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COPING WITH THE MENOPAUSAL TRANSITION:
IDENTIFYING RESILIENT RESOURCES FOR SUCCESSFUL ADAPTATION

A Thesis in
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by
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ABSTRACT

The benefits of habitual physical activity are well-established; however, the effectiveness of physical activity to alleviate menopausal symptoms remains equivocal. These inconclusive findings can be attributed to the complexity and individualized experience of the menopausal transition (MT), which requires the understanding of both between- and within-person factors in biobehavioral and psychosocial processes. The overarching aim of the present study was to identify resilient resources in coping with the MT through a positive and multi-dimensional lens. Specifically, the study was designed to unveil potential underlying pathways of the physical activity and menopausal symptom association to better understand the critical question of “whether, how, for whom, and under what circumstances” physical activity may help ameliorate symptoms. Community-dwelling middle-aged women (N=103; age range 40-60 years) completed daily Internet surveys at the end of the day and wore an accelerometer for the objective assessment of physical activity for 21 days. Both positive affect and coping efficacy emerged as resilient resources that could assist a woman in successfully adapting to her symptoms on a daily basis. Whereas physical activity did not impact symptom burden directly at the between- or within-person level, multi-level mediational analysis revealed one way in which physical activity may work to alleviate symptom burden was through its capacity to generate personal resources (i.e., positive affect, coping efficacy) for coping well with one’s symptoms. These findings underscore the importance of encouraging physical activity during this period in a woman’s lifespan; not only as a compelling tool for health promotion and prevention, but as a means to enhance a woman’s ability to cope with her symptoms on a day-to-day basis.
Table of Contents

List of Tables.....................................................................................................................v
List of Figures.....................................................................................................................vi
Acknowledgements..........................................................................................................vii
Chapter 1. Problem Statement................................................................................................1
Chapter 2. Literature Review.................................................................................................4
Chapter 3. Methods...............................................................................................................22
Chapter 4. Results................................................................................................................32
Chapter 5. Discussion...........................................................................................................38
References...........................................................................................................................55
Appendix: Tables and Figures..............................................................................................78
  Tables..............................................................................................................................79
  Figures.............................................................................................................................86
List of Tables

Table 1. Participant Demographics

Table 2. Descriptives, Intraclass Correlation, and Correlations of Predictors and Symptom Burden

Table 3. Multilevel Models of Symptom Burden

Table 4. Additional Analyses of Multilevel Models of Symptom Burden

Table 5. Exploratory Analysis with Trait Resilience as a Moderator

Table 6. 1-1-1 Multilevel Mediation Model with Positive Affect as a Mediator

Table 7. 1-1-1 Multilevel Mediation Model with Coping Efficacy as a Mediator
List of Figures

Figure 1. A conceptual model adapted from Hersch et al. (2008)’s biopsychosocial model of hot flashes..............................................................86

Figure 2. Illustration of single-level and 1-1-1 multilevel mediation models .................87

Figure 3. Daily variability in symptom burden as reported by a random subset (50%) of the participants across the 21 consecutive study days.................................................................88

Figure 4. Daily variability in positive affect as reported by a random subset (50%) of the participants across the 21 consecutive study days.................................................................89

Figure 5. Daily variability in coping flexibility as reported by a random subset (50%) of the participants across the 21 consecutive study days.................................................................90

Figure 6. Daily variability in coping efficacy as reported by a random subset (50%) of the participants across the 21 consecutive study days.................................................................91

Figure 7. Physical activity levels of study participants (COPA) in comparison to a nationally-representative NHANES sample.................................................................92

Figure 8. Interaction of trait resilience and daily coping efficacy on daily symptom burden....93

Figure 9. 1-1-1 multilevel model framework including both between- and within-person levels with positive affect as mediator.................................................................94

Figure 10. Simplified cross sectional diagrams of 1-1-1 multilevel mediation...............95
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Chapter 1

Problem Statement

In the year 2010, there were approximately 40 million women in the U.S. reaching or at menopause (40-59 years), and these numbers will continue to grow for subsequent years to come (U.S. Census Bureau, 2012). Although menopause is a natural part of the aging process in a woman’s lifespan, it can also be a difficult transition period due to the biopsychosocial changes that take place during this time. These changes often give rise to menopausal symptoms, which vary substantially from individual to individual, depending on a multitude of factors (e.g., race, ethnicity, body mass index, and lifestyle) (Sherman, Miller, Nerurkar, & Schiff, 2005). Although some women are unaffected, symptoms can disrupt a woman’s daily functioning due to physical discomfort, distress, and social embarrassment (Woods & Mitchell, 2011), and women with severe symptoms report reduced quality of life (Elavsky, 2009). Indeed, of the 40 million women in the U.S. experiencing the menopausal transition (MT), it is approximated over half are bothered by these symptoms (Woods & Mitchell, 2005, 2011). Furthermore, vasomotor symptoms last an average of over 5 to 8 years, and can even persist as long as 12 years (Col, Guthrie, Politi, & Dennerstein, 2009; Freeman, Sammel, & Sanders, 2014; Politi, Schleinitz, & Col, 2008), magnifying the impact of symptoms on a woman’s health and wellbeing.

Among the diverse symptom management options that are available to women, physical activity has recently received increased attention as a means to alleviate menopausal symptoms. Indeed, physical activity may serve as a powerful tool for middle-aged women, due to its attenuating effects on many of the health risks associated with the MT, such as cardiovascular disease, osteoporosis, and increased abdominal fat distribution (Sternfeld & Dugan, 2011). Additionally, physical activity has been shown to enhance wellbeing and quality of life, which
makes it an essential ingredient in the pursuit of successful aging (Elavsky, 2009, Wolin, Glyn, Colditz, Lee, & Kawachi, 2007). Despite the well-established health benefits associated with leading a physically active lifestyle, the potential of physical activity to improve menopausal symptoms remains equivocal due to previous methodological shortcomings and lack of sufficiently powered randomized-control trials (Daley, Strokes-Lampard, & MacArthur, 2011). These inconclusive results can also be attributed to the complexity and individualized experience of the transition, which requires the understanding of both between- and within-person differences in biological and psychosocial processes. Consequently, the critical question of “whether, how, for who, and under what circumstances” physical activity can help ameliorate symptoms remains unanswered.

Prior research on menopause has predominantly taken a biomedical approach, equating symptomology to disease, which has resulted in negative stereotypes of the MT. It is becoming clearer however, that psychosocial elements are also an integral part of symptom experiences (Dodd et al., 2001; Hanisch, Hantsoo, Freeman, Sullivan, & Coyne, 2008; Woods & Mitchell, 2005). Despite this understanding, the existing literature has failed to systematically account for the complex pathways (e.g., biobehavioral, psychosocial) comprising the individualized experience of the MT. Moreover, contrary to the recent shift in the recognition of positive psychology, relatively few studies have approached the menopause with a focus on the positive pathways as well as the broad protective factors that may provide insight into why some women are resilient to the diverse changes and challenges associated with the transition period.

The foundational research on later life resilience suggests the presence of multiple routes in which successful adaptation can take place (Staudinger, Marsiske, Baltes, 1995). The overarching aim of this study therefore was to describe the underlying mechanisms of the
association between physical activity and menopausal symptoms through an integrative lens to identify the resources and processes underlying positive adaptation. In addition, the present study focused on the potential role that physical activity may play in generating personal resources and building reserve capacity; perhaps providing women with additional benefits, leading to growth, rather than decline, throughout the transition process.
Chapter 2

Review of the Literature

The Menopausal Transition

For women, midlife coincides with menopause, a normal developmental process involving physiological, psychosocial, and age-related changes (Hunter & Rendall, 2007). Menopause refers to a single biological event, defined as the point of cessation of ovarian follicular activity (i.e., end of female reproductive potential), identified in retrospect after 12 months of amenorrhea (Burger, Hale, Dennerstein, & Robertson, 2008). The majority of women experience menopause between the ages of 40-58 years, with the median age being 51.4 years (Lamberts, Van den Beld, & Van der Lely, 1997; McKinlay, 1996). Although the biological definition refers to menopause as a single time point, it is important to note that the MT does not occur in isolation. That is, spanning menopause, the entire reproductive system undergoes change, characterized by fluctuating hormone levels which lead to physiological changes throughout various body systems (Santoro, 2005). For instance, changes in body composition and fat distribution occur specific to the MT (Sowers et al., 2007), and accelerated bone mineral density loss is a hallmark of this period (Greensdale, et al., 2012). As a result, women become more prone to diseases such as cardiovascular disease, osteoporosis, and the metabolic syndrome (Janssen, Powell, Crawford, Lasley, & Sutton-Tyrrell, 2008; Recker, Lappe, Davies, & Heaney, 2004; Rosano, Vitale, Marazzi, & Volterrani, 2007). In addition, psychosocial experiences from important life events to changes in personal roles also impact women during the MT with some studies suggesting midlife to be associated with significantly more stressful life events (e.g., interpersonal losses) compared to other stages of a woman’s lifespan (Schmidt, Murphy, Haq,
Rubinow, & Danaceau, 2004). In summary, the MT is multi-faceted and complex, making it a difficult transition period for many women.

