soules et al., 2001). Women with a menstrual cycle in the previous twelve months but not in the previous three, or women who had menstrual bleeding in the previous three months, but who had experienced increasing irregularity in cycle length over the past year were considered peri-menopausal. Women who reported menses in the previous three months, with no increase in irregularity were defined as premenopausal and were not included in the study.

Demographic and health questionnaire. During screening, participants answered questions pertaining to age, sex, and gender to determine eligibility. Once eligible, participants completed additional demographics questions concerning race/ethnicity, occupational status, marital status, and level of education. Participants also completed a health questionnaire

concerning health status and health history with questions pertaining to alcohol use, tobacco use, caffeine, self-rated health, health conditions (e.g., cancer, heart disease, high blood pressure, diabetes, and chronic pain), current stress, mental health history, and medication use.

Eating behavior. Eating behavior was measured with The Eating Disorder Questionnaire (EDE-Q; (Fairburn & Beglin, 1994). The EDE-Q is a 28-item, self-report measure that assesses attitudes, feelings, and behaviors related to eating and body image over the past 28-days. The EDE-Q assesses subthreshold eating behaviors as well as diagnostic criteria for eating disorders. Subthreshold eating behaviors are answered on a 7-point Likert scale ranging from 0, 'not one day', to 6, 'every day'. The measure yields a Global score and four subscale scores: Restraint (5 items; e.g., "have you been deliberately trying to limit the amount of food you eat to influence your shape or weight"), Shape Concern (SC; 8 items; e.g., "Have you had a definite fear that you might gain weight?"), Weight Concern (WC; 5 items; e.g., Have you had a strong desire to lose weight?"), and Eating Concern (EC; 5 items; e.g., "have you had a definite fear of losing control over eating?"). The Global score is the average of the four subscale scores and can range from 0-38. Items within each subscale can be averaged to provide subscale scores. Higher scores are indicative of higher eating disorder psychopathology. Diagnostic criteria for eating disorders are assessed via frequency (number of times) and occurrence (engaging in the behavior at least one time) of eating disorder behavioral features (e.g., objective bulimic episodes, objective binge eating episodes). The current study assessed frequency and occurrence of binge eating through the use of three questions assessing occurrence and frequency of this behavior (i.e., eating an unusually large amount of food (given the circumstances) and having a sense of loss of control over eating). The binge eating score was determined as the average number of times women endorsed eating a large quantity of food and endorsed a loss of control when eating. The EDE-Q

has demonstrated adequate reliability and validity with Cronbach alpha coefficients ranging from 0.81 - .94 for the EDE-Q global and subscale scores. Test-retest correlations range from .81 to .94 for the four subscales and from .57 to .70 for the frequency of key behavioral features such as binge eating (Fairburn & Beglin, 1994). For the current study, the EDE-Q four subscale scores and binge eating score were used for aim 1 analyses. For the aim 1 analyses, binge eating was recoded to mimic the scoring of the four subscales. In particular, it was recoded on a 1-6 scale with "1" indicating "no days" and "6" indicating "every day." This was done in order to be able to compare the binge eating scores to the other subscale scores for the proposed analyses.

Menopause symptoms. Menopause symptoms were measured with the Women's Health Questionnaire (WHQ). The WHQ is a 36-item questionnaire assessing nine domains of physical and emotional health rated on four-point scales (0 = no, not at all, 3 =yes, definitely; (Hunter, 2000). The subscale items are summated and divided by the number of items in each subscale to determine a score for each subscale. The WHQ was developed to evaluate changes experienced by women during the menopause transition and includes nine domains including, depressed mood (6 items), somatic symptoms (7 items), anxiety/fears (4 items), vasomotor symptoms (2 items), sleep problems (3 items), sexual behavior (3 items), menstrual symptoms (4 items), memory/concentration (3 items), and attractiveness (3 items). The current study utilized the vasomotor (e.g., "I suffer from night sweats"), sexual behavior (e.g., "I have lost interest in sexual activity"), memory/concentration (e.g., "my memory is poor"), and somatic (e.g., "I suffer from backache or pain in my limbs") scales to assess vasomotor symptoms, sexual desire, cognitive complaint symptoms, and pain, respectively. The WHQ demonstrates good validity and reliability with test-retest reliability ranging from 0.78 to 0.78 (Hunter, 2000). The WHQ was utilized for aim 1 analyses.

Negative mood. Negative mood was assessed via the Patient Health Questionnaire (PHQ-8) and the Generalized Anxiety Disorder 7(GAD-7) Questionnaire. Both the PHQ-8 and GAD-7 were utilized for aim 1 analyses.

Patient health questionnaire-8 (PHQ-8). The 8-item Patient Health Questionnaire is a self-report measure used to assess depression. Participants are given the prompt, "Over the last 2 weeks, how often have you been bothered by any of the following problems?" Each item is rated from 0 to 3, where ratings correspond to (0) Not at all, (1) Several days, (2) More than half the days, and (3) Nearly every day. Example items include: "Little interest of pleasure in doing things," "Feeling bad about yourself—or that you are a failure or have let yourself or your family down," and "Feeling, down, depressed, or hopeless." Total scores range from 0 to 24 with a score greater than or equal to 10 on the PHQ-8 corresponding with clinically significant depression (Kroenke, Spitzer, & Williams, 2001). The 8-item PHQ omits the ninth question on the PHQ-9, which asks about suicidal and self-injurious thoughts. Researchers relying on self-administered questionnaires instead of a direct interview tend to use the PHQ-8 over the PHQ-9, as intervention cannot be provided if a participant endorses suicidal thoughts or behaviors (Kroenke & Spitzer, 2002). The removal of the last item has minimal effect on scoring, with identical thresholds for depression severity for the PHQ-8 and PHQ-9 (Kroenke et al., 2001). The PHQ-8 has been established as a reliable and valid measure in both clinical practice and population-based studies (Kroenke et al., 2009).

Generalized anxiety disorder-7 questionnaire (GAD-7). The GAD-7 (Spitzer, Kroenke, Williams, & Löwe, 2006) is a self-reported questionnaire for screening and severity measuring of generalized anxiety disorder (GAD). GAD-7 has seven items, which measure various signs of GAD. Individuals are asked to rate the frequency of anxiety symptoms in the last 2 weeks on a

Likert scale ranging from 0-3 (0 = not at all, 3= nearly every day). Items are summed to provide a total score with higher scores indicating higher levels of anxiety. Scores range from 1-21 with scores in the 15-21 range indicating severe anxiety. The measure demonstrates high validity and reliability with high internal consistency (Cronbach α = .92) and test-retest reliability (intra-class correlation = 0.83).

Sleep. Sleep was assessed via the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-rated questionnaire that assesses sleep quality and disturbances over a 1-month time interval. Nineteen individual items generate seven "component" scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The component scores on the measure can be used to calculate a global score of sleep quality. This measure has acceptable internal consistency (Chronbach's α = 0.83) and test-retest reliability (Chronbach's α = 0.85). It has concurrent validity with polysomnography recordings and displays discriminant validity in its ability to differentiate between good and poor sleepers with a sensitivity and specificity of 89.6% and 86.5%, respectively (Buysse et al., 1989). For the current study, the global score of sleep quality was utilized as the sleep measure for aim 1 analyses.

Other measures. Participants additionally completed a measure of perceived stress during baseline procedure using the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Perceived stress refers to how individuals view different events in their lives in terms of how stressful they are, how they relate to their values, and their ability to cope with stressors. Perceived stress was utilized for descriptive purposes in the current study. The PSS is a 10-item scale developed by Cohen, Kamarck, & Mermelstein (1983). Examples of items on the PSS include: "In the past month please describe how often have you…a) been upset because of

something that happened unexpectedly, b) felt nervous and stressed, c) felt that you could not cope with all of the things that you had to do." Participants rated each item on a scale from 1 to 5 with 1 = never, 2 = almost never, 3 = sometimes, 4 = fairly often, and 5 = very often. The PSS demonstrates good reliability and validity with Cronbach's alpha levels exceeding .70 (Lee, 2012).

Daily Measures. The daily measures were chosen based on previous studies investigating daily menopause symptoms and daily eating behaviors (Burleson et al., 2010; Gibson et al., 2011). The menopause symptoms of primary interest for the daily diary portion of the study included vasomotor symptoms, negative mood, and sleep problems. Participants also recorded daily problematic eating behaviors.

Vasomotor symptoms. Hot flashes were defined as, "uncomfortable sensations of heat under the skin (usually of the head, neck, or chest) that occur when awake that spread rapidly over the body and may or may not be accompanied by flushing." Night sweats were defined similarly, with the requirement that they must occur during periods of sleep rather than during daytime hours. To measure daily hot flashes and night sweats, participants indicated: (a) how many hot flashes or night sweats they experienced in the last 24 hours and (b) rated the overall experience of hot flashes and night sweats in past 24-hours in respect to bother (4-point scale ranging from "not at all" [0] to "a lot" [3]). Hot flashes and night sweats were combined in analyses to create two vasomotor symptom subscores. The first subscore represented the total number of vasomotor symptoms (i.e., sum of hot flashes and night sweats experienced in past 24-hours), and the second subscore represented the level of bother of vasomotor symptoms. The bothersome subscore consisted of the average of ratings of daily and nightly vasomotor

symptoms. The scores ranged from 0-3 with higher scores indicating higher levels of bothersome vasomotor symptoms.

Negative mood. Participants rated how strongly they felt nine negative moods (anxious, blue/down, stressed, frustrated, nervous, hostile, ashamed, guilty, and irritable) in the past 24-hours using a 5-point scale (0 "not at all" to 3 "extremely"). The mood variables have been used in previous studies investigating daily menopause symptoms (Burleson et al., 2010; Gibson et al., 2011; Thurston, Blumenthal, Babyak, & Sherwood, 2005). Mood symptoms were combined to create a cumulative "negative mood" variable that ranged from 0 – 27 with higher scores indicating higher negative mood.

Sleep. Daily sleep behavior was assessed with a sleep diary. Sleep diaries have become a primary method of sleep assessment due to their ease of use, ecological validity, and reliability assessing sleep behaviors (Carney et al., 2012). The Consensus Sleep Diary for Morning (Carney et al., 2012) was used to assess daily sleep. The sleep diary contained questions about the following: time in bed, sleep onset latency, number and duration of awakenings, final wake time, early morning awakenings, time out of bed, and total sleep time. Respondents also rated the perceived quality of their sleep the previous night a scale from 1 to 4 (1 = *very poor* to 4 = *very good*). In the current study, the sleep variables of sleep duration (i.e., total sleep time minus WASO and sleep onset latency), wake after sleep onset (WASO), sleep quality (SQR), and sleep efficiency (SE), were utilized in daily analyses.

Problematic eating behavior. Problematic eating behavior was assessed through adapted subscales of the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994). The EDE-Q has good concurrent validity, criterion validity, and it has been determined to be well-suited to use in prospective studies investigating problematic eating behaviors (Luce &

Crowther, 1999). Furthermore, it has been adapted for use in ecological momentary assessments. Previous studies utilizing the EDE-Q in ecological momentary assessment found good internal reliability, stability, and criterion validity (Barker, Williams, & Galambos, 2006). The current modified the four subscales of the EDE-Q (restraint, eating concerns, shape concerns, and weight concerns). In order to adapt validated questionnaires for daily use, items with the highest factor loadings for each subscale were selected for daily use (Gunthert et al., 2007). As such, each subscale consisted of three questions to decrease attrition and/or random responding. The daily problematic eating questions also modified the binge eating questions from the EDE-Q given that women in midlife endorse high rates of binge eating compared to alternative problematic eating constructs (Marcus et al., 2007; Micali et al., 2017). The daily eating questions consisted of 12 items. Overall problematic eating was calculated by summing the four subscales. The four subscales and the binge eating scores were additionally determined by summing each set of questions. In the current study, the overall problematic eating score was utilized in aim 2 and three analyses. Subscale scores and the binge eating score were utilized for descriptive purposes.

Data Analyses

Aim 1 Analyses. A structural equation model (SEM) was used to examine how menopausal symptoms were associated with problematic eating behavior in midlife women. This analysis determined: 1) to what extent menopause symptoms (i.e., sleep, negative mood, vasomotor symptoms, cognitive complaints, sexual desire, and pain) directly related to problematic eating behaviors (i.e., restraint, eating concerns, shape concerns, weight concerns, and binge eating), and 2) how this association differed by menopause status. To achieve adequate power to detect an effect using SEM analyses, researchers have recommended a minimum sample size of greater than 100, with an ideal sample size between 200-400 (Meyers, Gamst, &

Guarino, 2016). In this study, a minimum sample of 200 was recruited to obtain adequate power to detect an effect using SEM. The final sample included 281 women.

A two-step structural equation modeling strategy was used. The first step involved the estimation of the measurement model. The measurement model provided an assessment of convergent validity and discriminant validity of the latent factor of "menopause symptoms" and provided the degree to which the indicator variables (i.e., depressive symptoms, anxiety, sleep, cognitive complaints, pain, vasomotor symptoms, and sexual behavior) captured or "fit" the latent factor (i.e., menopause symptoms).

Step two included the simultaneous estimation of the measurement and structural model. The structural model determined the relation among menopause symptoms and problematic eating. In particular, the structural model estimated how the latent factor of "menopause symptoms" was directly related to problematic eating (i.e., restraint, eating concerns, shape concerns, weight concerns, and binge eating; Figure 2). Estimating the measurement model in conjunction with the structural model in step two enabled a comprehensive assessment of the full latent model.

The following criteria were used to assess goodness of fit for the models: ratio of chi-square to degrees of less than 2.0; traditional fit indices, including the comparative fit index (CFI) goodness of fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), and Tucker-Lewis index (TLI), higher than .90 which would indicate adequate fit (Byrne, 2010; Hu & Bentler, 1999); and a root mean square error of approximation (RMSEA) of .08 or less would indicate adequate fit (Tabachnick & Fidell, 2007). Lastly factor loadings above 0.30 were determined to be adequate fit for the models (Tabachnick & Fidell, 2007).

To determine whether the model is equivalent depending on menopause status, an omnibus comparison was utilized to examine whether there are overall model differences between groups. A chi-square analysis determined if the model differs between groups. If the models significantly differed, post-hoc tests were to be used to determine which specific paths differed between groups.

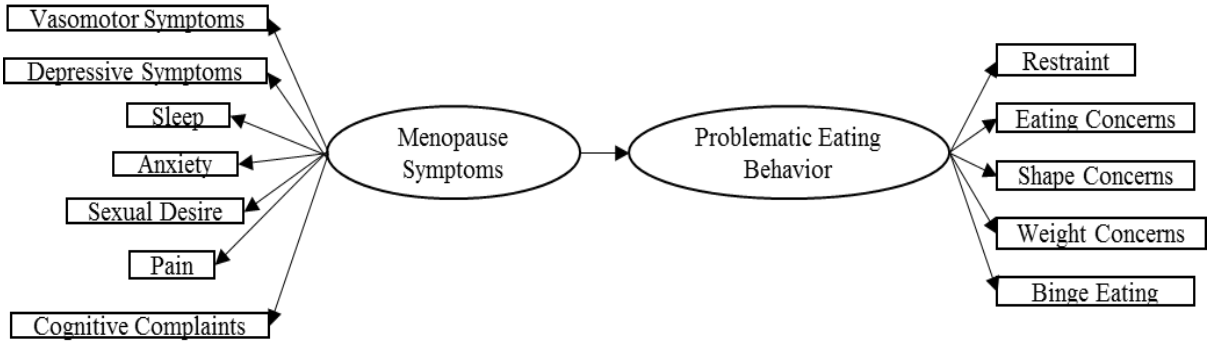

Figure 2. Structural equation model of the relation between menopause symptoms and problematic eating.

Aim 2 Analyses. To determine between-person and within-person variability, intra-class correlation coefficients (ICC) were calculated for both predictor (i.e., vasomotor symptoms, negative mood, and sleep) and outcome (i.e., problematic eating constructs) variables. ICC values estimated the amount of between-subject variance relative to total variance. Subtracting the amount of variance due to between-person effects from the total amount of variance created an estimation of within-person variance. The percentage of within-person variability represented the amount of variability in the construct not accounted for when examining mean values. When this value is substantial (e.g., greater than five percent; Heck, Thomas, & Tabata, 2010) it suggests that mean values may not be capturing a complete picture of the construct of interest.