**Symptom Experiences during the Menopausal Transition**

During the MT, women experience a diverse range of symptoms that can be broadly categorized into vasomotor, psychological, somatic, and sexual symptoms. Although there have been challenges in the identification of symptoms associated with the MT, longitudinal studies that have closely tracked alterations in hormones indicate vasomotor symptoms (i.e., hot flashes and night sweats) and certain urogenital symptoms to be menopause-specific (Ford, Sowers, Crutchfield, Wilson, & Jannausch, 2005). Hot flashes are often the most disruptive symptom to appear during the transition, depicted as a sudden and transient sensation of heat, often accompanied by flushing, sweating, palpitations, irritability, and panic (Kronenberg, 1990). Hot flashes become more common as women progress through the MT, with up to 80% of women experiencing them at some point during the transition (Williams et al., 2008), although studies also suggest highly bothersome hot flashes are only experienced by a select few (Ford et al., 2005).

Other “general” symptoms that midlife women frequently report during this period include fatigue, forgetfulness, sleep impairments, mood swings, as well as musculoskeletal aches and joint pains (Sherman et al., 2005; Warren, 2007). In fact, prevalence rates for these host of symptoms have been reported to be higher compared to vasomotor symptoms in some populations (Chim et al., 2002; Mishra, Lee, Brown, & Dobson, 2002). While these general symptoms have been shown to be more strongly associated to aging and psychosocial issues that surround midlife (Ford et al., 2005), recent evidence has also indicated depression and sleep
disturbances to be uniquely impacted by menopause (Cohen, Soares, Vitonis Otto, & Harlow, 2006; Freeman, Sammel, Lin, & Nelson, 2006; Kravitz et al., 2003).

In general, symptoms start to show up at least one year prior to the menopause (i.e., menstrual period cessation) and persist several years after. Recent longitudinal studies have even shown vasomotor symptoms continue for an average duration of 5-8 years, with evidence now indicating moderate to severe hot flashes to last for more than 10 years after the final menstrual period (Col et al., 2009; Freeman et al., 2014; Politi et al., 2008). Substantial differences exist however, from individual to individual, in terms of the type, duration, frequency, and severity of symptom experiences. Whereas some women will be fortunate and report few or even no symptoms during the transition, others will experience mild to severe symptoms that can be disruptive and bothersome (Avis et al., 2001).

The inter- and intra-individual variability in symptom reporting stems from the fact that symptom experiences are influenced by a multitude of psychosocial factors such as demographics, menopausal status, body mass index (BMI), lifestyle (e.g., physical activity, smoking, alcohol consumption), as well as psychological and cognitive factors such as negative emotions and attitudes (Busch, Barth-Oloffson, Rosenhagen, & Collins, 2003; Freeman et al., 2006). For example, results from the Study of the Women’s Health Across the Nation (SWAN) demonstrated African American women to be more likely to experience vasomotor symptoms compared to Caucasians, and Asian-American women (i.e., Japanese and Chinese) to experience less (Gold et al., 2000). Numerous studies have also indicated a positive association between high BMI and vasomotor symptoms, and heavy smokers to have a higher risk of experiencing these symptoms (Gold et al, 2004, Whiteman et al., 2003). Some researchers have also demonstrated certain personality characteristics (e.g., neuroticism, symptom sensitivity) to be
related to symptom reporting (Nedstrand, Wijma, Lindgren, & Hammar, 1998). Consequently, it can be seen that physiological explanations (e.g., decrease in estrogen levels) are insufficient to fully capture and understand one’s symptom experiences. Rather, a multi-faceted approach is needed, one which takes into consideration the diverse components that comprise a woman’s symptom experiences.

One such model is the biopsychosocial model, put forth by Hanisch et al. (2008) as an effort to better understand the heterogeneity of hot flash experiences. This conceptual framework is all-encompassing in that it was established from a review of the literature that covered the varying dimensions of the hot flash experience (i.e., course and symptomology, physiological indicators, neurocircuity, biochemical mechanisms, pharmacotherapy, and behavioral treatment). A key strength of this model lies in the conceptual move to incorporate the role of psychological influences in the explanation of hot flash experiences, an area that has been understudied due to the strong biological nature of hot flashes. However, it is clear much of the previous research has focused on the examination of the unfavorable aspects (e.g., negative emotions, stress) of symptomology. The present study therefore sought to focus on the psychological and cognitive pathways that are depicted in the biopsychosocial model (see Figure 1) through a positive and integrative lens.

**Symptom Management**

Until recently, hormone therapy (HT) was the most effective and primary treatment for the relief of symptoms and a means of prevention; however, publicity of the termination of the Women’s Health Initiative (WHI) trial prompted many women to discontinue treatment. The risk to benefit ratio of HT is rather complex and individualized, varying with the duration and timing of treatment as well as the patient’s characteristics (e.g., presence of other comorbidities, use of
current medications, age and time since menopause) (Col, 2005; Harman et al., 2011). For instance, results from large prospective studies indicate acute and short-term use of HT can increase cardiovascular disease risk (e.g., thromboembolic events, stroke), and long-term use has been shown to induce breast cancer (Chlebowski et al., 2003; Rossouw et al., 2007; Wassertheil-Smoller et al., 2003).

The uncertainty and risks associated with HT has led to a drastic decline in this treatment modality (Haas, Kaplan, Gerstenberger, & Kerlikowske, 2004). HT is currently only recommended for the relief of symptoms, at the shortest duration with the smallest effective dose (Hersh, Stefanick, & Stafford, 2004). Consequently, both the medical profession and women have turned to more natural and alternative ways for symptom management. In fact, it has been estimated approximately 40 to over 70% of peri- and post-menopausal women rely on alternative and complementary treatments for symptom management options, although there is insufficient evidence in regards to both the effectiveness and safety of these emerging treatments (Nedrow et al., 2006; Newton, Buist, Keenan, Anderson, & LaCroix, 2002). Fortunately for women, there is now a wide range of different symptom management options available from non-hormonal pharmaceutical options (e.g., anti-depressants, noradrenergic reuptake inhibitors), Complementary and Alternative Medicine (CAM) that include vitamins, acupuncture, and reflexology, as well as behavioral interventions such as exercise and stress management (National Institutes of Health, 2005; Warren, Shortle, & Dominguez, 2002). Indeed, reflective of the fact many women use a number of these strategies (Bair et al., 2005; Daley et al., 2006), the biopsychosocial model of hot flashes (Hersch et al., 2008) would also suggest symptom management should not be constrained to the sole selection of these options. Rather, it should incorporate multiple components addressing the diverse aspects of symptom experiences.
Physical Activity and Menopausal Symptoms

Physical activity is one of the most frequently recognized non-pharmacological strategies for the improvement of symptoms and the North American Menopause Society has advised symptomatic women to first consider lifestyle changes such as mild to moderate physical activity before initiating HT (NAMS, 2004). Importantly, through changes in physical activity levels, even previously inactive women can prevent and modify the adverse health consequences (e.g., weight gain, increased waist circumference, arterial stiffening) that occur concurrently with the MT (Owens, Matthews, Räikkönen, & Kuller, 2003, Sternfeld et al., 2004). Despite the fact that habitual engagement in physical activity holds many promises for middle-aged women, participation rates are especially discouraging with less than 50% of women participating in any recreational physical activity (McTiernan, Stanford, Daling, & Voigt, 1998), and general trends illustrating decreases in activity levels with age (Hawkins et al., 2009; Troiano et al., 2008).

One explanation to these sobering trends may be a result of the uncertainty regarding the effectiveness of physical activity to ameliorate menopausal symptoms. Whereas some studies (i.e., observational and intervention) indicate reduced symptom reporting with physical activity (Gold et al., 2004, Guthrie, Dennerstein, Taffe, Lehert, & Burger, 2005), several studies have demonstrated no association (Mirzainjmabadi, Anderson, & Barnes, 2006; Nelson et al., 2008). Moreover, studies have even shown higher levels of physical activity to be associated with increased vasomotor symptoms (Aiello, Yasui, & Tworoger, 2004; Romani, Gallicchio, & Flaws, 2009), which may make women reluctant to initiate or participate in physical activity, due to concerns over making symptoms such as hot flashes worse. A recent Cochrane review (Daley, Stokes-Lampard, & MacArthur, 2011) reflected these overall findings indicating that although a weak trend was observed for two (of the three) studies comparing exercise with a no treatment or
control group in favor of physical activity’s effectiveness in alleviating vasomotor symptoms, a lack of robust studies limited any conclusions to be drawn.

In essence, the current state of the literature demonstrates a vague understanding of the physical activity and vasomotor symptom association. A major contributing factor for the inconsistent evidence lies in the methodological shortcomings of existing studies such as nonrandomized designs, small sample sizes, heterogeneity in measures employed, as well as the lack of objective assessment of vasomotor symptoms and physical activity. A recent large MsFLASH (Menopause Strategies: Finding Lasting Answers for Symptoms and Health) randomized control trial designed to overcome many of the shortcomings of previous studies, has however demonstrated that 12 weeks of yoga class plus home practice compared to usual activity did not improve vasomotor frequency or bother, although improvements were seen in symptoms of insomnia (Newton et al., 2013). This suggests more studies are necessary to better understand the complex association between physical activity and symptom experiences.

**How Physical Activity May Work.** The mechanisms by which physical activity may have an impact on menopausal symptoms are still not well understood; however, a number of plausible mechanisms have been proposed. In particular, the varying neuroendocrine processes that result from both acute (including a single bout of exercise) and chronic physical activity are implicated. For instance, one biological pathway suggests that physical activity may have a favorable effect in ameliorating vasomotor symptoms through the production of endogenous opioids (i.e., β-endorphins) (Heitkamp, Huber, & Scheib, 1996). Endorphins have been noted to have multiple physiologic effects such as temperature regulation, decrease in sensitivity to pain, and anti-stress effects (i.e., inhibition of peripheral sympathetic activity) that are tenable in reducing both the frequency and bother of vasomotor symptoms (Gillman & Katzeff, 1988;
Schwarz & Kindermann, 1992). Alternatively, it has also been suggested physical activity may induce vasomotor symptoms due to the increase in core body temperature that occurs with exercise, which may be relevant to peri-menopausal and post-menopausal women with narrowed thermoneutral zones (Freedman & Krell, 1999).

From a psychological perspective, it has been suggested physical activity has a distraction effect by helping an individual divert attention away from one’s daily worries and negative affect (Bahrke & Morgan, 1978), and may therefore, temporarily distract a woman from attention on her hot flashes. Moreover, the general mental health benefits and overall quality of life enhancing aspects of physical activity that has been well established across a diverse range of populations is compelling in itself (Elavsky et al., 2005; Herring, O’Connor, & Dishman, 2010; Mandelblatt et al., 2011; Rimer et al., 2012). Specifically, despite the equivocal findings for physical activity to alleviate vasomotor symptoms per se, physical activity has been shown to improve the other general symptoms that women experience during the MT such as mood, sleep impairment, and fatigue (Sternfeld & Dugan, 2011). Further, the few studies that have examined psychosocial mechanisms in midlife women have demonstrated physical activity to be associated with enhanced personal resources such as self-worth, self-esteem, and exercise self-efficacy (Elavsky & McAuley 2005, Elavsky 2009, McAndrew et al., 2009), which can have beneficial influences on symptoms, health-related behaviors, and a woman’s quality of life. Hence, the intermediate psychological outcomes that can be derived from physical activity illustrate how physical activity may provide additional health benefits and build reserve capacity for women during the transition period.

More recently however, attention has been directed towards the immediate affective benefits of physical activity (Ekkekakis et al., 2000; Maher et al., 2012; Segar, Eccles, &
Richardson, 2011), which raises the question of how proximal, daily quality of life-enhancing aspects of physical activity play a role as women navigate about in their “real worlds”. For instance, recent research employing within-person approaches have begun to better understand that the extent to which physical activity impacts vasomotor symptoms, the cardinal symptoms of menopause, may vary due to individual difference variables such as personality, perceived control, affect, and fitness (Elavsky, Gonzales, Proctor, Williams, & Henderson, 2012, Elavsky, Molenaar, Williams, & Aronson, 2012). These differential responses to physical activity underscore the need to further probe and delineate the pathways underlying the physical activity and symptom association, and to clarify whether, how (i.e., indirect or direct), for whom, and under what circumstances physical activity may be effective in alleviating symptoms associated with the MT (McAndrew et al., 2009).

The present study attempted to address whether physical activity, positive affect, coping flexibility, and coping efficacy operate as resilient resources that facilitate successful adaptation to menopausal symptoms. In addition, trait resilience was explored as a stable personality trait that may contribute positively to daily experiences of symptoms and coping. Accumulating evidence indicates individuals who are high in trait resilience show faster recovery from stressful experiences, further indicating this link is mediated by the continuous flow of positive affect (Ong, Bergeman, Bisconti, & Wallace, 2006; Tugade & Frederickson, 2004). Accordingly, women who are characterized with high trait resilience may be more protected from the adverse consequences of the MT. Of particular interest to this study was to delineate the pathways in which physical activity has the potential to assist a woman in symptom management through the generation of positive affect, coping flexibility, and coping efficacy.
Positive Affect and Physical Activity

One underlying mechanism in which physical activity may function to reduce the burden from symptoms experienced during the MT is through its potential to enhance and sustain positive emotional states. The robust association between physical activity and positive affect has been well demonstrated across varying time scales (i.e., weekly, daily, momentary) in both laboratory and naturalistic settings (Ekkekakis, Hall, Van Landuyt, & Petruzzellow, 2000; Hyde, Conroy, Pincus, & Ram, 2011; Kanning & Schlicht, 2010; Reed & Buck, 2009; Reed & Ones, 2006; Wichers et al., 2012). Although greater variability exists in affective responses to high intensity activity, the improvements that are seen with low to moderate intensity physical activity are generalizable (Reed & Ones, 2006), and even short bouts of brisk walking have been shown to improve positive affect and increase activation (Ekkekakis et al., 2000). Women who are more physically active on a regular basis (i.e., overall) would thus have a steady diet of positive emotions. Further, a growing number of studies employing ecological momentary assessments (EMA) have provided converging evidence for the ability for daily physical activity to enhance positive affect (i.e., within-person associations), illustrating that for a given woman, more positive affect will be experienced on a day she is more physically active than is typical for her (Hyde et al., 2011; Kanning & Schliht, 2010; Wichers et al., 2012).

The marked association of physical activity to positive affect may indeed be one of the routes in which physical activity acts as a buffer to reduce the negative impact of symptom experiences. There is now strong empirical evidence on the effects of positive affect on both physical and psychological health outcomes, independent of the effects of negative affect (Pressman & Cohen, 2005; Steptoe, Dockray, & Wardle, 2009). In the context of stress and coping, theoretical frameworks have highlighted the importance of positive affective states as...
psychological resources that accumulate over time to aid an individual’s coping efforts (Frederickson & Joiner, 2002; Hobfoll, 1989). In particular, positive affect broadens cognition and creative thinking (Isen, 2000), facilitates adaptive coping (Folkman & Mostkowitz, 2004), and counteracts the physiological consequences of negative emotions (Tugade & Frederickson, 2004). Perhaps more importantly however, Zautra, Smith, Affleck, and Tennen’s (2001) Dynamic Model of Affect (DMA) suggests positive affect may especially have value in times of high stress and negative affect. Accordingly, by providing a psychological time out and restoring resources depleted by stress (Lazarus, Kanner, & Folkman, 1980), the presence of positive affect during episodes of unpleasant and unpredictable symptoms may help a woman to successfully deal with her symptoms.

**Coping and Physical Activity**

Another underlying mechanism of interest is the role of physical activity to promote psychological coping resources (e.g., perceived control, self-efficacy, self-esteem), thereby improving an individual’s ability to successfully manage stressful situations and emotions (i.e., coping success). Psychological coping resources are personal characteristics that reside within the self, which people draw upon when dealing with situational demands (Pearlin & Schooler, 1978). Whereas coping resources represent what is available to the individual in developing one’s specific responses, coping strategies refer to the actual behavior and or cognitive attempts to manage one’s stressors (Lazarus, Kanner, and Folkman, 1980).

Although investigators have categorized distinct forms and styles of coping (e.g., problem-focused, emotion-focused) and their relation to certain outcomes, there has been inconsistency as to which coping strategies or styles of coping are most effective. That is, just as there is no “magic bullet” coping strategy that can solve any problems, there is also no one
strategy that is maladaptive across all situations (Aldwin & Revenson, 1987; Cheng 2001, Thoits, 1995). Instead, the construct of coping flexibility has been recognized as a potential marker of successful coping (Bonnano, Papa, Lalande, Westphal, & Coffman, 2004; Cheng, 2001). Indeed, researchers and theorists who specialize in personality and coping have long stressed the benefits of being able to flexibly deploy diverse types of coping behaviors to varying situational demands (Block & Block, 1980; Lazarus & Folkman, 1984).

Previous and emerging literature on coping flexibility demonstrates it to be an essential component of psychological flexibility, which holds substantial value for healthy functioning (Kashdan & Rottenberg, 2010, Rozansky & Kubzansky, 2005). Specifically, coping flexibility has been associated with greater perceptions of control (Haithornthwaite, Menefee, Heinberg, & Clark, 1998), reduced anxiety and depression (Cheng, 2003), and improved psychological adjustment outcomes (Bonnano et al., 2004), all of which are suggestive of the ways in which coping flexibility could help a woman to successfully cope with her symptoms. Despite the theoretical and practical importance of this construct however, coping flexibility has received surprisingly little empirical attention. Furthermore, the few studies that have specifically focused on capturing this construct have been restricted to laboratory settings which make conclusions difficult to generalize in a natural context.

Another promising marker of successful coping that is separate from coping flexibility is coping efficacy, which is the subjective evaluation of whether one’s coping efforts were successful in attaining one’s goals in a particular situation (Aldwin & Revenson, 1987). Much of the earlier work emphasized the examination of the frequency in use of a particular coping strategy, which could only capture a parochial view of the coping process. Aldwin & Revenson (1987) brought attention to the importance of assessing coping efficacy by demonstrating that
coping efficacy predicted improvements in wellbeing beyond what was attributable to the selection of coping strategies themselves. In a sample of rheumatoid arthritis patients, Keefe et al. (1997) also highlighted the unique ability for daily coping efficacy to have dual benefits of improving pain and enhancing mood on a given day. Accordingly, coping efficacy represents a crucial intermediate step that bridges the gap between one’s coping efforts and health outcomes, hence providing another fruitful way to examine how successfully a woman is coping with her symptoms, especially in the context of daily symptom experiences. Of note, perceived control (i.e., a woman’s perception of her ability to cope or self-manage symptoms), which is related to the concept of coping efficacy, has been associated with less distress for hot flashes (Reynolds, 2000), and has also been recognized as an important factor in the experience of hot flashes in the biopsychosocial model of hot flashes (Hanish et al., 2008). Hence, it can be speculated that a woman who demonstrates greater coping efficacy would be more likely to cope well with her symptoms.