Aim 3 Analyses. Aim 3 was examined using multilevel modeling (MLM) analyses. MLM, also known as hierarchical linear modeling or mixed effects modeling, allows for the

analyses of change in individual cases over an extended time period (Tabachnick & Fidell, 2007). MLM is an extension of the general linear model and does not require observations to be independent. As such, MLM was well suited to the analysis of daily data due to the hierarchical structure of the data, with daily observations nested within the same participant (Singer, Davidson, Graham, & Davidson, 1998; Singer, Fuller, Keiley, & Wolf, 1998; Singer, Willett, & Willett, 2003). Additionally, MLM allowed all available data to be included in the analyses as it assumes random missing data and consequently does not exclude a case due to one missing data point (Bryk & Raudenbush, 1992). This approach was beneficial when employing an intensive daily process design as missing data occurs. Using MLM, the current study examined how menopause symptoms predicted problematic eating constructs both within- (level 1) and between- (level 2) persons. Level 1 analyses addressed questions such as, "On days where midlife women have high ratings of negative mood, do they also display greater problematic eating behaviors?" Alternatively, level 2 analyses addressed person-level questions such as, "Do midlife women who generally report poor sleep report higher levels of problematic eating behavior?"

Daily menopause symptoms were used to predict problematic eating behavior using a five-step MLM approach. A series of five hierarchical model steps were used, with each successive model building on the previous model(s). To determine the model of best fit for each construct of interest, a comparison of -2 Log Likelihood (-2LL) values for each successive model were conducted. Lower -2LL values indicate a better model fit. A total of three MLM models were implemented to assess how each daily menopause symptom (i.e., vasomotor, negative mood, and sleep) predicted daily problematic eating behavior. Each model used the five-step MLM approach. Table 4 outlines each successive step of the five-step approach.

Table 4. *MLM Analytic Plan Displaying Successive Steps and Predictors of Model*

Step	**Description of successive steps of MLM model**	**Predictors of daily problematic eating:**
1	• overall group-average problematic eating (L2) • between-person (L2) random error term • within-person (L1) random residual component	N/A
2	• linear time	N/A
3	• L2 effects of mean-level covariates	• Mean of covariates
4	• L2 effects of mean-level menopause symptom • L1 effects of daily-centered daily menopause symptom • L2 random error term • L1 random residual component	• Mean menopause symptom • Daily menopause symptom
5	• menopause status * random menopause symptoms (L1 and L2): • status * L2 effects of mean-level menopause symptoms • status * L1 effects of daily-centered daily menopause symptoms	• Mean menopause symptom *status • Daily menopause symptom *status

Note: L1 refers to within-person variables and L2 refers to between-person variables.

MLM examined fixed and random effects. Fixed effects are average effects that apply to all individuals, whereas random effects reflect the level of individual variability in fixed effects. In the current model, fixed effects were examined at two levels. Level 2 effects were estimated

using mean values calculated overall for each individual, while Level 1 effects were estimated using person-centered daily scores (i.e., individual's daily score - individual's mean). Level 1 effects represented daily deviations from the mean value, for each person, for each predictor examined.

Step 1 included the null (no predictors) model and estimated the fixed and random intercept for the problematic eating construct (i.e., overall problematic eating). This model specified that problematic eating behavior for person *j* on day *i* is a function of overall group-average problematic eating constructs, a between-person random error term, and a within-person random residual component. This step provides a comparison for later models.

Step 2 included time functions (linear) which was added as a covariate to the null model. The addition of time controlled for any systematic change in the data resulting from the effects of seven days of measurement. This model specified that problematic eating for person *j* on day *i* is a function of: average problematic eating, linear time, between-person random error term, and within-person random residual component. This step controls for any within-person inflations that may be caused by a systematic growth in the data.

Step three included the fixed effects of covariates including age, race/ethnicity, educational level, body mass index, and physical activity. Race/ethnicity was coded as "0" and "1" in the MLM analyses, where "0" indicated "White" and "1" indicated "Persons of Color." This was done to allow interpretation of the variable in MLM analyses.

Next, fixed and random effects of daily menopause symptoms (i.e., vasomotor symptoms, negative mood, and sleep) were added to the model (step 4). Step four was different for each of the three MLM models. Each model included variables representing one menopause symptom (i.e., vasomotor, negative mood, or sleep) in step four. Problematic eating in step four was

predicted by: average level of problematic eating, linear time, and between-person effects of the mean-level menopause symptom, within-person effects of the daily-centered daily menopause symptom, between-person random error term, and within-person random residual component.

Lastly, in step 5, interaction terms for menopause symptoms and menopause status were added. Step 5 included the interaction between the daily symptom assessed in step 4 and menopause status. Similar to step 4, each of the three models included one menopause symptom (i.e., vasomotor, negative mood, or sleep). Also included were daily fixed and random effects as well as overall mean (fixed) effects. Only significant variables from step 4 were added to the step 5 analyses. This was done to increase power for MLM analyses and avoid redundant analyses.

Power calculation for MLM analyses are complicated given the presence of both between-person and within-person levels of analyses. Furthermore, sample size has different effects at different levels of analyses. Specifically, larger sample sizes increase reliability of measures of within-person variability at level 1 and reliability of measures of between-person differences at level 2. To obtain adequate power to detect an effect with MLM, researchers have recommended a minimum sample size of $n = 6$ per Level 1 unit and a minimum of $N = 10$ for higher-level units (Snijders & Bosker, 1993). In this study, 4 level 1 units were nested within 9 level 2 units which exceeded the suggested minimum requirements for adequate power to detect an effect using multilevel modeling analyses. As such, a minimum of 90 participants was needed to obtain adequate power to observe effects. The final daily diary sample size included 226 women which met requirements for MLM analyses.

RESULTS

Descriptive Results

The total number of women who participated in the study were 290 women (176 post-menopause, 105 peri-menopause; see Tables 5-6 for descriptive statistics). Of the original 290 women, 226 women participated in the seven-day daily diary study (122 post-menopause, 93 peri-menopause). On average, participants were 51.95 years old (*SD* = 6.56), primarily White (84.3%), with over 73.2% of participants having a two-year associate's degree or greater. About half (49.3%) of the sample were married and 62.4% reported having a romantic partner. A majority of women in the sample had children (73.8%).

Women in the sample rated their health as 1.92 out of 4 (*SD* = 0.96). A small number (4.1%) of women were on hormone replacement therapy. In the current study, 42 women in the post-menopause group (23.5%) reported having a hysterectomy, and 29 women in the post-menopause group (16.2%) reported having an oophorectomy (Table 7). No women in the peri-menopause group reported having a hysterectomy or oophorectomy. Overall, women were generally overweight (BMI = 29.57 +/- 7.97) with 39.9% of the sample in the "obese" range. Women in the peri-menopause group had slightly higher BMI (30.55 +/- 8.98) compared to the post-menopause group (29.07 +/- 7.32), although the difference was not statistically significant, t (279) = -1.49, p = .135. Levels of obesity are slightly lower in the current sample (i.e., 39.9%) compared with the national average of midlife women in 2016 (i.e., 44.7%; Hales, Caroll, Fryar, & Ogden, 2017). See Table 7-10 for a full listing of participants' health characteristics.

Table 5. *Demographic Information for Overall Sample, Post-, and Peri-Menopause Groups*

	Overall		**Post-Menopause**		**Peri-Menopause**	
	Count	**%**	**Count**	**%**	**Count**	**%**
Age (*M, SD*)	(51.95, 6.56)		(54.92, 3.39)		(46.80, 1.85)	
40-45	56	20.6	14	8.4	40	41.7
46-50	54	19.9	19	11.4	33	34.4
51-55	71	26.1	49	29.3	20	20.8
56-60	62	22.8	57	34.1	3	3.1
61-65	29	10.7	28	16.8	0	0
Race/Ethnicity						
White	252	84.3	149	83.7	92	86.6
Black	19	6.4	14	7.9	4	3.8
Asian	10	3.3	3	1.7	5	4.7
Hispanic/Latino	5	1.7	4	2.2	1	0.9
Middle Eastern/North African	1	0.3	1	0.6	0	0
Native Hawaiian/Pacific Islander	1	0.3	1	0.6	0	0
American Indian/Alaska Native	6	2.0	2	1.1	4	3.8
Other	2	0.7	2	1.1	0	0
Prefer not to answer	2	0.7	2	1.1	0	0
Sexual Orientation						
Straight	203	70.2	137	76.5	66	62.3
Bisexual	17	5.9	8	4.5	9	8.5
Lesbian	3	1.0	3	1.7	0	0
Queer	1	0.3	0	0	1	0.9
Pansexual	3	1.0	1	0.6	2	1.9
Asexual	8	2.8	4	2.2	4	3.8
Prefer not to answer	1	0.3	0	0	1	0.9
Education						
Less than HS	1	0.3	1	0.6	0	0
HS or equivalent	34	11.7	21	11.9	12	11.4
Some college	66	22.8	41	23.3	25	23.8
Associates	47	16.2	31	17.6	16	15.2
Bachelors	77	26.6	42	23.9	34	32.4
Masters	38	13.1	25	14.2	12	11.4
Doctorate	8	2.8	6	3.4	2	1.9
Professional	13	4.5	9	5.1	4	3.8
Location						
Northeast	35	12.1	25	14.2	9	8.6
South	127	43.8	77	43.8	49	46.7
Midwest	71	24.5	46	26.1	25	23.8
West	47	16.2	27	15.3	19	18.1
Puerto Rico/Other U.S. Territory	1	0.3	0	0	1	1.0
Other	3	1.0	1	0.6	2	1.9
Romantic Partner						
Yes, one	176	60.7	104	59.1	69	65.7

Yes, multiple	5	1.7	2	1.1	3	2.9
No	103	35.5	70	39.8	33	31.4
Marital Status						
Married	143	49.3	83	47.2	59	56.2
Common-Law	9	3.1	6	3.4	3	2.9
Separated	14	4.8	9	5.1	4	3.8
Divorced	59	20.3	44	25.0	15	14.3
Widowed	6	2.1	6	3.4	0	0
Single (never married)	53	18.3	28	15.9	24	22.9

Table 6. *Additional Demographic Information for Overall Sample, Post-, and Peri-Menopause Groups*

	Overall		Post-Menopause		Peri-Menopause	
	Count	%	Count	%	Count	%
Children						
None	76	26.2	48	27.3	28	26.7
One	52	17.9	41	23.3	10	9.5
Two	82	28.3	43	24.4	38	36.2
Three	42	14.5	28	15.9	14	13.3
Four or More	32	11.0	16	9.1	15	14.3
Age of Children						
Preschool (0-5 years old)						
No	191	65.9	120	93.7	68	88.3
Yes, full-time	17	5.9	8	6.3	9	11.7
Elementary (6-13 years)						
No	157	54.1	108	84.3	47	61.0
Yes, full-time	48	16.5	18	14.0	29	37.7
Yes, part-time	2	0.7	2	1.7	0.0	0.0
Yes, do not live with me	1	0.3	0	0.0	1	1.3
Adolescent (14-18 years)						
No	140	48.3	104	81.2	29	41.4
Yes, full-time	59	20.3	21	16.4	35	50.0
Yes, part-time	4	1.3	1	0.8	3	4.3
Yes, do not live with me	5	1.7	2	1.6	3	4.3
Adult (19+ years)						
No	57	19.6	23	18.1	32	41.5
Yes, full-time	36	12.4	19	14.9	16	20.8
Yes, part-time	9	3.1	6	4.7	3	3.9
Yes, do not live with me	106	64.9	79	62.2	26	33.8
Work Status						
Employed Full-Time	91	31.4	49	27.8	40	38.1
Employed Part-Time	50	17.2	31	17.6	19	18.1
Homemaker	36	12.4	16	9.1	19	18.1
Retired	23	7.9	23	13.1	0	0.0
Self-Employed	42	14.5	26	14.8	16	15.2

Student	2	0.7	1	0.6	1	1.0
Unable to Work	22	7.6	19	10.8	3	2.9
Unemployed (Looking)	14	4.8	9	5.1	5	4.8
Unemployed (Not Looking)	4	1.4	2	1.1	2	1.9
Provide unpaid assistance or care to a family member or friend						
No	208	71.7	132	75.0	75	71.4
Yes	75	25.9	44	25.0	30	28.6

Table 7. *Participant Health Information for Overall Sample, Post-, and Peri-Menopause Groups*

	Overall (N = 290)		Post-Menopause (N = 176)		Peri- Menopause (N = 105)	
	Count	%	Count	%	Count	%
BMI (*M*, *SD*)	(29.57, 7.97)		(29.07, 7.32)		(30.55, 8.98)	
< 18.5 (“underweight”)	6	2.1	4	2.3	2	1.9
18.5–24.9 (“healthy”)	89	31.7	57	32.6	31	30.1
25–29.9 (“overweight”)	74	26.3	45	25.7	27	26.2
≥ 30 (“obese”)	112	39.9	69	39.4	43	41.7
Physical Activity (min/week; *M*, *SD*)	(108.12, 128.57)		(108.82, 135.10)		(108.10, 119.29)	
Alcohol Use	138	47.6	84	47.7	51	48.6
0 servings per day (avg)	63	21.7	41	23.3	21	20.0
1–2 per day	64	22.1	39	22.2	24	22.8
3–4 per day	7	2.4	3	1.7	4	3.8
Greater than 5 per day	3	1.0	1	0.6	1	1.0
Caffeine Use	268	92.4	166	94.3	100	95.2
0 per cups day (avg)	8	2.8	6	3.4	2	1.9
1–3 per day	200	68.9	122	69.3	76	72.4
4–6 per day	50	17.2	31	17.7	19	18.2
Greater than 6 per day	7	2.3	2	1.2	2	2.0
Nicotine Use	59	20.3	35	19.9	23	21.9
1–5 cigarettes per day	12	4.0	7	4.0	4	3.8
6–10	17	5.8	9	5.1	8	7.7
11–20	24	8.2	16	9.1	8	7.7
Greater than 20	6	2.0	3	1.7	3	3.0
Hysterectomy	42	14.5	42	14.5	0	0.0
Oophorectomy	30	10.4	30	10.4	0	0.0
Heart Disease	13	4.5	12	6.8	1	1.0
Cancer	4	1.4	3	1.7	1	1.0
AIDS	0	0	0	0	0	0
High Blood Pressure	85	29.3	61	34.7	23	21.9
Neurological Disease	11	3.8	6	3.4	5	4.8
Breathing Problems	44	15.2	24	13.6	20	19.0
Diabetes	35	12.1	27	15.3	8	7.6
Hypothyroidism	49	16.9	38	21.6	11	10.5
Chronic Pain	138	47.2	88	50.0	49	46.7
GI Disease	90	31	61	34.7	29	27.6

Urinary Tract Problems	21	7.2	12	6.8	9	8.6
Hormone Replacement Therapy	12	4.1	10	5.7	2	1.9
Weight loss Rx for health reasons	101	34.8	61	34.7	40	38.1
Weight loss Rx to reduce central obesity	71	24.5	42	23.9	29	27.6
Mental Health Treatment (current)	54	18.6	34	19.3	19	18.1
Mental Health Treatment (ever)	150	51.7	96	54.5	53	50.5
Mental Health Disorder (ever)	137	47.2	86	48.9	50	47.6
Perceived Stress (*M*, *SD*)	(7.20, 3.72)		(7.04, 3.80)		(7.48, 3.80)	
Self-Reported Health (*M*, *SD*)	(1.92, 0.96)		(1.90, 0.97)		(1.92, 0.94)	
Poor	17	5.9	11	6.3	6	5.7
Fair	80	27.6	52	29.5	28	26.7
Good	108	37.2	65	36.9	43	41.0
Very Good	79	27.2	48	27.2	28	26.7

Note: All health concerns refer to a current diagnosis unless otherwise specified; Perceived Stress was determined with the PSS-4, a 4-item scale (range 0 -16) with higher scores indicating higher stress.

Table 8. *Description of Last Cycle Length for Post-Menopause Group*

	Post-Menopause Group	
Last Cycle (year)	N	%
1985 – 1989	4	2.3
1990 - 1994	3	1.7
1995 – 1999	8	4.5
1999 – 2003	8	4.5
2004 – 2008	30	16.7
2009 – 2013	51	28.5
2014 – 2019	77	43.1

Table 9. *Mean and Standard Deviations Scores of Specific EDE-Q Variables for Overall Sample and Each Menopause Status Group*

	Overall		Post-Menopause		Peri-Menopause		Range
	Mean	SD	Mean	SD	Mean	SD	
Binge Eating (large amount of food)	3.48	7.30	3.13	6.05	4.10	9.10	0-56
Binge Eating (felt a loss of control)	2.45	5.19	2.40	5.15	2.56	4.35	0-32
Binge Eating (large amount + LOC)	2.00	4.23	2.10	4.26	1.85	4.24	0-28
Vomiting	0.05	0.51	0.05	0.61	0.04	0.27	0-28
Laxative Use	0.06	0.45	0.06	0.50	0.05	0.35	0-28
Compulsive Exercise	0.69	3.17	0.65	3.14	0.77	3.28	0-28

Note: For each behavior, participants were asked how many TIMES in the past 28 days they engaged in the behavior.