Researchers who have previously examined physical activity as a coping strategy for stress have noted multiple ways in which physical activity functions in the coping process. For instance, physical activity has been noted to assist both emotion and physiological regulation, and allow an individual to work through a problem during activity (Rostad & Long, 1996). As noted earlier, the existing literature also suggests physical activity participation may lead to improved coping as it has the ability to not only promote physical resources (e.g., improved cardiovascular health), but also psychological resources (e.g., self-competence) (Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). Although individuals may utilize physical activity as a coping modality for multiple purposes depending on the situation, the numerous benefits of coping through physical activity may be indicative of the potential of physical activity to
facilitate successful coping (e.g., through the generation of coping flexibility and coping efficacy). Nonetheless, no studies to date have examined this link in the context of symptom management with the menopause.

**Trait Resilience**

Although it is crucial to better understand the underlying pathways of the physical activity and menopausal symptom association, individual differences in personality traits also play an important role in shaping one’s daily experiences of emotions, stress, and health (Bolger & Zuckerman, 1995; Zautra, Affleck, Tennen, Reich, & Davis, 2005). Therefore, identifying psychological traits that can facilitate short-term adaptation (i.e., resistance and recovery) from unpleasant and/or disruptive symptom experiences may further provide insight into the diverse symptom experiences that have been recognized. One broad protective factor that has been highlighted is trait resilience, characterized as the ability to successfully adapt to the many challenges and adversities of life in a flexible manner (Block & Kremen, 1996). Individuals who are high in trait resilience have shown greater resistance to stress even in the context of their daily lives, and have also demonstrated the ability to recover more quickly (both emotionally and physiologically) from stressful situations (Ong et al., 2006; Tugade & Frederickson, 2004).

Accordingly, it may be worthwhile to explore how a relatively stable trait such as psychological resilience unfolds in the symptom experiences of women in the context of their daily lives.

**Daily Process Approach to Coping with Menopausal Symptoms**

The transactional theory of stress and coping views coping as a process (Lazarus & Folkman, 1984) and is best studied in situ as it unfolds over time and across differing situations. Indeed, in response to the criticism made at the retrospective distortion that is inevitably associated with methods requiring lengthy recall periods, the use of daily assessments have
allowed for sensitive process measures of coping (Affleck, Urrows, Tennen, & Higgins, 1992). Consequently, the recognition for fine-grained and time-intensive methods to capture the dynamic and multidimensional nature of coping has been underscored (Tennen, Affleck, Armeli & Carney, 2000). However, previous research that has studied menopause and coping has not addressed this issue through a daily investigation, which is a major limitation. As noted earlier, there is no universal experience of the MT, with substantial inter-individual variability in symptom experiences (Avis et al., 2001). Moreover, symptom bother can vary within individuals on a day-to-day basis, and as a function of context. Accordingly, coping resources will also vary, impacting the way a woman cope. Yet, little is known about how a woman deals with her symptoms on a daily basis, and about the resources which may help her to successfully cope with her potentially unpredictable symptoms.

In addition, objectively monitoring physical activity levels with an accelerometer will provide accurate and reliable physical activity estimates compared to self-reports, which have been prevalently used but suffer from a myriad of limitations such as difficulty recalling activities, social desirability bias, or the misinterpretation of questions due to wording (Sallis & Saelens, 2001). Indeed, the majority of studies that have addressed the physical activity and menopausal symptom association have used subjective measures of activity, at times through a single global question, which is clearly limited in its ability to accurately assess physical activity levels. Accelerometers provide one way to objectively assess physical activity that overcomes many limitations of self-report measures. What is more, the use of accelerometers may be especially pertinent for this sub-population as middle-aged women are more likely to engage in habitual physical activity (i.e., light-intensity physical activity) such as household chores, occupational activity, and caregiving tasks (Shaw, 1999), which can be challenging to assess.
through self-reports, but have been shown to be validly captured with direct measures of activity (Haskell, 2012).

**The Present Study**

The present study was conducted to better understand the physical activity and symptom association in women experiencing the MT. As the effectiveness of physical activity to impact symptom experiences may vary due to a complex interplay of individual and psychosocial factors, a 21-day daily diary study was conducted to delineate potential underlying mechanisms. The application of intensive longitudinal methods was particularly suitable in order to understand and capture the potential dynamic processes which underlie a woman’s symptom experiences and how (fluctuating) daily physical activity levels, affect, and coping impact middle-aged women. Lastly, the existing literature has predominantly portrayed and examined the MT from a biological framework, which has engraved a pessimistic view on the MT and the issues that surround it. Indeed, although there is considerable understanding of who may be vulnerable to the changes associated with the MT, it is unclear what factors can assist and protect women to successfully navigate the transition. Therefore, a key focus and strength of the present study was to approach the MT from a broader and positive perspective, in order to fully encompass the multi-dimensional nature of the transition. The overarching research question was to identify resilient resources in coping with the MT through an exploration of psychosocial processes.

The first aim of the present study was to investigate the extent to which physical activity, positive affect, coping flexibility, and coping efficacy can help women manage their MT, by alleviating symptom burden. Although the association between physical activity and vasomotor symptoms is equivocal, it is unknown whether physical activity could alleviate overall menopausal symptoms (i.e., vasomotor symptoms and the other symptoms of menopause
together) on a daily basis. Further, as aforementioned, previous studies have demonstrated the potential for positive affect, coping flexibility, and coping efficacy to be key resources which assist an individual in the coping process. Whether this applies to women coping with menopausal symptoms however, is unclear, especially in a natural setting, and on a day-to-day basis. It was hypothesized that at the between-person level, middle-aged women who are more physically active, experience greater positive affect, and display enhanced coping flexibility and coping efficacy will have improved coping resources and skills, and report lower symptom burden. At the within-person level, on days when a woman (a) is more physically active, (b) experiences more positive affect and (c) displays enhanced coping flexibility and coping efficacy than what is typical for her, she will demonstrate improved coping resources and report reduced symptom burden.

Second, an exploratory analysis was conducted as an extension of the first aim, to explore whether trait resilience would emerge as a broad protective factor that facilitates adjustment to daily symptom burden. As resilience has recently gained attention as one personality trait that assists individuals to generate and sustain positive emotional states in stressful situations (Ong et al., 2006; Tugade & Frederickson, 2004), this question was put to test in the present sample of women coping with their menopausal symptoms. It was hypothesized that on a day-to-day basis, women who are characterized with higher levels of the personality characteristic of trait resilience will indicate higher positive affect and better coping, resulting in lower symptom burden.

The third aim of the present study was to determine potential mediating pathways of the physical activity and symptom association at the daily level. Although numerous mechanisms have been proposed for how physical activity may alleviate menopausal symptoms, few studies
have attempted to identify these underlying pathways. Due to the robust association that has been evidenced between physical activity and positive affect, the focus of the meditational pathway will be on positive affect. Specifically, it was examined whether the mechanism by which physical activity alleviates symptom burden involved the enhancement of positive affect, subsequently leading to decreased symptom burden. Additionally, due to the potential of physical activity to generate coping resources that could assist a woman to successfully manage her symptoms, this work also explored whether the pathway by which physical activity mitigates symptom burden involved the enhancement of coping flexibility and coping efficacy. It was hypothesized that on days when a woman is more physically active than usual she will report reduced symptom burden through the enhancement of positive affect, coping flexibility, and coping efficacy.
Chapter 3

Methods

Participants and Procedures

Participants comprised community-dwelling women in the MT experiencing a wide range of menopausal symptoms. All participants completed screening procedures through an online screening survey or over the phone. Eligibility criteria for the study included: (1) being 40-60 years of age, (2) being capable of performing normal physical activity, (3) having experienced at least one symptom on the Green Climacteric Scale symptom list within the past two weeks, and (4) daily access to Internet. Participants were excluded if they had a history of hysterectomy with bilateral oophorectomy, had used HT in the previous 6 months, or regularly used CAM specifically targeted towards menopausal symptom management.

All procedures were approved by the Institutional Review Board at the local institution. Recruitment took place between the months of May and September 2013. Participants were recruited through handouts and flyers placed in community locations (e.g., public bulletin boards, libraries, cafes) and word of mouth. Recruitment letters were also mailed out to potential contacts in the lab’s research volunteer database, and an online ad was also posted on the research studies website for volunteers at the local institution. In order to increase recruitment efforts, two newspaper ads were also posted in the local papers.

The total enrolled sample comprised of 108 women. Of this sample, 104 women completed the daily assessment component of the study, and 103 women provided sufficient data to be included in the analysis. The sample consisted of predominantly white (94.2%), married (84.5%), well-educated (73.8% college graduate) women, and the average age was 52.6
(SD=4.7) years. Classification of menopausal status was based on self-reported menstrual history using the STRAW-10 staging criteria (Harlow et al., 2012) (see TABLE 1).