Table 10. *Description of Stressful Life Events for Overall Sample (N = 290)*

Stressful Life Event	**Count**	**%**
None in past year/month/week/day	130	44.8
Past year	110	37.9
Past month	24	8.2
Past week	8	2.7
Past day	12	4.1
Description of Stressful Life Event	**Count**	**%**
Personal Health	22	12.4
Hospital admission	1	0.5
Cancer-related care	1	0.5
Health/medical issue	16	9.0
Recovering addict	1	0.5
Extreme insomnia	1	0.5
Auto accident	1	0.5
Menopause	1	0.5
Health/Well-Being of Family/Close Friends	83	46.9
Health/medical issue of family member	25	14.1
Death of family member or close friend	49	27.7
Death of pet	4	2.2
Family member went to prison	3	1.7
Daughter attempted suicide	1	0.5
Birth of twins to family member	1	0.5
Home-Related Concerns	27	15.2
Moved homes	18	10.2
Home improvement project	2	1.1
Adult child moved in/moved out	3	1.7
Home in foreclosure	1	0.5
Flood	1	0.5
House fire	1	0.5
Harassment/bullying at place of residence	1	0.5
Relationship-Related Concerns	19	10.7
Break up/separation/divorce	7	3.9
Marital issues	4	2.2
Primary caregiver to parent	7	3.9
Alienation of family member	1	0.5
Employment/Financial-Related Concerns	21	11.9
Unemployment	8	4.5
New job	2	1.1
Financial issues	11	6.2
Other Concerns	5	2.8
Legal issues	2	1.1
Lost car keys	1	0.5
Rather not say	2	1.1

Aim 1: Determine Which Menopause Symptoms are Associated with Overall and Specific Components of Problematic Eating Behavior in Midlife Women

The purpose of aim 1 was to globally examine how menopausal symptoms were associated with problematic eating behaviors in midlife women. Table 11 provides an overview of all menopause symptoms and problematic eating variables. A structural equation model (SEM) was developed using AMOS 21.0 (Arbuckle, 2007) to examine: (1) how menopause symptoms "map onto" problematic eating behaviors, and, (2) how the "mapping" of menopause symptoms and problematic eating behavior differs by menopause status (peri-menopause, post-menopause). For this analysis, it was hypothesized that menopause symptoms would be directly and positively related to problematic eating and that this association would differ by menopause status (exploratory hypothesis).

Table 11. *Mean and Standard Deviations Scores of Each SEM Predictor and Outcome Variable for Overall Sample and Each Menopause Status Group*

	Overall (N = 281)		Post-Menopause (N = 176)		Peri-Menopause (N = 105)		
Variable	Mean	SD	Mean	SD	Mean	SD	Range
EDE-Q Total	2.02	1.32	2.02	1.33	1.95	1.29	0–6
Restraint	1.75	1.70	1.77	1.75	1.64	1.62	0–6
Eating Concerns	1.07	1.10	1.02	1.12	1.05	1.03	0–6
Shape Concerns	2.83	1.74	2.87	1.73	2.76	1.75	0–6
Weight Concerns	2.41	1.65	2.43	1.63	2.35	1.68	0–6
Binge Eating	0.85	1.37	0.82	1.33	0.89	1.45	0–6
Depressive Symptoms	7.90	5.94	7.68	5.89	8.35	6.04	0–24
Anxiety	6.54	5.63	6.18	5.68	7.10	5.56	0–20
Sleep	8.96	4.67	8.80	4.72	9.24	4.62	0–20
Pain	2.25	0.71	2.20	0.72	2.31	0.67	1–4
Cognitive Complaints	2.30	0.80	2.25	0.82	2.36	0.78	1–4
Vasomotor Symptoms	2.21	1.04	2.10	1.07	2.37	0.99	1–4
Sexual Behavior	2.42	0.65	2.45	0.66	2.28	0.61	1–4

Note: Depression was calculated with the PHQ-8; Anxiety was determined via the GAD-7; Sleep was determined using the Global Sleep Score of the PSQI; Pain, cognitive complaints, vasomotor symptoms, and sexual behavior were calculated with the WHQ subscales of Somatic Symptoms, Memory and Concentration, Vasomotor Symptoms, and Sexual Behavior, respectively; Binge eating score was recoded to mimic the scoring of the four EDEQ subscales.

Prior to running the measurement and structural models, variables were assessed to determine if they met criteria for SEM analyses. The skewness and kurtosis coefficients for the menopause symptoms of sleep, depression, anxiety, pain, cognitive complaints, and sexual behavior did not suggest departures from normality. Additionally, the problematic eating variables of shape concerns, weight concerns, and restraint did not depart from normality. The menopause symptom of vasomotor symptoms and the problematic eating variables of eating concerns and binge eating did suggest departures from normality with slight kurtosis values (Table 12). Eating concerns and binge eating also displayed slight skewness values. Lastly, a Mardia's coefficient of 5.68 (with a critical ratio of 4.35) suggested that the variables were multivariate kurtotic. A series of transformations w employed sequentially from least to most severe (square root, base 10, and then inverse square root), and the transformations generally resulted in larger skewness and kurtosis coefficients. Additionally, transformations complicated data interpretation. As a result, the raw data were retained, and the models should be interpreted in light of their potential to generate smaller path coefficients or worse fit statistics than might be expected with more normal distributions.

Table 12. *Skewness and Kurtosis Values of Model Variables*

Variable	Scale	Skewness	Kurtosis
Menopause Symptoms			
Depressive Symptoms	PHQ-8	0.61	-0.49
Anxiety Symptoms	GAD-7	0.75	-0.47
Sleep	PSQI Global Score	0.37	-0.64
Cognitive Complaints	WHQ Memory and Concentration Scale	0.05	-0.95
Pain	WHQ Somatic Symptoms Scale	0.80	-0.90
Vasomotor Symptoms	WHQ Vasomotor Symptom Scale	0.23	-1.32
Sexual Behavior	WHQ Sexual Behavior Scale	-0.10	-0.33
Problematic Eating			
Restraint	EDEQ Restraint Subscale	0.67	-0.57
Eating Concerns	EDEQ Eating Concerns Subscale	1.50	1.83
Shape Concerns	EDEQ Shape Concerns Subscale	0.44	-1.14
Weight Concerns	EDEQ Weight Concerns Subscale	0.18	-0.94
Binge Eating	EDEQ Binge Eating + Loss of Control	2.26	5.10

Note: The binge eating and loss of control questions for the binge eating symptom was transformed. Number of days for individuals who engaged in binge eating and LOC eating was transformed into 1-6 response question option to mirror subscale answer choices.

Aim 1a: Measurement Model

The measurement model assessed the fit of the seven menopause symptoms on the latent factor of "menopause symptoms." The χ^2 test for the model was statistically significant, $\chi^2(7, N = 295) = 100.86$, $p < .001$, suggesting that the model failed to fit the data. However, the significance of the χ^2 may be caused by the large sample size in this study. As such, other model fit indices were used to determine fit. The indices of IFI, CFI, and GFI were in the good range at .89, .90, .90, .91, respectively. However, NFI, RFI, TLI, and AGFI were in the less than adequate range at .89, .83, .85, and .81. RMSEA (.14) was also in the poor range. After an inspection of factor loadings, six of the seven factors (i.e., sleep, depressive symptoms, anxiety, vasomotor symptoms, pain, and cognitive complaints) loaded highly on the latent factor at .35 or greater. The factor of sexual behavior was determined to be a poor fit for the model with a factor loading of 0.25 on the latent factor of menopause symptoms.

To improve the measurement model, sexual behavior was removed from the model as it loaded poorly onto the latent factor of menopause symptoms. Additionally, after an examination of correlations among factors, the error terms of depression and anxiety were correlated, and the error terms of pain and vasomotor symptoms were correlated to strengthen model fit. Theoretical evidence on the connection between mood symptoms and somatic symptoms supports this association (Freeman et al., 2003; Woods & Mitchell, 2005). After these adjustments, the χ^2 test for the model was statistically significant, $\chi^2(7, N = 295) = 36.26$, $p < .001$, suggesting that the model failed to fit the data. However, as previously indicated, the significance of the χ^2 may be caused by the large sample size in this study. As such, other model fit indices were used to determine fit. The NFI, IFI, CFI, and GFI for the second measurement model were all in the good range at .96, .97, .97, .96, respectively. The RFI, TLI, and AGFI were in the adequate range at .91, .93, and .89, respectively. Lastly, the RMSEA (.10) was in the fair range.

Upon final examination of the model, the manifest variables loaded adequately to highly (beta-weights $\geq .35$ and all p-values $< .001$) onto their latent constructs. The correlations among the factors additionally ranged in magnitude from .01 to .49, indicating that there was sufficient discriminant validity among the latent constructs to proceed to the structural model. Taken together, the fit indices for the measurement model suggest that the model fit the data adequately. The final model incorporated six of the seven menopause symptoms (i.e., anxiety, depression, sleep, pain, vasomotor symptoms, and cognitive complaints). The final measurement model can be seen in Figure 3.

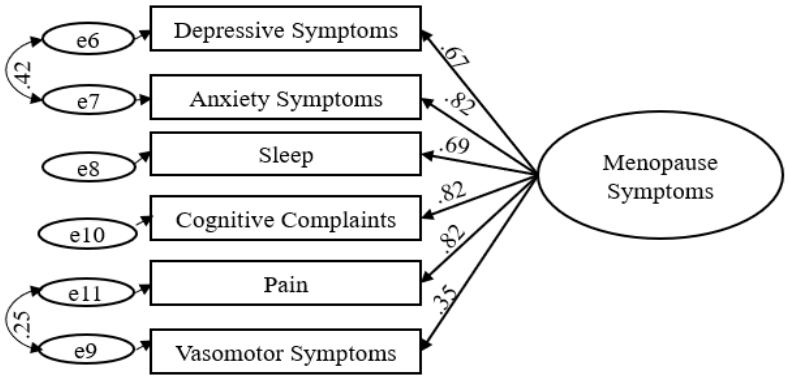

Figure 3. Final measurement model for SEM analysis.

Table 13. *Measurement Model Fit Indices*

	Measurement Model 1	Measurement Model 2
CMIN/DF	100.86/14	36.26/7
GFI	0.91	0.96
AGFI	0.81	0.89
NFI	0.89	0.96
RFI	0.83	0.91
IFI	0.90	0.96
TLI	0.85	0.93
CFI	0.90	0.97
RMSEA	0.14	0.10
AIC	152.63	64.26
BIC	204.24	115.88

Note: Measurement Model 1 includes all seven menopause symptoms and does not include any error-term correlations. Measurement model 2 is the final model with six menopause symptoms and two error-term correlations.

Aim 1a: Full SEM Model

The full SEM model was comprised of the final measurement model and the structural model. The structural model estimated how the latent factor of "menopause symptoms" was directly related to problematic eating. The first full SEM explained 16.9% of the variance in problematic eating. Within this model, menopause symptoms ($\beta = .40$, $p < .001$) were uniquely associated with problematic eating. Additionally, all menopause symptoms and problematic eating variables were statistically significant. The fit indices for this model generally suggested

adequate or good fit, although the AGFI, RFI, and RMSEA both suggested slightly less than adequate fit (Table 14).

To improve the model, the error terms between eating concerns and binge eating were correlated. Previous research has highlighted a connection between eating-related concerns and binge eating behavior (Mangweth-Matzek et al., 2014). The second full SEM including the structural model (Figure 4) explained 16.7% of the variance in problematic eating. The standardized path loadings and correlation all remained similar. Menopause symptoms were uniquely associated with problematic eating and all menopause symptoms and problematic eating variables were statistically significant. The fit indices for the second model were improved compared to the first model and suggested adequate or good fit (Table 14), now with AGFI and RFI falling in the adequate range, and the RMSEA value falling in the adequate range. As such, model 2 was determined to be the best fit for the data. In the final model, the path between menopause symptoms and problematic eating was .40, $p < .001$, indicating that women who had higher endorsement of menopause symptoms experienced higher levels of problematic eating. Specifically, higher endorsement of anxiety, depressive symptoms, sleep concerns, cognitive complaints, pain, and vasomotor symptoms was directly associated with greater endorsement of problematic eating behaviors.

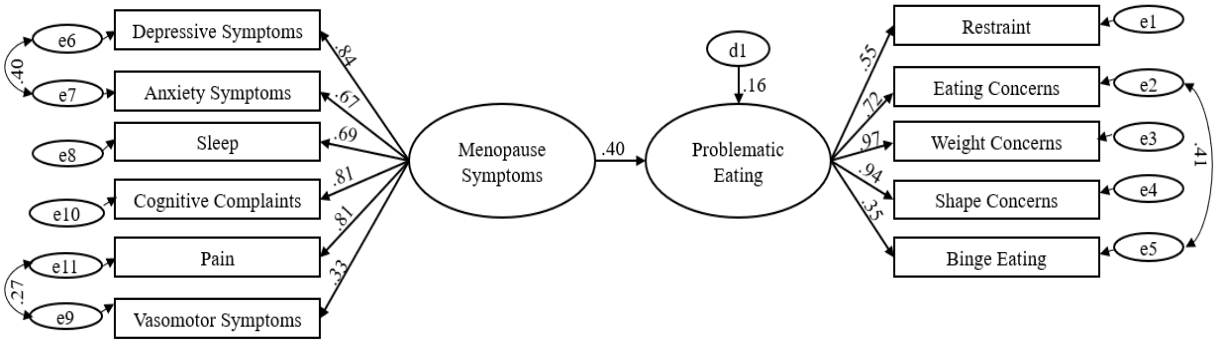

Figure 4. Full model for SEM analysis.

Table 14. *Full Model Fit Indices*

	SEM 1	SEM 2
CMIN/DF	159.95/41	108.15/40
GFI	0.91	0.94
AGFI	0.86	0.90
NFI	0.92	0.94
RFI	0.89	0.92
IFI	0.94	0.96
TLI	0.91	0.95
CFI	0.94	0.96
RMSEA	0.09	0.08
AIC	209.95	160.15
BIC	302.13	256.014

Aim 1b: Status Differences

Lastly, in order to determine whether the SEM differed by menopause status (i.e., post-menopause, peri-menopause), an invariance design was employed as a function of menopause status. The analysis evaluated the difference between an unconstrained model, which assumes that the groups are yielding different parameter values when the model is applied to the data, and an unconstrained model, which assumes that the groups are yielding equivalent parameter values. Five sets of comparisons were of interest: measurement weights, structural weights, structural covariances, structural residuals, and measurement residuals.

Results of the invariance comparison analyses indicated that all five sets of comparisons were non-significant (all *p*s > .17). These results suggest that the menopause status groups did not significantly differ within the SEM model. There were no group differences in the association between menopause symptoms and problematic eating. Therefore, both post-menopause women and peri-menopause women can be described by the SEM (Figures 5-6). Although the peri-menopause group did have higher factor loadings on menopause symptoms and problematic eating constructs and had a slightly higher unique association between

menopause symptoms and problematic eating (i.e., 0.44 for peri versus 0.37 for post), this difference was not significant.

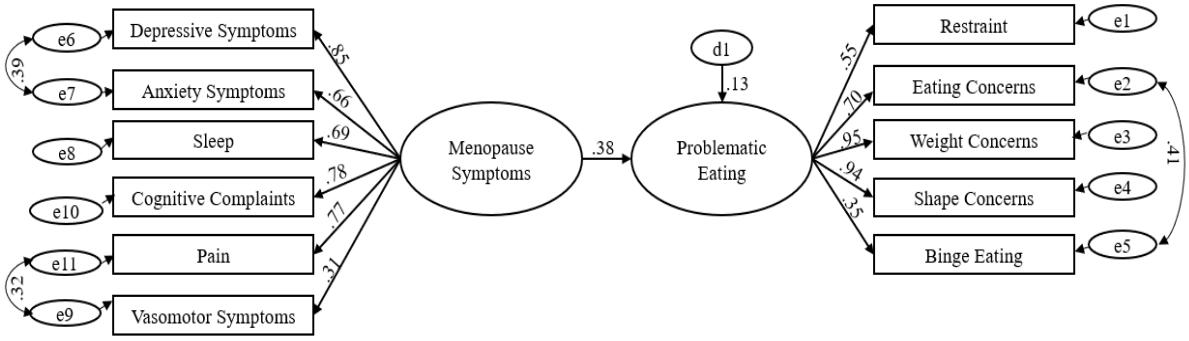

Figure 5. Post-menopause full model with measurement weights.