At the first lab visit, participants provided informed consent and completed a baseline survey which included demographic and psychosocial questionnaires. At this introductory lab visit, participants were directed on how to access the daily Internet surveys through a secure website (administered through the Qualtrics program) at the end of each day between 7:00pm and 2:00am, over the course of the 21-day study period. Participants were also fitted with an accelerometer and were instructed to position the monitor over their non-dominant hip during all waking hours for the duration of the study, except when showering, bathing, or when engaging in water-related activities. In order to maximize the compliance rates for the completion of daily Internet surveys, participants were told that by completing 80% of the 21 possible surveys, their name would be entered into a lottery drawing to win one of five gift certificates to Target for $30.00. For every 5% increase in survey completion rates, an individual’s name could be entered multiple times.

Completion and compliance rates were examined for the daily assessments. Participants completed surveys for a total of 2,132 of the 2,163 possible person-days (98.6% completion rate), and 2,098 (98.4%) of the completed surveys were considered valid (i.e., completed within the designated time frame and within a reasonable time period) to be included in the analysis. 80.5% of the participants (N=83) completed all 21 surveys, and 97.1% of the participants (N=100) completed 19 of the 21 surveys. Participants also provided accelerometer data for a total 2,114 of the 2,163 possible person-days (97.7%). 72.8% of participants (N=75) provided accelerometer data on all 21 days with the majority providing data on 19 of the 21 days (96.1%, N=99). The average accelerometer wear time during waking hours was 15 hours and 43 minutes.
Measures

**Symptom Burden.** The Greene-Climacteric Scale (Greene, 1998) was used to assess daily symptom burden. This scale is comprised of 21-items, and provides a brief but comprehensive and valid measure of menopausal symptoms. The scale yields three main independent symptom measures; psychological, somatic, and vasomotor symptoms, with an additional probe related to sexuality. For each of the items, participants were asked to indicate the extent to which they had been bothered by any of these symptoms today. For the present study, ratings were made on a visual 0-100 scale, ranging from 0 (*not at all*) to 100 (*very much*). The mean of the 21 items (i.e., symptoms) was used as the total symptom burden score. Although the 0 to 100 scale that was used for the daily assessments makes comparisons difficult, Greene Climacteric Scale ratings from the baseline questionnaire indicated symptom burden reports in accordance with a non-clinical sample (see TABLE 1). The internal consistency of the scale in the present study was acceptable (Cronbach’s α= 0.81 for psychological, 0.68 for somatic, 0.68 for vasomotor symptoms, respectively).

**Physical Activity.** Physical activity was objectively assessed using a tri-axial accelerometer (Actigraph model GT3X, Pensacola, FL). Each participant wore an accelerometer that was initialized to collect data in 60 second epochs and was placed on the anterior superior iliac spine along the anterior axillary line on the non-dominant hip. The data were processed and analyzed using ActiLife data analysis software (version 6.8.0). Data were screened to determine valid days which were defined as days with more than 10 hours of valid wear time. Non-wear time was defined as a period of 90 minutes or more when the accelerometer recorded zeros, according to recent recommendations (Choi, Liu, Matthews, & Buchowski, 2011). The accelerometer data were examined using the counts per minute variable, which is the raw
physical activity counts representing average intensity of physical activity without imposing any cut point decisions.

**Positive and negative affect.** Daily positive and negative affect was assessed using a modified version of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Participants were asked to indicate the extent to which they had felt a range of feelings and emotions throughout the day. Ratings were made on a visual 0-100 scale, ranging from 0 (not at all) to 100 (very much). Due to the fact that the original 20 PANAS items primarily measures high activation affect, eight additional items (cheerful, satisfied, relaxed, self-assured, depressed, worried, lonely, miserable) were also included from selected octants of the mood circumplex (Feldman, 1995) to supplement the scale with low-activated items. The within-person reliability (Cranford, et al., 2006) for each scale was calculated and were acceptable (Rc = 0.85 and 0.89 for positive and negative affect scales, respectively).

**Coping Flexibility.** In the present study, coping flexibility was operationalized as the total number of coping strategies used on a given day based on the items from the Daily Coping Inventory (Stone & Neale, 1984), which has been adapted for chronic pain coping (Affleck et al., 1992). We adapted the questionnaire specifically for coping with menopausal symptoms. Participants were given a list of eight statements and asked to “Please indicate by checking the Yes or No box what you did or thought, if anything, to cope with the symptoms you experienced today”. The eight statements each corresponded with a different coping strategy: (1) direct action: “did something specific to try to reduce the symptom”; (2) relaxation: “did something to help me relax”; (3) distraction: “diverted attention from the pain by thinking about other things or engaging in some activity”; (4) redefinition: “tried to see the pain in a different light that made it seem more bearable”; (5) emotional expression: “expressed emotions to reduce my anxiety,
frustration, or tension about the symptoms; (6) *spiritual comfort*: “sought spiritual comfort or support”; (7) *emotional support*: “sought emotional support from loved ones, friends, or professionals”; and (8) *physical activity*: “did something active or got some exercise”. The last coping item was added to the original 7 items due to the possibility that women may specifically use positive health behaviors (i.e., physical activity) as means of coping with her symptoms (Ingledew, Kardy, Cooper, & Jemal, 1996).

**Coping Efficacy.** Two items were selected and adapted from the Coping Strategies Questionnaire (Rosentiel & Keefe, 1983) to assess judgments on coping efficacy. The ability to alleviate symptoms read as follows: “Based on all the things you did to cope, or deal with your symptoms today, how much were you able to alleviate it?” Responses were made on a visual 0-100 scale, ranging from 0 (*not at all*) to 100 (*very much*). The ability to control symptoms by coping read as follows, “Select a number between 0-100 which best describes how much personal control you were able to exert over the amount of symptoms you experienced today?” The responses on the visual 0-100 scale ranged from 0 (*no control*) to 100 (*complete control*). The correlation between a person’s mean rating of these two items was highly significant (*r* = 0.96, *p* < 0.05). The combination of these two items has been used previously as an overall coping efficacy measure.

**Trait Resilience.** The Ego-Resilience Scale (Block & Kremen, 1996) was administered to assess trait psychological resilience, which is defined as the capacity for the individual to bounce back from adversity and modify responses to various situational demands. This scale consists of 14 items, each responded to on a 4-point Likert scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Sample items include “I enjoy dealing with new and unusual
situations” and “I quickly get over and recover from being startled”. The Cronbach’s alpha reliability for this sample was 0.75. Block and Kremen (1996) reported alpha was 0.76.

**Data Reduction and Analysis**

The present study used data obtained from the daily Internet surveys and objective physical activity assessments from the accelerometer to predict symptom burden through a multi-level modeling (MLM) framework. MLM is an extension of the general linear model that does not require observations to be independent, making it an appropriate tool for intensive longitudinal data due to its hierarchical structure with daily observations nested within persons (Singer, 1998). Additionally, both fixed and random effects can be estimated using this approach. In the present study, fixed effects were examined at two levels. Whereas the level 2 fixed effects examined between-person association across all participants, level 1 fixed effects assessed the daily association (between day level variation in a predictor and day level variation in an outcome) across all participants and occasions. Random effects test whether significant individual differences are present in the obtained fixed effects. For instance, if a within-person association is found between physical activity and symptom burden, adding a random slope may be feasible if there is clear variability in how symptom burden is influenced by physical activity across women. A significant random variance would therefore indicate that the strength of the within-person association between physical activity and symptom burden differs across individuals.

Considering the nested nature of the data in this work (21 consecutive days nested within 103 women), the MLM framework was employed and estimated using SAS 9.3 PROC MIXED (Little, Milliken, Stroup, & Wolfinger, 1996). In preparation for data analysis, and to separately test between- and within-person associations, all between-person predictors were person means
and all within-person predictors were person-day centered following standard procedures (Bolger, Davis, & Rafaeli, 2003; Snijders & Bosker, 1999). To illustrate, a woman i’s mean score across the 21 days constituted her level 2, between-person variable (e.g., *Overall Physical Activity*). The difference between her daily score and her mean score constituted the level 1 (within-person) person-centered variable representing day-to-day deviations relative to her average across the 21 days (*Daily Physical Activity*). Variables with skewed distributions were transformed. Daily symptom burden was root square transformed and physical activity was natural log transformed. Transformed values were used to calculate correlations and to estimate parameters in the multilevel models.

To investigate the extent to which physical activity, positive affect, and coping can help women manage their MT, by alleviating symptom burden, daily symptom burden (*DSB* ) was regressed on overall and daily physical activity, controlling for individual differences in positive affect, coping flexibility, and coping efficacy.

**Within-Person Model (Level-1):**

\[
DSB_{di} = \beta_{0i} + \beta_{1i}(\text{Daily Physical Activity}_{di}) + \beta_{2i}(\text{Daily Positive Affect}_{di}) + \\
\beta_{3i}(\text{Daily Coping Flexibility}_{di}) + \beta_{4i}(\text{Daily Coping Efficacy}_{di}) + e_{di}
\]

**Between-Person Model (Level-2):**

\[
\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Overall Physical Activity}_i) + \gamma_{02}(\text{Overall Positive Affect}_i) + \\
\gamma_{03}(\text{Overall Coping Flexibility}_i) + \gamma_{04}(\text{Overall Coping Efficacy}_i) + u_{0i}
\]

\[
\beta_{1i} = \gamma_{10} + u_{1i}
\]

\[
\beta_{2i} = \gamma_{20} + u_{2i}
\]

\[
\beta_{3i} = \gamma_{30} + u_{3i}
\]

\[
\beta_{4i} = \gamma_{40} + u_{4i}
\]
where $\gamma_{01}$ to $\gamma_{04}$ represent the influences of overall physical activity, positive affect, coping flexibility, and coping efficacy (between-person effects) on symptom burden, $\gamma_{10}$ to $\gamma_{40}$ represent the average strength of the influences of daily physical activity, positive affect, coping flexibility, and coping efficacy (average within-person effects) on symptom burden. $u_{0i}$ to $u_{4i}$ represent individual-level residual deviations that are uncorrelated with the day-level residuals $e_{di}$.

**Adjusted Analysis.** In order to strengthen the findings from the initial set of analyses, adjusted analyses were conducted controlling for plausible third variables (e.g., day in study, day of week) that could impact the associations that were found between positive affect, coping flexibility, coping efficacy, and symptom burden. Previous research has demonstrated the presence of a weekly mood cycle which indicates that emotions are dynamic, with strong weekly rhythms in day-to-day mood (Larsen & Kasimatis, 1990). Therefore, the day of the week was controlled for to account for changes in affect as a result of potential weekly mood cycles. Further, EMA researchers have been sensitive to issues of reactivity as a result of participating in repeated measures studies, although few studies have addressed the effects of reactivity through a systematic approach (Barta, Tennen & Litt, 2012). Accordingly, the day in study sequence was also controlled for to account for any changes in daily self-reports of affect, coping, and symptoms that were a result of study participation.

**Multilevel Mediation Analysis**

As all variables of interest were measured at the daily level (i.e., Level-1), 1-1-1 multilevel mediation models were estimated at the within-subjects level. In Figure 2, the top panel illustrates a single-level mediation whereas the bottom panel depicts the 1-1-1 multilevel mediation model of the present analysis. In single-level mediation, paths $a$, $b$, and $c'$ are assumed to be constant (fixed effects) across all persons $i$. In multilevel mediation models however, it is
possible for these effects to vary from person to person as represented in the circled random effects of the \(a\), \(b\), and \(c'\) fixed effect path coefficients (Figure 2, bottom 1-1-1 multilevel model). When both slopes in the \(a\) and \(b\) paths are random, the calculation and inferential test of the indirect or mediated effect must account for the covariance of the \(a\) and \(b\) random effects (see for example: Bauer, Preacher, & Gil, 2006), and will be different than the sum of \(a*b + c'\) as in classic mediation analysis. Nonetheless, in the present analysis, the random effect for the \(b\) paths were the only paths demonstrating substantial variance. Therefore, the indirect effects (product of the \(a\) and \(b\) paths), which were the central concerns of the third aim, were examined to test the mediating pathways.

Baron & Kenny (1986)’s classic demonstration of statistical mediation has been noted to have low statistical power for detecting mediated effects (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Accordingly, in the present analysis, more current recommendations which place emphasis on the higher power direct test of the indirect effect for demonstrating mediation was followed (MacKinnon, Fairchild, & Fritz, 2007). Traditional approaches in testing multilevel mediation using hierarchical linear modeling are prone to confounding within-group effects with between-group effects. The principles highlighted in Zhang, Zyphur, and Preacher (2009) were therefore used to appropriately test multilevel mediation at both the within-person level. To illustrate, the following analyses tested whether daily physical activity (\(X\)) indirectly impacted (i.e., reduced) daily symptom burden (\(Y\)) through the enhancement of positive affect (\(M\)).

Level-1: \[
\text{Daily Positive Affect}_{di} = \beta_{0i} + \beta_{1i}(\text{Daily Physical Activity}_{di}) + e_{di}
\] (1)

Level-2: \[
\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{Overall Physical Activity}_{i}) + u_{0i}
\] (2)
\[
\beta_{1i} = \gamma_{10} + u_{1i}
\] (3)
The first set of equations (1-3) predicts the mediator, daily positive affect from daily physical activity (i.e., path $a$). The second set of equations (4-7) then estimates the path of daily positive affect predicting daily symptom burden while controlling for daily physical activity (paths $b$ & $c'$, respectively). After fitting these two sets of models, the within-person indirect effect of $a*b$ was estimated as the product of $\gamma_{10}$ from equation (3) and $\gamma_{21}$ from equation (7). Similarly, the indirect effects of the between-person effects were estimated from the product of $\gamma_{01}$ from equation (2) and $\gamma_{02}$ from equation (5). In order to make inferential conclusions about the $a*b$ path, the Monte Carlo boot strapping procedure was utilized to test the significance of the indirect effect with 20,000 replications. Monte Carlo simulation is a simple yet powerful to use technique, and the appropriate coefficients from the between- and within-level were used (Selig & Preacher, 2008).
Chapter 4

Results

Descriptive Statistics

Descriptives, correlations, and intraclass correlations (ICCs) are presented in Table 2. On average, participants reported relatively low symptom burden (24.14 on a 0 to 100 scale). As indicated by the ICC estimates, more than half of the variability in symptom burden was attributed to within-person differences (55%, ICC = 0.45)(See Figure 3). Women also reported moderate levels of daily positive affect ($M=40.2$, $SD=16.89$) on a scale of 0 to 100. The ICC for positive affect was 0.66 with 34% of the variability occurring within-persons. As shown in Figure 4, the variability in positive affect responses spanned the entire scale. On average, women reported low use of coping strategies ($M=1.87$, $SD=1.55$) with some variation across the 21 days. As depicted in Figure 5, the majority of women reported towards the low end of the possible 0-8 range of total coping strategy use on a given day. Person means from the coping reports indicated women in the sample reported the most use of direct action ($M=0.39$, $SD=0.49$), relaxation ($M=0.60$, $SD=0.49$), and physical activity ($M=0.67$, $SD=0.47$) as strategies to cope with their symptoms. Women also reported moderate levels of coping efficacy ($M=45.27$, $SD=4.72$). The ICC for coping efficacy was 0.64 with 36% of the variability occurring within-persons. Similar to positive affect, daily coping efficacy reports also stretched the entire 0 to 100 scale (See Figure 6).

On average, women in this study were fairly active. The directly-measured activity counts as well as the distribution of time spent in various intensities of activity (e.g., moderate, vigorous) exceeded those from the nationally-representative NHANES sample as illustrated in Figure 7 (Troiano et al., 2008). When every minute exceeding the relevant cut point for MVPA
was examined, 72.8% of the women were meeting the federal guidelines for engaging in 150 minutes or more MVPA per week.

**Physical Activity, Positive Affect, and Coping to Predict Symptom Burden**

The first analysis examined whether physical activity, positive affect, coping flexibility, and coping efficacy predicted reduced symptom burden. Results from the multilevel models are presented in Table 3. The final predictive model for symptom burden was determined by a log likelihood ratio test ($X^2(1) = 34.8, p < 0.05$) including all predictors, and the random slope for both positive affect and coping efficacy. Although each predictor was initially analyzed in separate models, the fit of the model increased in the combined model, as indicated by a reduction in fit statistic values of $-2\text{LL}$ and AIC.

Contrary to prediction, there was no association between physical activity and symptom burden at both the between- ($\gamma_{01} = 1.11, p = 0.12$), and within-person level ($\gamma_{10} = 0.26, p = 0.15$). The between-person association between positive affect and symptom burden was also non-significant ($\gamma_{02} = -0.05, p = 0.61$). As hypothesized, however, on days when a woman experienced greater positive affect than her average, she experienced less symptom burden ($\gamma_{20} = -0.10, p < 0.05$). Contrary to what was hypothesized, the association between coping flexibility and symptom burden was non-significant at the between-person level ($\gamma_{03} = 0.12, p = 0.12$). Nonetheless, coping flexibility demonstrated a within-person association with symptom burden; albeit in the opposite direction than hypothesized ($\gamma_{30} = 0.05, p < 0.05$). That is, on days when a woman displayed enhanced coping flexibility than what was usual for her, she also reported greater symptom burden. Lastly, although the between-person effect of overall coping efficacy on symptom burden was non-significant ($\gamma_{04} = -0.97, p = 0.07$), the within-person association between coping efficacy and symptom burden was significant, conforming to what was predicted.
(γ_{40} = -0.62, p<0.05). To elaborate, on days when a woman reported greater coping efficacy than her average, she also reported less symptom burden.

The random slope for positive affect was statistically significant suggesting that the relation between positive affect and symptom burden varied across women (σ^2_{u1} = 0.08, p<0.05). A significant random slope for coping efficacy also arose, which indicated that the association between coping efficacy and symptom burden also varied across women (σ^2_{u2} = 1.66, p<0.05).

The same model was estimated looking at minutes spent in moderate to vigorous physical activity (MVPA) to examine whether the association between physical activity and symptom burden varied when intensity specific activity as opposed to raw physical activity counts was considered. In order to make adjustments to accelerometer wear time, the average MVPA per hour variable was used. Model results were similar across all predictors, and MVPA did not impact symptom burden at either the between- and within- person level (See Table 4).