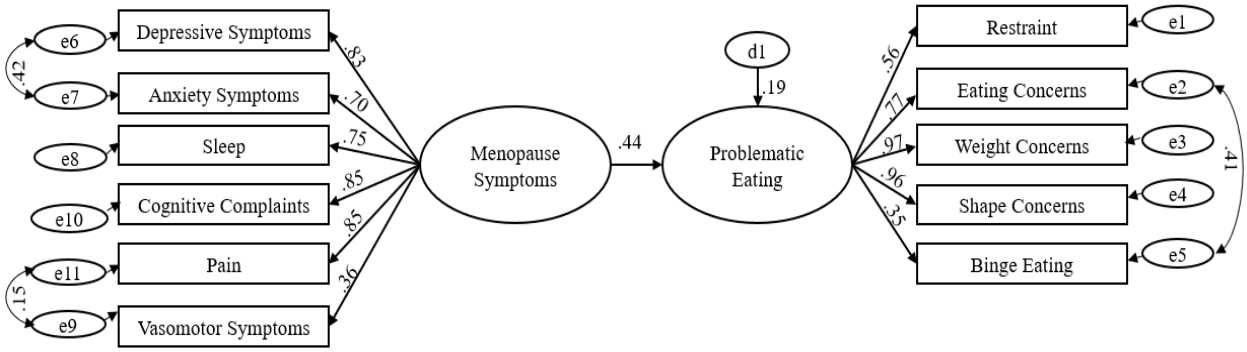

Figure 6. Peri-menopause full model with measurement weights.

Follow-Up Analysis: Independent Samples T-Test

As a follow-up analysis, independent sample t-tests were conducted to determine if mean differences existed between each menopause symptom and each problematic eating construct used in the final SEM model among peri- and post-menopause women. An independent sample t-test was run with each predictor variable used in the final SEM model and menopause status as the grouping variable. Results demonstrated that the variable of vasomotor symptoms significantly differed between peri-menopause and post-menopause women. In particular, the peri-menopause group endorsed more vasomotor symptoms (M = 2.37, SD = .99) in comparison

to the post-menopause group (M = 2.10, SD = 1.07), t (279) = -2.10, p = .037. The symptoms of depressive symptoms, anxiety symptoms, sleep, cognitive complaints, and pain did not display significant differences between the peri-menopause and post-menopause groups. There were also no significant differences in problematic eating variables between the peri-menopause and post-menopause groups. Table 15 displays the results of the t-test analyses.

Table 15. *t-test Comparing Mean Differences of Menopause Symptoms and Problematic Eating Among Peri- and Post-Menopause Women*

	Peri-Menopause		Post-Menopause		
Menopause Symptoms	M	SD	M	SD	*t*-test
Depressive Symptoms	8.35	6.04	7.68	5.89	-0.91
Anxiety	7.10	5.56	6.18	5.68	-1.34
Sleep	9.24	4.61	8.80	4.72	-0.76
Cognitive Complaints	2.36	0.78	2.25	0.82	-1.20
Pain	2.31	0.67	2.20	0.72	-1.19
Vasomotor Symptoms	2.37	0.99	2.10	1.01	-2.10*
Problematic Eating Behaviors					
Restraint	1.64	1.62	1.77	1.75	.432
Eating Concern	1.05	1.03	1.02	1.12	.527
Shape Concern	2.76	1.75	2.87	1.73	.839
Weight Concern	2.35	1.68	2.43	1.63	.971
Binge Eating	0.89	1.45	0.82	1.33	.889

Aim 2: Identify the Extent to which Daily Menopause Symptoms and Problematic Eating Behaviors Fluctuate Daily both Within- and Between-Midlife Women

The purpose of aim 2 was to establish the extent to which women in midlife vary in their expression of daily menopause symptoms (vasomotor symptoms, negative mood, and sleep) and daily problematic eating behavior. It was hypothesized that within-person variability would be greater than five percent for each predictor and outcome variable to warrant further multi-level analyses.

Results indicated that for each predictor and outcome variable, there was enough variability to warrant further analyses. Within-person variances ranged from 30.3% - 72.0% for the predictor variables in the overall sample (Table 16). Women in the post-menopause group

displayed within-person variances between 19.4–83.1%, and the peri-menopause group displayed within-person variances between 21.4–72.5%. The within-person variance for the outcome variable was 20.2% for the overall sample, 19.4% for the post-menopause group, and 21.4% for the peri-menopause group (Table 17). As all variables exceeded the greater than 5% cut-off value, it was determined that mean values may not be capturing the complexity of these variables.

Table 16. *Intra-Class Correlation Coefficients for Predictor and Outcome Variables for Overall Sample*

	ICC	Within-person variance (%)
Total Problematic Eating	.798	20.2
Restraint	.769	23.1
Eating Concerns	.733	26.7
Shape Concerns	.836	16.4
Weight Concerns	.854	14.6
Sleep Duration	.280	72.0
WASO	.253	74.7
Sleep Efficiency	.299	70.0
Sleep Quality	.406	59.4
Mood	.696	30.3
Hot Flashes	.693	30.7
Bothersome HF	.522	47.8

Table 17. *Intra-Class Correlation Coefficients for Predictor and Outcome Variables Between Post-Menopause and Peri-Menopause Women*

	Post-Menopause		Peri-Menopause	
	ICC	Within-person variance (%)	ICC	Within-person variance (%)
Total Problematic Eating	.806	19.4	.786	21.4
Restraint	.774	22.6	.756	24.4
Eating Concerns	.750	25.0	.704	29.6
Shape Concerns	.845	15.5	.836	16.4
Weight Concerns	.856	14.4	.850	15
Sleep Duration	.279	72.1	.308	69.2
WASO	.169	83.1	.356	64.4
Sleep Efficiency	.327	67.3	.275	72.5
Sleep Quality	.434	56.6	.356	64.4
Mood	.750	25.0	.617	38.3
Hot Flashes	.719	28.1	.676	32.4
Bothersome HF	.630	37.0	.396	60.4

Table 18. *Mean and Standard Deviations Scores of Mean Daily Diary Variables for Overall Sample and for Each Menopause Status Group*

	Overall (*N* = 226)		Post (*N* = 122)		Peri (*N* = 93)		
Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*	Range
Problematic Eating							
Total PE	4.14	3.08	4.33	3.24	3.89	2.87	0–12
Restraint	0.93	0.99	1.01	1.03	0.83	0.94	0–3
Eating Concern	0.51	0.71	0.55	0.77	0.45	0.64	0–3
Shape Concern	1.30	0.93	1.34	0.95	1.26	0.92	0–3
Weight Concern	1.40	0.99	1.44	1.01	1.35	0.97	0–3
Binge Eating	0.07	0.25	0.07	.26	0.05	0.23	0–1
Mood							
Total Mood Score	6.82	5.53	6.41	5.62	7.36	5.39	0–26
Sleep							
Sleep Duration (min)	401.02	105.76	406.19	105.29	394.25	106.57	215–582.14
WASO (min)	31.50	69.30	31.06	68.95	32.09	69.82	0–349.86
Sleep Efficiency (%)	84.84	16.82	85.13	16.45	84.46	17.35	37.82–100
Sleep Quality	1.14	0.69	1.11	0.72	1.18	0.66	0–3
Vasomotor Variables							
Vasomotor (Freq)	1.68	2.83	1.44	2.33	1.99	3.36	0–19.29
Vasomotor (Bother)	2.31	1.49	2.18	1.43	2.45	1.56	0–3

Note: Problematic Eating (i.e., PE) total score was calculating the sum of the four sub-scales; Total mood score represents the sum of 9 mood scores; Sleep duration and WASO are calculated in minutes, sleep efficiency is calculated via percentage (%); Vasomotor (Freq) indicates frequency.

Aim 3: Identify How Daily Menopause Symptoms are related to Daily Problematic Eating

Aim 3 investigated how daily menopause symptoms (i.e., vasomotor symptoms, negative mood, and sleep) temporally related to daily engagement in problematic eating behaviors in midlife women using multi-level modeling analyses. Table 18 provides an overview of daily menopause symptom and daily problematic eating behaviors.

Before calculating the multilevel models (MLM), multicollinearity between the predictor variables of mood, hot flashes/night sweats (i.e., total per day and bothersome rating), and sleep (i.e., sleep duration, WASO, sleep efficiency, and sleep quality) were examined. Given the lack of consensus on how best to handle multicollinearity in MLM variables were examined for correlations at or above a level of 0.80. An examination of bivariate correlations among

predictors of each model indicated that there were no variables that met or exceeded a correlation value of .80 at the between person level (i.e., mean-level variables) or within-person level (i.e., centered variables; Tables 19-21).

Prior to conducting each MLM model, the intra-class correlation coefficient (ICC) was calculated from the null model with problematic eating as the outcome. The ICC serves as an index of the amount of within and between-person variability to be explained by problematic eating behavior (Bryk & Raudenbush, 1992). The ICC for the null model was 0.87. This indicates that 12.6% of the overall variability in problematic eating was occurring within-persons and 87.4% was occurring between-persons.

Table 19. *Bivariate Correlations of Mean Sleep Predictors*

	SD_Mean	SE_Mean	WASO_Mean	SQR_Mean
SD_Mean	1	--	--	--
SE_Mean	.482**	1	--	--
WASO_Mean	-.188**	-.664**	1	--
SQR_Mean	-.374**	-.408**	.297**	1

Note: SD refers to sleep duration, SE refers to sleep efficiency, WASO refers to "wake after sleep onset," and SQR refers to sleep quality rating.

Table 20. *Bivariate Correlations of Centered Sleep Predictors*

	SD_centered	SE_centered	SQR_centered	WASO_centered
SD_centered	1	--	--	--
SE_centered	.508**	1	--	--
SQR_centered	-.297**	-.262**	1	--
WASO_centered	-.040	-.181**	.009	1

Note: SD refers to sleep duration, SE refers to sleep efficiency, WASO refers to "wake after sleep onset," and SQR refers to sleep quality rating.

Table 21. *Bivariate Correlations of Mean and Centered Vasomotor Predictors*

	HF_mean	HF Bother_mean	HF_centered	HF Bother_centered
HF_mean	1	--	--	--
HF Bother_mean	.478**	1	--	--
HF_centered	.001	.002	1	--
HF Bother_centered	.000	.006	.416**	1

Mood Model

The mood model included five steps. See Tables 22-23 for a listing of the model steps and estimates. In the final MLM with mood predicting problematic eating behavior, the covariates of BMI, physical activity, and education were significant predictors of problematic eating. Women with higher BMI $\beta = 0.12$, $t(202.33) = 4.96$, $p < .001$, greater physical activity, $\beta = 0.004$, $t(200.46) = 3.00$, $p = .003$, and higher education levels, $\beta = 0.38$, $t(200.92) = 3.32$, $p = .001$, endorsed greater problematic eating.

There were also significant predictors at the within-person and between-person level. At the between-person (level 2) level, mood was a significant predictor of problematic eating, $\beta = 0.28$, $t(221.36) = 7.27$, $p < .01$. Women with lower mood endorsed higher problematic eating behavior. At the within-person (level 1) level, mood was also a significant predictor of problematic eating, $\beta = 0.11$, $t(168.32) = 5.67$, $p < .001$. On days with worse mood, women also experienced higher problematic eating behavior. There were no significant interactions between mood and menopause status at level 1 ($p = .348$) or level 2 ($p = .12$) in the model.

Lastly, the model contained a significant random effect of mood, $\beta = 0.02$, Wald's $Z = 4.59$, $p < .01$. This random effect suggests that for the within-person associations, there were significant interindividual differences in the size of the effects. Overall, this model explained approximately 37% of the within-person variance and 32% of the between-person variance.

Table 22. *Fixed and Random Effects of Mood Predicting Problematic Eating*

			Problematic Eating Fixed Effects		
Predictor Variable	*B*	*SE*	*df*	*t*	*p*
Within-Person					
Time	-.015	.017	213.77	-.93	.35
Mood	.110	.019	168.32	5.67	.000
Between-Person					
Age	-.002	.028	227.42	-.077	.939
BMI	.119	.024	202.33	4.96	.000
Physical Activity	.004	.001	200.46	3.00	.003
Education	.382	.115	200.92	3.32	.001
Race/Ethnicity	.039	.458	200.55	.085	.932
Mood	.283	.038	221.36	7.27	.000
Interaction					
Mood (L1) * Status	-.027	.029	157.20	-.94	.350
Mood (L2) * Status	-.039	.038	620.05	-1.04	.300

			Problematic Eating Random Effects	
Covariance parameter estimate	*B*	*SE*	*Z*	*p*
Within-Person				
Mood	.016	.003	4.59	.000
				Within Pseudo R^2 = .37
				Between Pseudo R^2 = .32

Table 23. *Model Parameters of Mood Predicting Problematic Eating Model*

Models	-2LL	-2LL △	-2LL △ p value	AIC	BIC	R^2_b	R^2_w
Null	5439.181			5445.181	5461.135		
Time	5395.959	43.22	.00	5405.959	5432.549	.027	.131
Added Covariates	4855.493	540.466	.00	4875.49	4927.784	.125	.174
Mood	4607.406	248.087	.00	4633.406	4701.384	.310	.369
Interaction	4605.454	1.952	.38	4635.454	4713.891	.319	.369

Vasomotor Symptom Model

The vasomotor symptom model contained six steps. The predictors of total vasomotor symptoms and bothersome rating of vasomotor symptoms were added to the model individually. Tables 24-25 provide a complete listing of each step including model parameters and estimates. In the final MLM model, the covariates of education and BMI were significant predictors of problematic eating. Higher levels of education, β = 0.54, $t(138.55) = 3.48$, $p = .001$ and higher

BMI, β = 0.096, *t*(139.52) = 3.30, *p* = .001 were associated with greater endorsement of problematic eating. There were also significant predictors at the between-person level. At the between-person level, the bothersome rating of hot flashes was a significant predictor of problematic eating, β = 0.82, *t*(149.94) = 3.66, *p* < .001. Women who rated their vasomotor symptoms as more bothersome also reported higher levels of problematic eating. There were no significant predictors of problematic eating at the within-person level and there was no significant interaction between bothersome hot flashes (L2) and menopause status (*p* = .065). Overall, this model explained approximately 15% of the within-person variance and 30% of the between-person variance in problematic eating.

Table 24. *Fixed and Random Effects of Vasomotor Symptoms Predicting Problematic Eating*

	Problematic Eating Fixed Effects				
Predictor Variable	*B*	*SE*	*df*	*t*	*P*
Within-Person					
Time	-.005	.025	144.29	-.216	.829
HF	-.013	.055	45.90	-.234	.816
HF Bother	-.014	.088	88.08	-.157	.875
Between-Person					
Age	-.050	.035	156.024	-1.43	.155
BMI	.096	.029	139.524	3.30	.001
Physical Activity	.002	.002	139.167	1.07	.286
Education	.542	.155	138.553	3.48	.001
Race/Ethnicity	.394	.552	139.491	.71	.476
HF	.024	.108	140.391	.230	.818
HF Bother	.816	.223	149.945	3.66	.000
Interaction					
HF Bother (L2) * Status	-.329	.178	357.278	-1.85	.065

	Problematic Eating Random Effects			
Covariance parameter estimate	*B*	*SE*	*Z*	*P*
Within-Person				
HF	.033	.033	.996	.319
HF Bother	.084	.068	1.232	.218
				Within Pseudo R^2 = .15
				Between Pseudo R^2 = .30

Table 25. *Model Parameters of Vasomotor Symptoms Predicting Problematic Eating*

Models	-2LL	_2LL △	-2LL △ p value	AIC	BIC	R^2_b	R^2_w
Null	5439.181			5445.181	5461.135		
Time Added	5395.959	43.22	.00	5405.959	5432.549	.027	.131
Covariates	4855.493	540.466	.00	4875.49	4927.784	.125	.174
HF	4850.561	4.932	.18	4876.561	4944.539	.136	.182
HF Bother	3322.700	1527.861	.00	3354.700	3432.029	.294	.156
Interaction	3319.359	3.34	.07	3353.359	3435.250	.323	.164

Sleep Model

The sleep model contained a total of eight steps. Sleep duration, WASO, sleep efficiency, and sleep quality were added into the model individually. Tables 26-27 provide a complete listing of each step including model parameters and estimates. In the final MLM with sleep predicting problematic eating behavior, the covariates of BMI, physical activity, and education were significant predictors of problematic eating. Women with higher BMI, β = 0.12, $t(202.74) = 4.68$, $p < .001$, greater physical activity, β = 0.003, $t(201.28) = 2.20$, $p = .029$, and higher education levels, β = 0.34, $t(200.99) = 2.65$, $p = .009$, endorsed greater problematic eating.