**Adjusted Analysis.** Results from the adjusted multilevel models controlling for day of week and the day in study sequence are also presented in Table 4, and were by and large consistent with the unadjusted models.

**Exploratory Analysis with Trait Resilience**

A set of exploratory analyses was conducted to determine whether the within-level (i.e., day level) associations between positive affect and symptom burden and/or coping efficacy and symptom burden varied as a function of the stable personality trait of psychological resilience. Previous models demonstrated differences in the slopes of positive affect and coping efficacy, which provided good reasoning to further explore whether broad protective factors (i.e., individual difference variables) could account for this variability. The analyses indicated trait resilience did not moderate the association between daily positive affect and symptom burden
(γ₁₁=0.004, p=0.42) but a moderation effect by trait resilience was observed between daily coping efficacy and symptom burden (γ₂₁= - 0.10, p<0.05). The former interaction term was therefore not included in the final model.

Results from the multilevel model examining the interaction between coping efficacy and trait resilience are presented in Table 5. The random slope for positive affect was statistically significant (σ²_u1=0.07, p<0.05), indicating the association between positive affect and symptom burden varied across women. This interaction is depicted in Figure 8, which illustrates the association between coping efficacy and symptom burden was stronger for women who are characterized with high trait resilience. That is, on days when a woman high in trait resilience (1 SD above the mean) displayed greater coping efficacy than her average, she reported reduced symptom burden (M=4.32, SD=0.67) compared to a woman who was low in trait resilience (1SD below the mean; M=4.59, SD=0.61).

**Multilevel mediational analysis of the Physical Activity and Symptom Burden Relation**

Figure 8 provides a visual of the complete 1-1-1 multilevel model framework depicting both the between- and within-person levels with positive affect as a mediator. A simplified cross-sectional diagram indicating the indirect effects from the subsequent analyses can be found in Figure 9.

**Positive Affect.** The first set of multilevel mediational analyses examined whether physical activity had an indirect effect on symptom burden through the enhancement of positive affect. Results from the analyses are presented in Table 6. Both daily physical activity (γ₁₀=1.47, p<0.05) and overall physical activity (γ₀₁=2.11, p<0.05) demonstrated a positive and significant association to daily positive affect and overall positive affect, respectively. However, positive affect reduced symptom burden only at the within-person level (γ₂₀= -0.14, p<0.05), and the
between-person association was non-significant ($\gamma_{02}=-0.11, p=0.20$). The indirect effect of daily physical activity on symptom burden at the within-person level was -0.21 ($p<0.05; 95\% \text{ CI based on 20,000 Monte Carlo replications } [-0.33, -0.10]$). That is, on days when a woman was more physically active than her average, she experienced greater positive affect, which in turn reduced her symptom burden. The between-person effect was -0.23 (95\% CI based on 20,000 Monte Carlo replications [-0.71, 0.11]) in the hypothesized direction; however, the confidence intervals overlapped with zero demonstrating non-significance.

**Coping flexibility.** As coping flexibility was not associated with woman’s daily symptom burden in previous analyses, it was not tested as a mediator in the 1-1-1 multilevel mediational analysis.

**Coping efficacy.** Results from the previous multi-level models demonstrated daily coping efficacy to have the ability to reduce a woman’s daily symptom burden. Therefore, similar set of additional multilevel mediational analyses were tested to determine whether coping efficacy was a mediator of the physical activity and symptom burden association. Both daily physical activity ($\gamma_{10}=0.13, p<0.05$) and overall physical activity ($\gamma_{01}=0.31, p<0.05$) demonstrated a positive and significant association to daily coping efficacy and overall coping efficacy, respectively. Coping efficacy reduced symptom burden at both the between- ($\gamma_{02}=-0.91, p<0.05$) and within-person level ($\gamma_{20}=-0.81, p<0.05$) (See Table 7). The indirect effect of daily physical activity on symptom burden was -0.11 ($p<0.05; 95\% \text{ CI based on 20,000 Monte Carlo replications } [-0.19, -0.04]$). To elaborate, on days when a woman was more physically active than her average, she displayed enhanced coping efficacy which in turn reduced her symptom burden. Although the a and b paths at the between-person level suggested that overall physical activity enhances coping efficacy, which then reduced overall symptom burden, the
indirect effect (-0.28) at the between-person level was non-significant (95% CI based on 20,000 Monte Carlo replications [-0.77, 0.02]).
Chapter 5
Discussion

Physical Activity and Menopausal Symptoms

The results from the present study examining the direct association between physical activity and menopausal symptoms echoes the findings from the existing literature which, to date has demonstrated largely equivocal findings on the ability of physical activity to mitigate menopausal symptoms (Daley et al., 2011; Sternfeld & Dugan, 2011). The present study employed intensive longitudinal methods and the objective assessment of physical activity with an accelerometer as a means to overcome the methodological shortcomings of previous work. In spite of the fact that no direct associations were found for both overall physical activity and daily physical activity on reducing symptom burden, the present study unveiled some indirect pathways involving psychosocial mechanisms of the physical activity and symptom association, consistent with supposition of the psychosocial model of hot flashes (Hanisch et al., 2008). Specifically, it was found that on a day a woman is more physically active than what is typical for her, she experienced greater positive affect and enhanced coping efficacy, which in turn reduced her symptom burden.

The emergence of positive affect and coping efficacy as resilient resources that assisted women in successfully adapting to their symptoms supplements previous research indicating the relevance of these personal resources (Pimenta, Leal, Maroco, & Ramos, 2011; Reynolds, 1999; Tugade et al., 2004; Zautra et al., 2005). Considering the immediate affective benefits and the daily quality of life enhancing aspects of physical activity that has been evidenced (Ekkekakis et al., 2000; Reed & Ones, 2006), this may not be of surprise. In particular, the present findings replicated the existing literature, which has demonstrated the within-person and even momentary
associations between physical activity and positive affect (Hyde et al., 2011; Kanning & Schlicht, 2010; Wichers et al., 2012). Still, these findings shed light on the way in which boosts in daily positive affect can be acquired from increases in daily physical activity, specific to the context of middle-aged women coping on a day-to-day basis with their symptoms. Further, although the relation between daily physical activity and coping efficacy has been less evidenced in the literature, these results also support the notion of the protective effects of physical activity that has been found using person-specific analysis, distinctively through a sense of high control over symptoms (Elavsky et al., 2012b).

Collectively, these results are reassuring as they illustrate women can derive meaningful personal resources for coping well with her symptoms through the engagement of daily physical activity. Indeed, although much of the current recommendations for menopausal symptom management highlight modifications in lifestyle (i.e., overall) physical activity, accumulating acute bouts of physical activity throughout one’s day may be a valuable symptom management strategy that deserves further emphasis. In fact, as a starting point, encouraging women to be more physically active relative to her usual self may be better accepted as opposed to the prescription of reaching general physical activity guidelines.

At the same time however, it should be noted that increases in acute bouts of physical activity have been linked to greater subjective reports of hot flashes (i.e., lacking physiological corroboration), particularly in women with higher negative affect (Gibson, Matthews, & Thurston, 2014). In this respect, for women who may have greater resistance (e.g., women who may associate aerobic exercise as a trigger for hot flashes) and/or barriers to initiating and sustaining conventional forms of physical activity, mind-body therapies such as yoga, tai chi, and qi gong provide attractive alternatives. Mind-body therapies emphasize interactions among the
brain, mind, body, and behavior to promote overall wellbeing (physical and mental health) and would therefore map nicely onto the multiple dimensions that comprise menopausal symptom experiences. Indeed, the health benefits that can be derived from these activities are not limited to improvements in physical functioning, and span a wide array of positive effects (for a review see: Innes, Selfe, & Taylor, 2008; Innes, Selfe, & Vishnu, 2010). It may also be important to note the accentuation on the parasympathetic nervous system (e.g., attention to the breath cycle in yoga) in these movements, which may be especially pertinent to highly symptomatic women. Moreover, the immediate affective benefits (e.g., feelings of calmness and relaxation) and source of social support that can be attained from these activities have appeal both in its capacity to cultivate coping skills, and in its potential to sustain long-term compliance (Innes et al., 2008).

**Positive Affect as a Resource for Symptom Management**

Owing to the few decades of research demonstrating the unique beneficial consequences that can be derived from the presence of positive affect during times of stress, it was hypothesized that positive affect would be one of the key personal resources that can help a woman better adapt and be resilient to her symptoms. This hypothesis was partially supported. That is, although overall positive affect did not impact overall symptom burden, it was found that on days when a woman experienced greater positive affect than her average, she reported reduced symptom burden. Given the well-established literature on the benefits of positive affect in the coping process, the null findings from the between-person analysis may be of surprise. However, this may be reflective of studies that have shown more distressed samples to benefit more from positive affect interventions (Zautra et al., 2008). Perhaps, the benefit of overall positive affect may have been stronger if the present sample was restricted to women experiencing more severe symptoms or with depressive symptomology. Nonetheless, the ability
for positive affect to alleviate women’s day-to-day symptom experiences is notable, and provides support to the accruing literature which has evidenced the adaptive function of positive emotions during times of challenge and adversity (Folkman & Moskowitz, 2000; Frederickson, 1998; Tugade & Frederickson, 2004; Tugade, Frederickson, & Feldman, 2004; Zautra, Johnson, & Davis; 2005).