There were also significant sleep predictors at the between-person level. Between-persons, sleep quality was a significant predictor of problematic eating behavior, β = 1.21, $t(221.27) = 3.12$, $p = .002$. Women with worse sleep quality endorsed higher problematic eating behavior. There was also a significant interaction between sleep quality (L2) and menopause status, β = -.561, $t(562.73) = -2.25$, $p = .025$. In particular, the association between sleep quality and problematic eating was stronger for post-menopausal women such that worse sleep predicted greater problematic eating compared to peri-menopausal women.

The model also contained a significant random effect of sleep quality, β = .083, Wald's Z = 2.30, $p = .021$. A such, there were significant interindividual differences in the size of the effects at the within-person level. Overall, this model explained approximately 22% of the within-person variance and 21% of the between-person variance in problematic eating.

Table 26. *Fixed and Random Effects of Sleep Predicting Problematic Eating*

	Problematic Eating Fixed Effects				
Predictor Variable	*B*	*SE*	*Df*	*t*	*p*
Within-Person					
Time	-.017	.019	214.126	-.92	.357
Sleep Duration	-.0002	.0003	1032.55	-.64	.523
WASO	-.002	.001	428.28	-1.67	.097
Sleep Efficiency	-.002	.003	99.67	-.72	.470
Sleep Quality	-.011	.075	266.30	-.15	.880
Between-Person					
Age	-.041	.031	235.25	-1.32	.187
BMI	.122	.026	202.74	4.68	.000
Physical Activity	.003	.001	201.28	2.20	.029
Education	.337	.127	200.99	2.65	.009
Race/Ethnicity	-.184	.500	200.86	-.37	.713
Sleep Duration	-.005	.003	211.13	-1.84	.068
WASO	.008	.008	208.35	1.07	.284
Sleep Efficiency	.031	.028	202.17	1.13	.261
Sleep Quality	1.200	.384	221.27	3.12	.002
Interactions					
Sleep Quality (L2) * Status	-.561	.249	562.73	-2.25	.025

	Problematic Eating Random Effects			
Covariance parameter estimate	*B*	*SE*	*Z*	*p*
Within-Person				
Sleep Duration	1.65E-7	1.77E-6	.093	.926
WASO	.0003	.0003	.933	.351
Sleep Efficiency	7.44E-5	7.90E-5	.94	.346
Sleep Quality	.083	.036	2.30	.021
				Within Pseudo R^2 = .22
				Between Pseudo R^2 = .21

Table 27. *Model Parameters of Sleep Model*

Models	-2LL	_2LL △	-2LL △ p value	AIC	BIC	R^2_b	R^2_w
Null	5439.181			5445.181	5461.135		
Time Added	5395.959	43.22	.00	5405.959	5432.549	.027	.131
Covariates	4854.928	541.03	.00	4874.928	4927.219	.125	.174
Sleep Duration	4847.180	7.748	0.05	4873.180	4941.158	.147	.178
WASO	4843.607	3.573	.31	4875.607	4959.273	.156	.177
Sleep Efficiency	4836.575	7.032	.07	4874.575	4973.929	.155	.202
Sleep Quality	4819.864	16.711	.00	4863.864	4978.904	.179	.225
Interaction	4814.153	5.711	.06	4862.153	4987.652	.211	.223

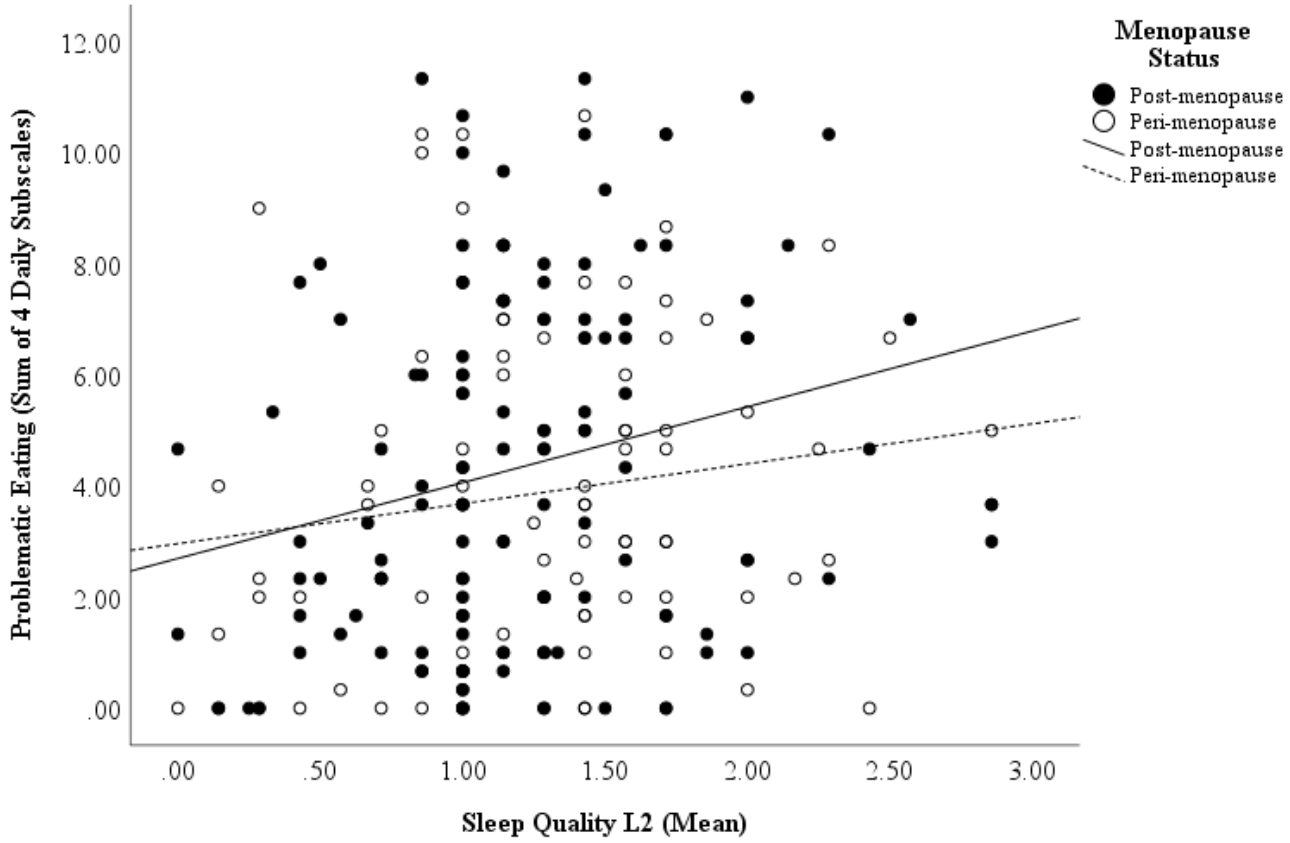

Figure 7. Interaction of mean sleep quality and problematic eating by menopause status. Sleep quality is reverse coded where higher values indicate worse sleep quality.

DISCUSSION

Review of the Findings

The aims of the current study were to: 1) determine if menopause symptoms were associated with problematic eating behavior in midlife women, 2) identify the extent to which daily menopause symptoms and problematic eating behaviors fluctuate both within- and between-midlife women, and 3) identify how daily menopause symptoms are temporally related to daily problematic eating behaviors. Problematic eating in this study was defined as eating behaviors and attitudes that increase risk for weight-related health outcomes and eating disorder

prognosis, yet do not meet the threshold for eating disorder diagnosis (Yoon et al., 2018). Overall, the current study found that greater endorsement of menopause symptoms was associated with greater endorsement of problematic eating behavior. Additionally, there were fluctuations of daily menopause symptoms and problematic eating behaviors which appeared to covary as reflected by significant daily associations among the specific menopause symptoms of negative mood, bothersome rating of vasomotor symptoms, and sleep quality with problematic eating behavior. In particular, worse negative mood, more bothersome vasomotor symptoms, and worse sleep quality was associated with greater endorsement of problematic eating on a daily basis?

Global Associations of Menopause Symptoms and Problematic Eating Behavior in Midlife Women

The first aim of the study globally examined how menopausal symptoms were associated with problematic eating behaviors in midlife women. In particular, the current study investigated how menopause symptoms mapped onto problematic eating behavior and how the mapping of menopause symptoms and problematic eating behavior differed by menopause status.

Results of this analysis demonstrated that menopause symptoms were significantly associated with problematic eating. Specifically, depressive symptoms, anxiety, sleep, cognitive complaints, pain, and vasomotor symptoms were the menopause symptoms that best "mapped onto" the experience of menopause symptoms in the current sample. Furthermore, these six menopause symptoms were significantly associated with problematic eating which was comprised of the constructs of restraint (e.g., limiting food intake), eating concerns (e.g., fear of losing control of eating), weight concerns (e.g., desire to lose weight), shape concerns (e.g., fear of weight gain), and binge eating (e.g., eating large portions of food and feeling a loss of

control). Higher endorsement of each menopause symptom was associated with higher levels of restraint, as well as more eating concerns, shape concerns, weight concerns, and higher endorsement of binge eating.

These results support previous work which has found a connection between particular menopause symptoms and eating behaviors. In particular, impaired sleep is linked to hormonal regulation of hunger and satiety as well as decreased impulse control which can lead to an increase in food consumption and/or disinhibited eating (Anderson & Platten, 2011; Bryant et al., 2007; Dahl, 1996; Guerrieri et al., 2007; Spiegel et al., 2004b). Furthermore, negative mood has been linked to problematic eating in midlife women. In particular, higher depressive symptoms and anxiety have been linked to higher levels of emotion-driven eating, increased consumption energy dense foods, and a greater overall intake of food. (Crawford et al., 2011; Konttinen et al., 2010; Schreiber & Dautovich, 2017; van Strien et al., 2016). Although previous research is limited in the connection between vasomotor symptoms and problematic eating, there is evidence that vasomotor symptoms are associated with weight (Freeman et al., 2006; Kravitz et al., 2003; Thurston et al., 2008). Previous work has also demonstrated that vasomotor symptoms tend to be rated as bothersome and can be a distressing symptom of menopause, thus potentially influencing problematic eating constructs (Freeman et al., 2006; Kravitz et al., 2003; Thurston et al., 2008). Lastly, the current analysis also provides support that pain and cognitive complaints are menopause symptoms that influence problematic eating behavior. Although these constructs have not yet been examined as factors related to eating behavior in midlife, pain is oftentimes managed via emotion-focused strategies which can lead to engagement in binge eating and/or increased food consumption (Almeida, 2005; Araiza & Lobel, 2018). Restraint and disinhibited eating have also been linked to cognitive depletion (Almeida, 2005; Araiza & Lobel, 2018). As

such, results provide evidence that the menopause symptoms of sleep, mood, vasomotor symptoms, pain, and cognitive complaints are relevant predictors of eating behavior in this population.

Although sexual functioning was not a strong variable associated with menopause in the current sample, previous work does highlight changes in sexual desire as a prominent symptom of menopause. In particular, women in menopause experience diminished sexual desire or interest, decreased sexual receptivity, and decreased sexual responsiveness (Avis & Crawford, 2000; Dennerstein et al., 2001, 1994). Although both peri-menopause (M = 2.28) and post-menopause (M = 2.45) women in the current sample endorsed this symptom, it did not present as a strong indicator of menopause symptoms in comparison to the other six symptoms. As such, it weakened the SEM model rather than provide additional value to the menopause symptom cluster. Due to this, it was not included as a predictor of problematic eating. It is possible that sexual behavior, although an important symptom of menopause, was better captured through other measured menopause symptoms in the current study. Previous research has highlighted that changes in sexual behavior, although a unique symptom of menopause, influence emotional and/or physical health (Leiblum et al., 2006). As such, it is possible that other menopause symptoms investigated in the current study (i.e., depressive symptoms and anxiety) better captured the experience of menopause in comparison to sexual behavior. Despite its lower impact in the current sample, future work could investigate how sexual functioning is independently associated with eating behavior in menopause.

Although individual symptoms were hypothesized to be associated with problematic eating in the first aim of the study, it is of importance to note that the aim 1 analyses did not treat menopause symptoms as individual constructs. Rather, the analysis treated symptoms as a

combination of symptoms which were then associated with problematic eating. It was of value to investigate menopause symptoms as a single construct comprised of multiple factors given that menopause is associated with a multitude of symptoms that co-occur and are inter-connected (Freeman et al., 2003). In particular, approximately 80% of women in midlife report one or more of the investigated menopause symptoms during the menopause transition, with 60% experiencing three or more symptoms (Freeman et al., 2003). As such, it is likely that a combination of symptom experiences impact quality of life with impairment to physical, emotional, and social domains rather than each symptom working in isolation. The current analysis aspired to demonstrate the complexity surrounding the connection between menopause symptoms and eating behavior. Similarly, the construct of problematic eating was comprised of subcomponents. This was conducted in order to model the complexity of problematic eating behavior in this population. Previous work investigating problematic eating behavior in women has also shown that women in this time period endorse multiple problematic eating behaviors (e.g., fear of weight gain, dissatisfaction with body, binge eating; Marcus et al., 2007) rather than one specific type of eating behavior. The current results support this finding by demonstrating that each of the five problematic eating constructs of restraint, eating concerns, shape concerns, weight concerns, and binge eating were strong indicators of problematic eating in the model and were associated with the aforementioned cluster of menopausal symptoms.

As such, results of these analyses provide evidence that a combination of menopause symptoms are associated with problematic eating in menopausal women. Although previous research has provided evidence that problematic eating occurs in midlife women, limited research has examined the etiology of problematic eating behavior during this time period. Hormonal changes have been examined as a precipitating factor leading to problematic eating in

this population, however, the evidence is inconclusive (Baker et al., 2017). Results of the current study provide evidence for emotional, cognitive, and behavioral factors that are associated with, may underlie, or increase of problematic eating in women. This is a novel finding, as emotional, cognitive, and behavioral factors of menopause have not yet been examined in their association to problematic eating.

To differentiate how menopause symptoms may differentially impact women in menopause, the last sub-aim in this analysis investigated how menopause symptoms would differentially map onto problematic eating constructs in peri-menopause versus post-menopause women. Results of this analysis suggested that the association between menopause symptoms and problematic eating did not differ by menopause status.

As a follow-up analysis to further explore the differences between peri- and post-menopause women in their experience of menopause symptoms, independent samples t-tests were run to further examine mean differences among menopause symptoms among the two menopause status groups. Although there were mean differences in menopause symptoms among peri- and post-menopause women with peri-menopause women endorsing higher ratings of depressive symptoms, anxiety, sleep concerns, pain, cognitive complaints, and vasomotor symptoms, results indicated that only vasomotor symptoms were rated *significantly* higher (i.e., worse) for peri-menopause women in comparison to post-menopause women. This finding corresponds to previous research which has found that hot flashes and night sweats increase in prevalence during peri-menopause (Woods & Mitchell, 2005). Despite there being no significant differences between menopause status groups, both groups endorsed mild anxiety (GAD-7 score between 5-9; Spitzer et al., 2006), mild depressive symptoms (PHQ-8 score between 5-9; Kroenke et al ,2008), poor sleep (i.e., PSQI score greater than five; Buysse et al., 1989), and mild

to moderate ratings of pain, cognitive complaints, and vasomotor symptoms (Hunter, 2000). As such, regardless of significant differences, symptom endorsement demonstrates that women, across menopause statuses, are impacted by menopause related-symptoms. Additionally, although women across status groups did not display significant differences in problematic eating, the current sample endorsed greater problematic eating behavior (M = 2.02) compared to a general population sample of adult women (M = 0.93; Aardoom, Dingemans, OptLandt, & VanFurth, 2012). Although the current results do not support menopause status differences in the full model of menopause symptoms predicting problematic eating, there remains evidence that group differences occur among individual symptoms of menopause. As such, results demonstrate that both menopause symptoms and problematic eating are important to address in midlife women regardless of menopause status.

Daily Fluctuations of Menopause Symptoms and Problematic Eating Behaviors in Midlife Women

The second aim of the study established the extent to which women in midlife vary in their expression of daily menopause symptoms (vasomotor symptoms, negative mood, and sleep) and daily problematic eating behavior. As menopause symptoms occur daily and interfere with daily functioning (Moilanen et al., 2010), and problematic eating behavior can vary on a day-to-day basis (Verstuyf et al., 2013), this aim examined intraindividual variability of menopause symptoms and problematic eating behavior in this population. Although, as mentioned above, menopausal symptoms are multifold and likely operate in concert, the focus of the remainder of the study was on the dynamics of the most commonly experienced individual symptoms. Focusing on a subset of symptoms, in isolation, was necessary to map the dynamic, daily processes of these symptoms and their associations with problematic eating.

Considerable variability was observed for all menopause symptoms and problematic eating constructs (i.e., 30.3%-72.0%). Peri-menopause women had more within-person variability in vasomotor symptom frequency and bother, while post-menopause had more within-person variability for sleep constructs. Overall, sleep variables showed the most within-person variability for both groups. Although research quantifying the extent of daily variability in menopause symptoms in midlife women is lacking, results support existing research that has examined variability in sleep and mood in general adult samples. Previous work has found sizeable variations within individuals (e.g., 50% of variations in sleep due to variability within-persons and 35% of variations in affect due to variations within individuals; Dautovich, 2010; Dautovich et al., 2008). This is in accordance with the current study which found 59.38% – 74.74% variability within-persons for the sleep variables of sleep duration, WASO, sleep efficiency and sleep quality. Women in both the post-menopause (56.6% - 83.1%) and peri-menopause (64.4 – 72.5%.) group demonstrated high within-person variability for the sleep variables.

The current study additionally found within-person variability for negative mood with within-person variability for both the post-menopause group (25%) and peri-menopause group (38.3%). Although research to date has not examined within-person variability for vasomotor symptoms, the current study found within-person variability for vasomotor symptoms (total number; 30.71%) and bothersome rating of vasomotor symptoms (47.76%) as well. Women in both the peri-menopause and post-menopause group displayed within-person variability for vasomotor symptoms (total number) and bothersome rating of vasomotor symptoms. These findings provide additional information on the nature of vasomotor symptoms in midlife women as previous research has demonstrated differences in frequency *between-persons* rather than

within-persons (Moilanen et al., 2010). In particular, Moilanen et al. (2010) found in previous work that 50% of peri-menopause women and 54% of post-menopause women reported high and bothersome levels of vasomotor symptoms. Although between-person differences highlight how experiences differ across women, within-person variability demonstrate how day-to-day experiences within the same individual can differ. For example, the current study found 60.4% within-person variability in bothersome level of vasomotor symptoms for peri-menopause women. This means that for peri-menopause women in the current sample, their experience of bothersome vasomotor symptoms varies substantially on a daily basis. As such, women likely get relief from bothersome vasomotor symptoms on certain days, while on other days symptoms are more impairing. Overall, the high amount of variability suggests symptomatology may be unpredictable and potentially dysregulating. Although research on within-person variability of menopause symptoms is limited, research has demonstrated that menopause symptoms that are unpredictable tend to negatively impact well-being and quality of life (Reynolds, 2002). As such, results of the current study provide support that that menopause symptoms of sleep, vasomotor symptoms, and mood are variable and warrant further analysis.

Lastly, although research has shown that problematic eating behavior can be variable between individuals (Crowther et al., 2001; Verstuyf et al., 2013), the current study provides additional information with the finding that problematic eating also varies within-individuals. Previous research has found that daily fluctuations in frustration and daily hassles are related to daily fluctuations in binge eating symptoms among adolescent and adult females (Verstuyf et al., 2013). The current study provides additional information in a specific midlife women sample with the finding that within-person variability for problematic eating was 20.2%. As such, within women, problematic eating behavior fluctuates and varies on a daily basis, although to a lesser

extent than menopausal symptoms. This finding supports previous research which has found that specific eating behaviors, such as binge eating, tend to fluctuate in adolescent and adult women (Verstuyf et al., 2013). Furthermore, the current study provides evidence of daily fluctuations in additional eating behaviors. The meaning of this finding requires further study. For example, a pattern of fluctuating behaviors and perceptions could be positive in that women experience days without problematic eating issues. However, similar to menopause symptoms, eating behaviors can be unpredictable and variable for women in this time period which can be distressing and have mental and physical health implications. Consequently, further research is needed to unpack variations in each of the symptom clusters.

Daily Covariations of Menopause Symptoms and Problematic Eating Behaviors

The final aim of the study investigated how daily menopause symptoms temporally related to daily engagement in problematic eating behaviors in midlife women. This aim specifically examined overall (mean) associations as well as daily (individual) associations between menopause symptoms and problematic eating behavior across seven days. Additionally, differences by menopause status were explored.

Differences emerged between individuals such that women with higher overall negative mood, worse sleep quality, and more bothersome vasomotor symptoms endorsed greater overall problematic eating behavior. Additionally, associations emerged within individuals such that on days when women endorsed worse mood, they also endorsed higher problematic eating behavior. Lastly, the overall association between sleep quality and problematic eating was stronger for post-menopausal women. In particular, worse sleep predicted greater problematic eating in post-menopause women compared to peri-menopausal women.

Mood as a predictor of problematic eating behavior. In the association between overall negative mood and problematic eating, higher ratings of negative mood predicted higher problematic eating behavior in midlife women. Additionally, on days with worse mood, women also experienced higher problematic eating behavior. These findings support previous research in midlife women that has found a connection between mood and eating behavior. In particular, in a cross-sectional, retrospective investigation of depressive symptoms and stress eating in midlife women, women with higher depressive symptoms were associated with higher endorsement of stress eating (Schreiber & Dautovich, 2017). Additional research has also found a link between negative mood and overconsumption of food in adult women (Crawford et al., 2011). The current study replicates the association between mood and eating behvaior and adds to current literature by confirming this finding using prospective methodology and a well-validated measure of eating behavior. In particular, the current study investigated problematic eating using adapted subscales of the Eating Disorder Examination Questionnaire (EDE-Q), a well-validated questionnaire which assess subthreshold eating disorder behaviors. Although previous work has pinpointed how mood influences specific eating behaviors (e.g., stress eating, fast food consumption; Crawford et al., 2011; Schreiber and Dautovich, 2017), the current study provides a more comprehensive view of problematic eating behaviors that are associated with increased risk for poor health outcomes.

In addition to the overall between-person association between mood and problematic eating, there was also a significant within-person effect of negative mood. Specifically, on days where women endorsed worse mood, they also experienced higher problematic eating behavior. This finding confirms a dynamic, day-to-day covariation between mood and eating behavior in this population. This daily covariation indicates that there is not just an overall association

between mood and eating behavior, but also that daily fluctuations in mood are associated with daily changes in eating behavior. This finding highlights the importance of capturing all aspects of mood and behavior across time for women in midlife. Although the between-person, mean-level estimates provide an overall sense of how mood is linked to problematic eating behavior for women in midlife, the within-person measurements of mood provide additional detail. In particular, the within-person finding highlights that even when mood fluctuates over time and can be unpredictable, it is still connected to problematic eating. Hence, the current results provide a more precise observation of the mood-problematic eating association over time. The current study highlights that both between-person and within-person aspects of mood are relevant to fully capture how problematic eating occurs in this population and provide insight to a potential intervention target to decrease risk of problematic eating behavior in midlife.

Given that previous research investigating mood and eating behavior in midlife has used retrospective, cross-sectional methodology, the current study provides additional insight into the complexity in this association. This finding is similar to previous daily research investigating the association between negative mood and additional menopause-related outcomes. Burleston, Todd, and Trevathan (2010) found that on days with worse mood, midlife women endorsed worse sleep and higher vasomotor symptoms. Additional daily studies in midlife women have found that daily fluctuations in mood impact sleep (Baker, Simpson, & Dawson, 1997; Burleson et al., 2010). The current study is the first, to our knowledge, to investigate how daily fluctuations in mood are linked to problematic eating behavior in this population. The finding that worse mood predicted higher problematic provides insight into the complex, dynamic nature between mood and eating behavior in this population.

Despite observing ties between negative mood and problematic eating across individuals as well as on a daily basis for women in midlife, the findings did not support an interaction of menopause status in the association between negative mood and problematic eating. In the current study, both peri-menopause and-post-menopause women endorsed mild to moderate symptoms of negative mood. This corresponds to previous research which has found that women negative mood can be high for women during *and* after menopause (Bromberger & Kravitz, 2011). Additionally, both groups endorsed similar ratings of problematic eating. As such, there was not a significant difference to support differential associations between negative mood and problematic eating. Furthermore, the association between negative mood and eating was similar across both groups. As women in this time period are at risk for subthreshold eating disorder behaviors, development of eating disorders, and poor weight-related outcomes, all of which influence mental and physical health (Yoon & Jacobs, 2017), the current study provides greater insight into how mood is tied to eating behaviors that have been shown to be risk factors for development of such concerns across the menopausal transition. Results demonstrate the durability of mood and problematic eating behaviors during and beyond the menopausal transition. Although the current study used an overall score for problematic eating behavior, a potential future direction would be to examine how individual indices of problematic eating (i.e., restraint, eating/shape/weight concerns) may be differentially impacted by mood.

Vasomotor symptoms as a predictor of problematic eating behavior. The model investigating the association between vasomotor symptoms and problematic eating found a significant between-person association of bothersome rating of vasomotor symptoms and problematic eating behavior. Specifically, women who overall endorsed more bothersome vasomotor symptoms endorsed higher overall problematic eating behavior. Although the

bothersome rating of vasomotor symptoms was significantly associated with problematic eating behavior, the current study did not find a significant association between vasomotor symptom frequency and problematic eating. In particular, it was not confirmed that women who experience a greater number of vasomotor symptoms experience greater problematic eating behavior. As such, current findings suggest that regardless of the number of vasomotor symptoms women experienced per day, those who were more *subjectively* impacted by their vasomotor symptoms endorsed higher problematic eating. This finding supports previous work that has suggested that vasomotor frequency and vasomotor bother are interconnected, yet distinct symptoms of menopause (Thurston et al., 2008). In particular, not all women who experience vasomotor symptoms are bothered by them (Thurston et al., 2008). Rather, vasomotor symptom bother is a component of vasomotor symptoms which can be impacted by affect, sensitivity to symptoms, general health, and sleep problems (Thurston et al., 2008). As such, vasomotor symptom bother is a unique factor of vasomotor symptoms that should not be used interchangeably with vasomotor symptom frequency (Thurston et al., 2008).

The current study found that women who overall endorsed higher vasomotor symptom bother endorsed overall higher problematic eating behavior. Although research to date has not investigated how vasomotor symptom bother impacts problematic eating behavior in midlife women, vasomotor symptoms have been linked to BMI in previous research (Thurston & Joffe, 2011). In particular, midlife women with higher body weight tend to experience more vasomotor symptoms. The current study provides a potential pathway through which vasomotor symptoms may influence weight-related outcomes. It is possible that women who are bothered by vasomotor symptoms engage in greater problematic eating behavior which then may impact their body weight.

Although previous research has not investigated how vasomotor symptom bother impacts problematic eating behavior, previous work which has found independent, significant associations among bothersome vasomotor symptoms, lower well-being, and negative mood (Gartoulla, Bell, Worsley, & Davis, 2015; Worsley, Bell, Gartoulla, Robinson, & Davis, 2017). As one proposed pathway leading menopause symptoms to problematic eating behavior is an emotional pathway (i.e., stress, negative emotionality; Figure 1), it is possible that vasomotor symptom bother may influence problematic eating via this pathway. As vasomotor symptoms are the most common complaint of menopausal women, are experienced by the majority of midlife women (i.e., 60-80%), and are the most common reason women seek medical care during menopause (Gold et al., 2006; Nelson et al., 2005), understanding their impact on problematic eating is of importance. Given the increased risk of subthreshold eating disorders, eating disorders, and weight-related health outcomes in this population, the current study highlights that in addition to decreased well-being and lower mood, bothersome vasomotor symptoms increase risk of problematic eating behavior. As such, understanding how women experience vasomotor symptoms and addressing their impact on functioning/well-being would likely be a helpful intervention target to decrease problematic eating in this population,

Although vasomotor symptom bother was a significant between-person effect on problematic eating, the study failed to find significant within-person effects of vasomotor symptoms (i.e., bother and frequency) on problematic eating. As such, although higher overall vasomotor symptom bother did predict problematic eating, there was not significant covariation among vasomotor symptoms and eating behavior across the seven-day time-period among midlife women in the current sample. This finding was surprising as women in the current sample displayed high levels of within-person variability in their ratings of bothersome

vasomotor symptoms. This finding potentially suggests that regardless of day-to-day variability of bothersome vasomotor symptom, women who overall endorse higher levels of bothersome vasomotor symptoms are more likely to engage in problematic eating behavior and that these associations may be best captured by averages of behavior. Consequently, the study also did not find a significant interaction among menopause status and vasomotor symptoms. Although previous research has estimated that women experience vasomotor symptoms for several years around the final menstrual period (i.e., peri-menopause), more recent research has found that many women continue to experience vasomotor symptoms for decades (Barnabei, Cochrane, & Aragaki, 2005; Barnabei, Grady, & Stovall, 2002). As such, it is possible that there was not enough variability in the experience of vasomotor symptoms in the current sample to produce significant group differences.

Sleep as a predictor of problematic eating behavior. Lastly, the model investigating sleep and problematic eating behavior found a significant between-person association between sleep quality and problematic eating behavior. Specifically, women who endorsed worse overall sleep quality also endorsed higher overall problematic eating. This finding supports previous research which has found an association between poor sleep and eating behavior. In particular, most work to date has found an association among short sleep duration and eating behavior. Chaput et al. (2011) found that short sleep duration was a predictor of disinhibited eating behavior in a sample of adults. Stern et al. (2014) additionally found that short sleep duration was associated with higher food intake and lower diet quality in post-menopausal women. Although the current study did investigate the association between sleep duration and problematic eating, the association between sleep duration and problematic eating was only a significant predictor of problematic eating when sleep quality was not included in the model.

When sleep quality was added, it emerged as the only predictor of problematic eating in the current sample.

The finding that sleep quality, rather than sleep duration, predicted problematic eating corresponds with a previous study that found that emotional and external eating was associated with poor sleep quality, but not short sleep duration in a sample of adult women (Dweck, Jenkins, & Nolan, 2014). Dweck et al. (2014) hypothesized that this was likely due to the fact that few participants in their study reported short sleep duration (i.e., fewer than 7 hours per night). It is possible that the current study replicates this finding as the average sleep duration of the current sample was ~6.7 hours per night. Previous work has also found that variability in sleep duration is linked to perception of sleep quality (Monk, Reynolds, Buysse, DeGrazia, & Kupfer, 2003) and the current sample did report highly variable sleep duration.

As such, although duration and quality are distinct constructs, they do contain overlap, with sleep quality encompassing an individual's *perception* of their sleep duration. Previous research highlights the importance of sleep quality as a unique sleep construct. In particular, previous work has found that midlife women report poor sleep quality in the absence of objective measures of sleep disruption (Young et al., 2003). Additionally, women in midlife tend to report a higher prevalence of self-reported sleep problems compared to men despite polysomnographic results suggesting that sleep architecture is better in midlife and older women compared to men (Baker, Maloney, & Driver, 1999). As such, sleep quality is a complex sleep construct that captures unique aspects of sleep not captured by objective measurements. In particular, subjective sleep quality tends to reflect an individual's perception of their sleep, which is important for diagnosis of sleep disorders (i.e., insomnia) and also has been shown to influence mental health outcomes (Buysse et al., 1991; Ohayon, 1997). The current study provides

evidence for the important role of sleep quality as a predicter of problematic eating behavior. Future work is need to further disentangle the influence of sleep quality in its relation to problematic eating behavior.

Although sleep has been linked to eating behavior in adults, the current study highlights the impact of sleep for problematic eating in a specific midlife women sample. This finding is important as 33-51% of women report sleep problems in menopause and women in the menopausal transition often rate sleep concerns as one of the most bothersome symptoms associated with menopause (Ford et al., 2005). As previous work investigating sleep and eating behavior has utilized general adult samples (Chaput et al., 2011) or samples of younger adult women (i.e., M = 18.7: Dweck et al., 2014), the current study provides more specific information on the connection between sleep and eating behavior in midlife women. In particular, it replicates the finding that poor sleep, specifically sleep quality, is associated with problematic eating behavior in midlife women.

Furthermore, the limited body of work investigating sleep and problematic eating in menopausal women has used retrospective, cross-sectional methodology (Stern et al., 2014) or has focused on the impact of sleep on weight outcomes rather than focus on problematic eating behavior (Appelhans et al., 2012). As previously stated, single-time, retrospective designs that involve global or average estimates of symptomatology can oftentimes obscure the inherent variability of daily experiences. As such, although the daily associations were not significant in the current study, the significant between-person associations were also based on repeated daily reports that were less susceptible to bias than traditional global retrospective reports. Additionally, although problematic eating behavior can lead to weight gain or weight-related health outcomes, weight gain and obesity are complex in origin, with influences from biological,

social, and psychological factors. Furthermore, problematic eating behaviors are harmful in their own right and do not always impact weight (Marcus et al., 2007). As such, understanding the association of sleep with problematic eating in addition to its ties with weight is important to differentiate in midlife women (Hays et al., 2002; Yoon et al., 2018). The current study highlights problematic eating behavior as a significant factor related to poor sleep quality.

Lastly, the current study found a significant interaction between between-person sleep quality and menopause status. Specifically, the association between sleep quality and problematic eating was stronger for post-menopausal women. In particular, worse sleep quality predicted greater problematic eating in post-menopause women compared to peri-menopausal women. To date, there have not been investigations regarding menopause status differences in problematic eating behavior. Although women in midlife are at risk for engagement in problematic eating behavior (Micali et al., 2017) and are more likely to report disordered eating behaviors and concerns compared with older women (Gravener et al., 2008; Lewis & Cachelin, 2001), menopause status differences have not been investigated prior to the current study. Additionally, most work investigating sleep difficulties in peri- and post-menopause women have noted that both status groups endorse poor sleep quality (Kravitz et al., 2003) and worse sleep in comparison to pre-menopause women (Young, Rabago, Zgierska, Austin, & Finn, 2003). Although one study by Hachul et al. (2009) found that women in post-menopause reported worse sleep quality in comparison to women who were in early menopause, most work to date indicates poor sleep quality among both groups.

In the current study, post-menopause women endorsed slightly worse sleep quality (M = 1.11) in comparison to peri-menopause women (M = 1.18). Post-menopause women also endorsed slightly higher problematic eating (M = 4.33) in comparison to the peri-menopause

women (M = 3.89). Despite the lack of previous research that has investigated this association, the current results highlight a potential important distinction in risk of problematic eating among women in menopause. Although both peri- and post- menopause women may both exhibit poor sleep outcomes (Young et al., 2003), the current study suggests that women in post-menopause may be more at risk for worse eating-related outcomes. As the post-menopause group were older (M_{age} = 54.9) compared to the peri-menopause group (M_{age} = 46.8), and possibly experiencing poor sleep quality to a longer extent in comparison to the peri-menopause women, one potential explanation for the interaction could be that accumulation of poor sleep increases risk of problematic eating. Previous work has found that poor sleep across time impacts BMI and waist circumference (Chaput & Tremblay, 2012; Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005). Future research is needed to further disentangle and understand the association among menopause status, sleep, and problematic eating behavior.

Strengths and Weaknesses

There are several strengths of the current study. First, the current study provided a novel investigation into the association between menopause symptoms and problematic eating. To our knowledge, this is the first study to conceptualize menopause symptoms as a predictor of problematic eating and provide understanding of how social, psychological, and behavioral factors of menopause are linked to problematic eating behavior.

In particular, the current study assessed how daily, individual menopause symptoms predict eating behavior, as well as how the *overall* experience of menopause is related to problematic eating. This dual approach is of value as menopause symptoms have been previously discussed as independent constructs, rather than co-cooccurring and interconnected constructs. The current study also examined a breadth of menopause symptoms including cognitive

complaints, pain, and sexual desire which have not been examined in their association with problematic eating.

The current study also has methodological strengths. First the study utilized both retrospective (aim 1) and prospective (aims 2 and 3) analyses. This allowed us to examine the association between menopause symptoms and problematic eating in a multi-faceted manner and expand upon previous research which has relied more extensively on retrospective analyses. The study also examined both intraindividual and between-persons variability of menopause symptoms in relation to problematic eating behavior. Few studies have examined within-person variability of menopause symptoms and the results suggest that there is significant variability in these constructs that may be overlooked by static measurements. By using both mean and intraindividual measures, significant overall effects could also be examined on an individual level. The results suggest that both between- and within-person analyses revealed unique associations between menopause symptoms and problematic eating. The current study also used both retrospective and prospective measures to examine the association between menopause symptoms and problematic eating. As menopause is a dynamic process that involves daily fluctuations of symptoms, single-time, retrospective designs that involve global or average estimates of symptomatology can obscure the inherent variability of the menopausal experience. As such, through the examination of the temporal association of daily menopause symptoms with daily eating behavior, the current study could capture the daily experience of menopause over time. This approach combined with the between-persons analysis and the global structural equation modeling of menopause symptoms provide an inclusive picture of the menopausal experience.

The current study had a relatively large sample size (N = 226) for daily diary study and a fair/good range for the SEM analyses (N = 281). For the comprehensive investigation of menopause symptoms and problematic eating, the study utilized well-validated measures of sleep, mood, and eating behavior. For all analyses, menopause status was assessed using well-validated self-reported methodology to assess status.

Although the current study contains many strengths, there are limitations to address. First, we were not able to measure biological factors of menopause including hormones levels (i.e., estrogen). Therefore, it is unclear whether hormonal fluctuation may affect problematic eating behavior. Future research is needed to investigate how hormonal/biological factors of menopause, as well as psychological and behavioral aspects of menopause influence problematic eating behavior. Additionally, in terms of our sample, we had more post-menopausal women in both the retrospective analyses (aim 1) and prospective, daily analyses (aim 2 and 3). Thus, these sample size discrepancies may have influenced results, as there was more power to detect associations in the post-menopausal group. We also grouped all peri-menopause women together rather than differentiating early and late peri-menopause. As menopause symptoms can vary from early to mid- to late-menopause (Woods & Mitchell, 2005), it may be useful for future investigations to differentiate early and late peri-menopause women.

Our sample was also limited in terms of race/ethnicity. The majority of the sample was White (84.3%). This limits our ability to investigate how menopause symptoms are associated with problematic eating in a more diverse ethnic/racial group. The study also utilized convenience sampling through an online data collection platform. By not randomly sampling the population, participants may have self-selected to participate in the study and may not fully represent the population of interest. Data collection was limited to women in midlife with access

to a computer and internet access on a daily basis. Additionally, by using online data collection methods, we had limited control as to when participants completed measures. Efforts were taken to distribute surveys at the same time each day, but many participants resided in different time zones. It is possible that participants completed daily diary entries at different time points each day rather than at the end of each day as requested.

Implications

The findings of the study have both theoretical and clinical implications. Theoretically, the current study demonstrated inherent within-person variability in both menopause symptoms and problematic eating in midlife women through measuring daily fluctuation in behavior. In particular, the study highlighted day-to-day variations in sleep, vasomotor symptoms, mood, and problematic eating behavior. Next, the current study highlighted the importance of examining psychological and behavioral symptoms of menopause on a mean-level and day-to-day level. In the current study, there was a dynamic, day-to-day covariation between menopause symptoms (i.e., mood) and problematic eating behavior. The study also confirmed daily covariation in the overall association between sleep quality and vasomotor symptom bother. As such, menopause symptoms had both mean-level and daily-level associations with problematic eating. This highlights the complexity of the association between menopause symptoms and eating behavior in midlife women and demonstrates that a significant portion of variability can be overlooked when only mean-level variables are considered. The current study lastly also investigated how menopause symptoms cohesively represent the experience of menopause to then predict problematic eating rather than solely investigating individual symptoms of menopause. Consequently, we could more accurately capture the experience of menopause and take into account the complexity surrounding menopause symptoms and problematic eating.

Clinically, the current study can provide important information regarding how menopause symptoms are tied to eating behavior. In particular, the current study provided evidence that a cluster of menopause symptoms, specifically poor sleep, frequent and bothersome vasomotor symptoms, low mood (i.e., anxiety, depression), higher levels of pain, and higher cognitive complaints were associated with problematic eating behaviors. The current study validates previous research that has shown that menopause symptoms co-occur and are interconnected. This finding provides support that a variety of symptoms link eating behavior in midlife rather than one isolated construct. The current study also highlighted that problematic eating in this population is comprised of multiple behaviors. As previous research highlights that women in midlife are at risk for eating disorders and subthreshold eating disorder behaviors (Marcus et al., 2007), the current study provided support of particular eating behaviors to target in intervention. The study also provides evidence of particular menopause symptoms that may serve as precipitants to problematic eating behaviors. In particular, it provides potential menopause symptoms to target in order to potentially reduce or improve problematic eating behavior.

Next, the current study provided support that a variety of physical, emotional, and social domains of menopause should be considered when identifying intervention targets to decrease problematic eating in this population. As previous work has focused more so on hormonal and biological changes in menopause as precipitants for increased risk of eating pathology, the current study highlighted that physical, emotional, and social factors of menopause are relevant to address as well. This includes mood, sleep, vasomotor symptoms, cognitive changes, and pain. As such, when addressing problematic eating in this population, it is of value to address a variety of psychological, behavioral, and social symptoms in addition to biological changes.

Next, the study quantified the amount of fluctuations in particular menopause symptoms (i.e., sleep, vasomotor symptoms, mood) and found that daily fluctuation in symptoms predicted engagement in problematic eating. These finding highlights considerable variability in the daily experience of menopause. As such, women likely get relief from symptoms on certain days, while on other days symptoms are more impairing. Furthermore, the study found variability in the endorsement of problematic eating behavior which suggests that eating behavior in this population may be unpredictable and potentially dysregulating.

Overall, the study findings provide important information in the treatment of both menopause symptoms and problematic eating in midlife women. First, findings demonstrate the importance of addressing daily experiences for women in this time period rather than solely capturing global indices of behavior. Findings also demonstrate the importance of capturing a variety of information when addressing problematic eating behavior. In particular, day-to-day fluctuation of symptoms, overall experience of menopause symptoms, and menopause status all presented as relevant factors to address regarding problematic eating behavior. Importantly, the current study found that many physical, emotional, and social symptoms of menopause as well as problematic eating behaviors were impairing for women regardless of menopause status. As such, the current study highlights the importance addressing all aspects of a women's experience of menopause when addressing problematic eating behavior.

Future Directions

The current study provides strong evidence for the relation between menopause symptoms and problematic eating behavior. To build upon the current findings, there are potential future investigations that would be helpful to further explore this association. First, it would be useful to include biological measures of status to more accurately determine status-

related differences in the connection between menopause symptoms and problematic eating behavior. Next, as the current study grouped all peri-menopause women together, it might be helpful to further differentiate status between early and late peri-menopause to further understand status differences among groups. The current study also grouped all problematic eating behaviors together. It may be useful for future studies to further disentangle the specific aspects of problematic eating that correspond to particular menopause symptoms. This could help to increase specificity of intervention to target specific eating behaviors or target women who engage in particular eating behaviors more frequently than others. Additionally, the current study found that the covariates of BMI, physical activity, and education were significantly related to problematic eating. In particular, higher BMI, higher levels of physical activity, and higher educational levels were associated with higher endorsement of problematic eating. Although BMI and physical activity have been investigated in their association to eating behavior (Baker & Runfola, 2016; Mangweth-Matzek et al., 2014), less work has investigated the role of education in relation to problematic eating in this population. It may be of value to further investigate the impact of educational level on problematic eating in midlife women in future studies to further investigate this association. Lastly, the current study found that certain menopause symptoms such as sleep duration and sexual behavior were endorsed by women in the sample, but did not serve as significant predictor of problematic eating when other symptoms of menopause were added to statistical models. As there is evidence that menopause symptoms serve as predictors of problematic eating, future research should further investigate the relation among additional menopause symptom and problematic eating in this population.

Conclusions

In summary, the current study provides evidence that menopause symptoms serve as significant predictors of problematic eating in a sample of peri-menopause and post-menopause women. Using retrospective measures of menopause symptoms and problematic eating behavior, the current study found that greater endorsement of menopause symptoms was associated with greater endorsement of problematic eating behavior. Specifically, higher depressive symptoms, anxiety, sleep, cognitive complaints, pain, and vasomotor symptoms were significantly associated with greater endorsement of problematic eating. Additionally, there were significant fluctuations of daily menopause symptoms and daily problematic eating behaviors which led to significant daily associations among the specific menopause symptoms of negative mood, bothersome rating of vasomotor symptoms, and sleep quality with problematic eating behavior. In particular, worse negative mood, more bothersome vasomotor symptoms, and worse sleep quality was associated with greater endorsement of problematic eating. Results provide support for the relation between menopause symptoms and problematic eating behavior in midlife women. These findings highlight the need for continued examination of the associations among menopause symptoms and problematic eating behavior to expand our understanding of risk factors for development of problematic eating in this population and to discover potential interventions to decrease engagement in these behaviors.

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Appendix A
Screening and Baseline Measures

Screening Questionnaire

1. What is your date of birth? __ __ / __ __ / __ __ __ __
2. What is your age in years? ____ years
3. What is your biological sex (check one)?

   ___ female ___ male ___ intersex
4. Which gender identity do you most identify?

   ___ female

   ___ male

   ___ transgender male

   ___ transgender female

   ___ gender variant/non-confirming

   ___ not listed: _____

   ___ prefer not to answer
5. What is your primary language? _____
6. Have you had a menstrual cycle in the past 12 months? ___ yes ___ no __ n/a
   a. If no, when was your last menstrual cycle (approximately)? xx/xxxx
   b. If yes, have you had a menstrual cycle in the past 3 months? ___ yes ___ no
      i. If yes, have you experienced any changes in your menstrual cycle predictability in the last year (e.g. skipped cycles)? __ yes __ no
7. Have you had a hysterectomy (i.e., surgical removal of uterus)? __ yes __no
8. Have you had an oophorectomy (i.e., surgical removal of ovaries)? __ yes __no

Baseline Questionnaires

Demographic and Health Questionnaire

What is your height? ____ feet ____inches

What is your weight? _____ lbs.

Which category describes your race/ethnicity? Choose all that apply

- **American Indian or Alaska Native**—For example: Navajo Nation, Blackfeet Tribe, Mayan, Aztec, Native Village of Barrow Inupiat Traditional Government, Nome Eskimo Community
- **Asian**—For example: Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese
- **Black or African American**—For example: Jamaican, Haitian, Nigerian, Ethiopian, Somalian
- **Hispanic, Latino or Spanish Origin**—For example: Mexican or Mexican American, Puerto Rican, Cuban, Salvadoran, Dominican, Columbian
- **Middle Eastern or North African**—For example: Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian
- **Native Hawaiian or Other Pacific Islander**—For example: Native Hawaiian, Samoan, Chamorro, Tongan, Fijian, Marshallese
- **White**—For example: German, Irish, English, Italian, Polish, French
- **Other** race, ethnicity, or origin, please specify: _____
- I prefer not to answer

Where do you live?

- **Midwest**—Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, North Dakota, South Dakota, Wisconsin
- **Northeast**—Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
- **South**—Arkansas, Alabama, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia
- **West**—Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming
- **Puerto Rico or other U.S. territories**
- **Other**, please specify: _____

What is the highest degree or level of school you have completed? (If you're currently enrolled in school, please indicate the highest degree you have *received.*)

- Less than a high school diploma
- High school degree or equivalent (e.g. GED)
- Some college, no degree

- Associate degree (e.g. AA, AS)
- Bachelor's degree (e.g. BA, BS)
- Master's degree (e.g. MA, MS, MEd)
- Professional degree (e.g. MD, DDS, DVM)
- Doctorate (e.g. PhD, EdD)

Are you currently in a romantic relationship with a partner or partners?

- No
- Yes, one partner
- Yes, I have multiple partners

If you answered "yes: to being in a romantic relationship, are you? Mark all that apply:

- Not applicable
- Married or in a civil union, and living together
- Married or in a civil union, and living apart
- Not married or in a civil union, and living together
- Not married or in a civil union, and living apart

What is your marital status?

- married
- single (never married)
- common-law
- widowed
- divorced
- separated

If you are in a romantic relationship, what is your partner's highest level of education?

- Less than a high school diploma
- High school degree or equivalent (e.g. GED)
- Some college, no degree
- Associate degree (e.g. AA, AS)
- Bachelor's degree (e.g. BA, BS)
- Master's degree (e.g. MA, MS, MEd)
- Professional degree (e.g. MD, DDS, DVM)
- Doctorate (e.g. PhD, EdD)

Do you have biological, adopted, foster, or step children?

- No
- No, but I am (or my partner is) pregnant or in the process of adopting
- Yes, one child
- Yes, two children
- Yes, three children
- Yes, four or more children

If you have children, what are the ages of your children and do they live with you?
Mark all that apply:

	Do not live with me	Live with me part-time	Live with me full-time
Preschool (0-5 years old)			
Elementary (6-13 years old)			
Adolescent (14-18 years old)			
Adult (19+ years old)			

What is your current employment status?

- Employed full time (40 or more hours per week)
- Employed part time (up to 39 hours per week)
- Unemployed and currently looking for work
- Unemployed and not currently looking for work
- Student
- Retired
- Homemaker
- Self-employed
- Unable to work

If answered "yes" to employment (i.e., employed part-time or full-time), what is your occupation? _____

Which of the following categories best describes the industry you primarily work in (regardless of your actual position)?

- Not employed
- Retired
- Agriculture, forestry, fishing, or hunting
- Arts, entertainment, or recreation
- Broadcasting
- Education—College, university, or adult
- Education—Primary/secondary (K-12)
- Education—Other
- Construction
- Finance and insurance
- Government and public administration
- Health care and social assistance
- Hotel and food services
- Information—Services and data
- Information—Other
- Processing
- Legal services

- Manufacturing—Computer and electronics
- Manufacturing—Other
- Military
- Mining
- Publishing
- Real estate, rental, or leasing
- Religious
- Retail
- Scientific or technical services
- Software
- Telecommunications
- Transportation and warehousing
- Utilities o Wholesale
- Other industry, please specify: _____

If answered "yes" to employment (i.e., employed part-time or full-time), how many hours do you work per week? _____

Do you provide unpaid assistance or care to a family member or friend because of a health condition or disability? *This could include a physical, mental, emotional, cognitive, behavioral or developmental disability; a chronic health condition or psychiatric condition, or blindness or deafness. Assistance can include medical care or help with everyday activities (including supervision or reminders).*

- Yes
- No
- Don't know
- Prefer not to answer

Health Survey

Do you drink alcohol?_____ yes _____ no

If yes, how many drinks do you have per day on average? _____

Do you consume caffeine (e.g. coffee, soda, chocolate, tea)? _____ yes _____ no

If yes, how much caffeine do you consume each day?

_____

Do you smoke cigarettes? _____ yes _____ no

If yes, how many cigarettes do you smoke per day on average? _____

Do you currently engage in physical activity? _____ yes _____ no

If yes, how many minutes per week? _____

In general, would you say that your health is (check one):

___ poor ___ fair ___ good ___ very good ___ excellent

Do you currently have heart disease? _____ yes _____ no

Do you currently have cancer? _____ yes _____ no

Do you currently have AIDS? _____ yes _____ no

Do you currently have high blood pressure? _____ yes _____ no

Do you currently have a neurological disease (e.g. Parkinson's disease or seizures)? __ yes __ no

Do you currently have breathing problems (e.g. asthma or emphysema)? ___ yes ___ no

Do you currently have diabetes? _____ yes _____ no

Have you been diagnosed with an underactive thyroid (i.e., hypothyroidism)? __yes __no

Do you currently have chronic pain (e.g. arthritis, back pain, migraines)? _____ yes _____ no

Do you have gastrointestinal problems such as stomach pain, irritable bowels, or ulcers?_

____ yes _____ no

Do you currently have urinary tract problems? _____ yes _____ no

Do you currently have any other medical problems or handicaps? _____ yes _____ no

If yes, please explain:

_____

Are you currently using hormone replacement therapy (HRT)? ____yes ____no

Has a health care provider recommended that you lose weight for health-related reasons?

__ yes ___ no

Has a health care provider recommended that you lose weight to reduce central or

abdominal obesity (i.e., excess weight in midsection)? __ yes ___ no

Have you experienced a stressful or disruptive life event (e.g. move, birth, death, illness,

marriage, divorce) over the past:

Year? ____ yes ____no

If yes, please explain:

_____

Month? _____ yes _____ no

If yes, please explain:

_____

Week? _____ yes _____ no

If yes, please explain:

_____

Day? _____ yes _____ no

If yes, please explain:

_____

Do you frequently feel nervous or depressed? _____ yes _____ no

If yes, please explain:

_____

Have you ever been diagnosed with a mental disorder (e.g., depressive disorder, anxiety disorder)? _____ yes _____ no

If "yes," please list the name of the mental disorder and the number of years you have had the disorder:

Number of years you have had each disorder:

- disorder: _____, _____ years
    - Current? __yes, __no
- disorder: _____, _____ years

- Current? __yes, __no

- …….

Has a mental health professional (psychiatrist, psychologist, or social worker) ever treated you? _____ yes _____ no

Are you currently being treated by a mental health professional? _____ yes _____ no

Are you currently taking medication for mental health concerns (e.g., antidepressant, anti-anxiety medication)? ____ yes ____ no

Please list all medications (including vitamins and over-the-counter medications) taken in the past month, how often you take them (e.g. daily, weekly), the time of day you take them, and the purpose of the medication:

Medication 1:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 2:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 3:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 4:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 5:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 6:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 7:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Medication 8:

Name of medication:

_____

Frequency:

_____

Time of day:

_____

Purpose:

_____

Manipulation Check

Instructions: For the next question, please ignore the question and respond with "2012:"

"What year is it?"

(a) 2012

(b) 2013

(c) 2018

(d) 2019

A. The Eating Disorder Questionnaire (EDE-Q)

Questions 1 to 12: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

On how many of the past 28 days…	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
1. Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
2. Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?	0	1	2	3	4	5	6
3. Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
3. Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
5. Have you had a definite desire to have any empty stomach with the aim of influencing your shape or weight?	0	1	2	3	4	5	6
6. Have you had a definite desire to have a totally flat stomach?	0	1	2	3	4	5	6
7. Has thinking about food, eating, or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?	0	1	2	3	4	5	6
8. Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?	0	1	2	3	4	5	6
9. Have you had a definite fear of losing control over eating?	0	1	2	3	4	5	6
10. Have you had a definite fear that you might gain weight?	0	1	2	3	4	5	6
11. Have you felt fat?	0	1	2	3	4	5	6
12. Have you had a strong desire to lose weight?		1	2	3	4	5	6

Questions 13-18: Please fill in the appropriate number in the boxes on the right. Remember that the questions only refer to the past four weeks (28 days). Over the past four weeks (28 days)….

13. Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)? _____

14. …On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)? _____

15. Over the past 28 days, how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)? _____

16. Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight? _____

17. Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight? _____

18. Over the past 28 days, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape, or amount of fat, or to burn off calories? _____

Questions 19 to 21: please circle the appropriate number. Please note that the questions the term "binge eating" means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

Binge eating can additionally include: eating much more rapidly than normal, eating until uncomfortably full, and eating large amounts of food when not hungry (Hilbert et al., 2012).

Over the past 28 days….	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
19. On how many days have you eaten in secret (i.e., furtively)? ……Do not count episodes of binge eating	0	1	2	3	4	5	6

	None of the times	A few of the times	Less than half	Half of the times	More than half	Most of the time	Every time
20. On what proportion of the times that you have eaten have you felt guilty (felt that you've done	0	1	2	3	4	5	6

wrong) because of its effect on your shape or weight? ……Do not count episodes of binge eating							

	Not at all		Slightly		Moderately		Markedly
21. Over the past 28 days, how concerned have you been about other people seeing you eat? ……Do not count episodes of binge eating	0	1	2	3	4	5	6

Questions 22 to 28: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).

Over the past 28 days……	Not at all		Slightly		Moderately		Markedly
22. Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
23. Has your shape influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
24. How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?	0	1	2	3	4	5	6
25. How dissatisfied have you been with your weight?	0	1	2	3	4	5	6
26. How dissatisfied have you been with your shape?	0	1	2	3	4	5	6
27. How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?	0	1	2	3	4	5	6
28. How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes?	0	1	2	3	4	5	6

B. Women's Health Questionnaire (WHQ)

Instructions: Please indicate how you are feeling now, or how you have been feeling THE LAST FEW DAYS, by putting a tick in the correct box in the answer to each of the following items:

	Yes, definitely	Yes, sometimes	No, not much	No, not at all
1. I wake early and then sleep badly for the rest of the night				
2. I get very frightened or panic feelings for apparently no reason at all				
3. I feel miserable and sad				
4. I feel anxious when I go out of the house on my own				
5. I have lost interest in things				
6. I get palpitations or a sensation of `butterflies' in my stomach or chest				
7. I still enjoy the things I used to				
8. I feel life is not worth living				
9. I feel tense or `wound up'				
10. I have a good appetite				
11. I am restless and can't keep still				
12. I am more irritable than usual				
13. I worry about growing old				
14. I have headaches				
15. I feel more tired than usual				
16. I have dizzy spells				
17. My breasts feel tender or uncomfortable				
18. I suffer from backache or pain in my limbs				
19. I have hot flushes				
20. I am more clumsy than usual				
21. I feel rather lively and excitable				
22. I have abdominal cramps or discomfort				
23. I feel sick or nauseous				
24. I have lost interest in sexual activity				
25. I have feelings of well-being				
26. I have heavy periods				
27. I suffer from night sweats				
28. My stomach feels bloated				
29. I have difficulty in getting off to sleep				
30. I often notice pins and needles in my hands and feet				
31. I am satisfied with my current sexual relationship				

32. I feel physically attractive
33. I have difficulty in concentrating
34. As a result of vaginal dryness sexual intercourse has become uncomfortable
35. I need to pass urine/water more frequently than usual
36. My memory is poor

C. Patient Health Questionnaire (PHQ-8)

Instructions: Over the last 2 weeks, how often have you been bothered by any of the following problems?

	Not at all	Several days	More than half the days	Nearly every day
1.Little interest or pleasure in doing things	0	1	2	3
2.Feeling down, depressed, or hopeless	0	1	2	3
3.Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4.Feeling tired or having little energy	0	1	2	3
5.Poor appetite or overeating	0	1	2	3
6.Feeling bad about yourself, or that you are a failure, or have let yourself or your family down	0	1	2	3
7.Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8.Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3

D. Generalized Anxiety Disorder 7 Questionnaire (GAD-7)

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	Over half the days	Nearly every day
1.Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all _____

Somewhat difficult _____

Very difficult _____

Extremely difficult _____

E. Pittsburgh Sleep Quality Index (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

BED TIME _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES _____

3. During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a) Cannot get to sleep within 30 minutes	0	1	2	3
b) Wake up in the middle of the night or early morning	0	1	2	3
c) Have to get up to use the bathroom	0	1	2	3
d) Cannot breathe comfortably	0	1	2	3
e) Cough or snore loudly	0	1	2	3

f) Feel too cold	0	1	2	3
g) Feel too hot	0	1	2	3
h) Had bad dreams	0	1	2	3
i) Have pain	0	1	2	3

j) Other reason(s), please describe_____
_____

How often during the past month have you had trouble sleeping because of this?

Not during the past month _____

Less than once a week _____

Once or twice a week _____

Three or more times a week _____

6. During the past month, how would you rate your sleep quality overall?

   Very good _____

   Fairly good _____

   Fairly bad _____

   Very bad _____

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

   Not during the past month _____

   Less than once a week _____

   Once or twice a week _____

   Three or more times a week _____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

   Not during the past month _____

   Less than once a week _____

Once or twice a week _____

Three or more times a week _____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

   No problem at all _____

   Only a very slight problem _____

   Somewhat of a problem _____

   A very big problem _____

10. Do you have a bed partner or roommate?

    No bed partner or roommate _____

    Partner/roommate in other room _____

    Partner in same room, but not same bed _____

    Partner in same bed _____

If you have a roommate or bed partner, ask him/her how often in the past month you have had …

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a) Loud snoring	0	1	2	3
b) Long pauses between breaths while asleep	0	1	2	3
c) Legs twitching or jerking while you sleep	0	1	2	3
d) Episodes of disorientation or confusion during sleep	0	1	2	3
e) Other restlessness while you sleep; please describe	0	1	2	3

F. Perceived Stress Scale (PSS)

Instructions: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

	Never	Almost Never	Sometimes	Fairly Often	Very Often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Appendix B
Prospective (Daily) Study Questions

Problematic Eating Behavior

Instructions**:** Answer the following questions about your eating behaviors in the past 24 hours.

	Not at all		Slightly		Moderately		Markedly
1. Did you deliberately try to limit the amount of food you ate today to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
2. Did you try to exclude any foods that you like from your diet today in order to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
3. Did you try to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight today (whether or not you have succeeded)?	0	1	2	3	4	5	6
4. Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?	0	1	2	3	4	5	6
5. Did you have a definite fear of losing control over eating today?	0	1	2	3	4	5	6
6. Did you feel guilt over eating today (felt that you've done wrong) because of its effect on your shape or weight?	0	1	2	3	4	5	6
7. Do you have a definite fear that you might gain weight today?	0	1	2	3	4	5	6
8. Did you feel fat today?	0	1	2	3	4	5	6
9. How uncomfortable did you feel seeing your body today (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?	0	1	2	3	4	5	6
10. Did you have a strong desire to lose weight today?	0	1	2	3	4	5	6

11. Did your weight influence how you thought about (judged) yourself today?	0	1	2	3	4	5	6
12. How dissatisfied are you with your weight today?	0	1	2	3	4	5	6

13. Did you binge today? ___ yes ___ no

If yes:

a) Would most people consider the amount of food consumed as unusually large? _ yes _ no
b) Did you have a sense of loss of control? _ yes _ no

Negative Emotion

Instructions: How strongly did you feel the following emotions in the past 24 hours?

	Not at all	Slightly	Moderately	Extremely
14.Anxious	1	2	3	4
15.Blue/down	1	2	3	4
16.Stressed	1	2	3	4
17.Frustrated	1	2	3	4
18.Nervous	1	2	3	4
19.Hostile	1	2	3	4
20.Ashamed	1	2	3	4
21.Guilty	1	2	3	4
22.Irritable	1	2	3	4

Sleep

Instructions: Answer the following questions about your sleep from the past 24 hours

	Example
23. What time did you get into bed? *This may not be the time that you began "trying" to fall asleep.*	10:15 pm
24. What time did you try to go to sleep? *Record the time that you began "trying" to fall asleep.*	10:45 pm
How long did it take you to fall asleep (in minutes)? *Beginning at the time you wrote in question 2, how long did it take you to fall asleep.*	30 minutes
25. How many times did you wake up, not counting your final awakening? *How many times did you wake up between the time you first fell asleep and your final awakening?*	3 times
26. In total, how long did these awakenings last?	90 minutes

What was the total time you were awake between the time you first fell asleep and your final awakening. For example, if you woke 3 times for 20 minutes, 35 minutes, and 15 minutes, add them all up (20+35+15= 70 min or 1 hr. and 10 min).		
27. What time was your final awakening? *Record the time you woke up in the morning.*	6:30 am	
28. What time did you get out of bed for the day? *What time did you get out of bed with no further attempt at sleeping? This may be different from your final awakening time (e.g. you may have woken up at 6:35 a.m. but did not get out of bed to start your day until 7:20 a.m.)*	6:50 am	
29. How would you rate the quality of your sleep? *"Sleep Quality" is your sense of whether your sleep was good or poor.*	○ very poor ○ poor ○ fair ○ very good	○ very poor ○ poor ○ fair ○ very good
30.If you have anything that you would like to say that is relevant to your sleep feel free to write it here:	I have a cold	

Vasomotor Symptoms

Instructions: Answer the following questions about hot flashes and night sweats you experienced in the past 24 hours.

31. How many hot flashes did you experience in the last 24 hours? _____

32. How bothersome was your overall experience of hot flashes in the past 24-hours?

Not at all	A little	Moderately		A lot
0	1	2		3

33. How many night sweats did you experience in the last 24 hours?

34. How bothersome was your overall experience of night sweats in the past 24-hours?

Not at all	A little	Moderately	A lot
0	1	2	3

Vita

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