The protective effects that positive affect exerts in making a woman more resilient to her symptoms is relevant, as the experience of positive affect is modifiable through intervention. Indeed, it is reassuring to note there are a wide range of feasible and accessible approaches for enhancing positive affect. Substantial evidence is accumulating for the capacity of individuals to generate positive affect deliberately from one’s own behavior, such as through engaging in acts of kindness, forgiveness, gratitude, and meditation (Frederickson, Cohn, Coffey, Pek, & Finkel, 2008; Lyubomirsky, Sheldon, & Schkade, 2005; Lundahl, Taylor, Stevenson, & Roberts; 2008; Moskowitz, 2010). More importantly, the mediational analysis from the present study demonstrated daily physical activity to be a key source of positive affect. As Frederickson’s (1998) Broaden-and build theory of positive emotions states people’s daily experiences of positive emotions can accumulate over time to produce a variety of personal resources (e.g., physical, intellectual, social), addressing this theory (i.e., specifically, whether the affective gains generated from physical activity can lead to a buildup of resources) in future work may provide further insight into how the daily physical activity and positive affect association generates beneficial influences on a woman’s ability to cope and improve symptom experiences.

Coping Flexibility as a Resource for Symptom Management

The recognition in recent stress and coping related literature on the ability to flexibly employ appropriate coping strategies to meet varying situational demands lead to the prediction
that coping flexibility would assist a woman to cope with her symptoms on a day-to-day basis. However, both overall coping flexibility and daily coping flexibility did not emerge as resilient resources that could assist a woman in managing her symptoms. Rather, contrary to what was predicted, on days when a woman displayed greater coping flexibility than her average, she reported more symptom burden. The low symptom burden that was reported as well as the low use of coping strategies in the study sample however, prevents drawing any definitive conclusions.

Additionally, coping flexibility was operationalized as the total number of coping strategies that were reported on a given day. Despite the fact that the within-person approach used in the present study allows for each person to serve as her own control, it is possible the mere use of a greater number of coping strategies was not sufficient to appropriately capture the complexity of this construct, and may have simply reflected, a result of more strategies reported on days when symptoms were more severe. In fact, this has been shown for instance, in a sample of rheumatoid arthritis patients where severe symptoms were linked with the more frequent daily use of a wide variety of pain coping strategies (Keefe et al., 1997). Research on coping flexibility, and a broader framework of regulatory flexibility and psychological flexibility are burgeoning. Yet, limitations are inherent in the current methodological approaches to accurately capture flexibility as a result of its nascence, as well as its poor and diverse conceptualizations (Bonanno & Burton, 2013). Still, traces of the potential for coping flexibility as a marker of successful coping have been present in menopause-specific contexts (Kafanelis, Kostanski, Komesaroff, & Stojanovska, 2009) Accordingly, despite the challenges that lie in this construct, the diversity of one’s coping repertoires and the examination of individuals to cope in a flexible manner still remains to be explored carefully, and in scrutiny.
Coping Efficacy as a Resource for Symptom Management

Coping efficacy has been posited to be a better predictor of wellbeing rather than the use of specific coping strategies (Aldwin & Revenson, 1987). It was therefore thought that coping efficacy would also serve as a marker for successful coping. Although overall coping efficacy was not associated with reduced symptom burden, the hypothesis was partially supported in that on a day when a woman reported greater coping efficacy than what is typical for her, she reported less symptom burden. Comprehensively, these findings lend credence to the importance of having high coping efficacy or a sense of control over one’s symptoms, which has been linked to greater hot flash distress and overall wellbeing (Reynolds, 2000; Rendall, Simonds, & Hunter, 2008). Reciprocally, women who seek help for their hot flashes or report distress have been noted to have lower coping abilities (Hunter, 1993; Nedstrand et al., 1998). A woman who experiences few symptoms may naturally have a high sense of control. However, for a woman experiencing severe and disruptive symptoms, cognitive and behavioral techniques that foster coping efficacy may reduce the subjective burden that is experienced from her symptoms.

In this sense, cognitive behavioral therapies (CBT) and mindfulness-based practices may be a promising avenue for developing these coping resources in women seeking support for symptom management, as it targets the psychological aspects that are often neglected, but which also play a crucial role in symptom experiences. Indeed, the line of research based on the model by Hunter and colleagues (e.g., Hunter & Mann, 2010) has consistently shown the benefits of CBT in reducing the impact and discomfort of vasomotor symptoms (Ayers, Mann, & Hunter, 2011; Ayers, Smith, Hellier, Mann, & Huynter, 2012; Mann et al., 2012; Stefanopoulou, & Hunter, 2014). Furthermore, recent studies have begun to uncover that CBT works to reduce symptom burden by improving a woman’s ability to control and cope (e.g., through the use of
paced breathing, change in beliefs) with her symptoms (Balabanovic, Ayers, & Hunter, 2012; Norton, Chilcot, & Hunter, 2014).

While mindfulness-based practices have been applied less extensively in the context of coping with menopausal symptoms, similar effects can also be expected. Specifically, mindfulness fosters awareness and insight, allowing the practitioner to recognize and discriminate between components of one’s experiences such as thoughts, feelings, and emotions in a nonjudgmental manner (Kabat-Zinn, 1996). Consequently, mindfulness can alter the cognitive appraisal of events (e.g., hot flashes) through its ability to desensitize and reduce emotional reactivity and foster effective emotion regulation skills (Broderick, 2005).

Mindfulness has been applied to a variety of contexts to improve coping in patients reporting a wide range of symptoms such as anxiety, stress, pain, and panic (Carlson & Garland, 2005; Grossman, Niemann, Schmidt & Walach, 2004; Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007). More recently, Carmody et al. (2006, 2011) have specifically tested the effects of mindfulness-based stress reduction (MBSR) as an intervention for women experiencing troublesome hot flashes. Although coping efficacy was not assessed in this study, reductions were observed in hot flash bother, rather than in the intensity of symptoms (Carmody et al., 2011), which is suggestive of the possibility that the MBSR was able to improve the women’s ability to cope.

Although prospective studies are warranted to further investigate whether mindfulness practices can improve coping efficacy (and optimally reduce symptom burden) in women experiencing bothersome symptoms, there is growing evidence demonstrating a link between these constructs (Carson, Carson, Gil, & Baucom, 2004; Luberto, Cotton, McLeish, Menguione, & O’Bryan, 2013; Zautra et al., 2008). What is promising, in Carson et al. (2004)’s relationship
enhancement study in couples, mindfulness lead to increases in day-to-day coping efficacy, and more mindfulness practice on a given day was associated with greater coping efficacy, illustrating the promise of these practices in the context of one’s daily life. Moreover, as the present study found daily physical activity to improve coping efficacy, it would be of interest to combine these cognitive and behavioral components, to determine whether an enriched intervention can have a greater impact. Noteworthy is also the fact that mindfulness is a central feature of the aforementioned active forms of mind-body therapies (yoga, tai chi, qi gong), which again reinforces the potential of these interventions.

**Trait Resilience**

While collectively, previous literature has indicated individuals high in trait resilience are able to generate and sustain positive emotions even in times of stress, and are therefore able to recover and adapt more successfully from stressful situations (Ong et al., 2006; Tugade & Frederickson, 2004), the strength of the association between daily positive affect and trait resilience in the present work did not vary between high and low trait resilient women. These results were contrary to what was hypothesized, which may partially be due to the sample of the present study (i.e., relatively healthy community-dwelling middle-aged women with low to moderate menopausal symptoms).

Interestingly however, trait resilience emerged as a broad protective factor through a different pathway. Specifically, women who were high in trait resilience were able to more successfully cope with their symptoms on days when they reported greater coping efficacy, in comparison to women who were characterized with low trait resilience. This is reflective of the resilience literature which indicates habitual successful coping to be a key personal resource in resilient individuals (Frederickson, Tugade, Waugh, & Larkin, 2003). Moreover, one distinct
factor that has been recognized as to why trait resilient individuals are able to better cope and adapt to adversities is psychological flexibility (Block & Block, 1980, Block & Kremen, 1996), which may imply high trait resilient women were able to more flexibly cope with her symptoms due to this stable personality trait. Accordingly, although the mechanisms differed, these results also support trait resilience to be a pertinent individual difference variable that merits future research. Indeed, it may be a personality trait that can provide further insight into a woman’s successful trajectory through the MT.

**Implications**

To summarize, results from the present study identified positive affect and coping efficacy as resilient resources that can help a woman to cope with her symptoms in the context of her daily life. Trait resilience also emerged as a broad protective factor that may help to identify and differentiate women who are better able to cope successfully with her symptoms as a result of her enhanced coping efficacy. Importantly, the present study was able to illuminate how physical activity works to alleviate symptom burden by identifying the potential that daily physical activity holds in generating personal resources for coping well with one’s symptoms.

Due to the ambivalence that has been shown in the literature for physical activity to mitigate menopausal symptoms, health care professionals may be skeptical to offer physical activity as an effective means for symptom management. Yet, the well-established health promoting and disease preventive aspects of physical activity are also applicable to menopausal women, and should not be put to rest. Indeed, although physical activity may not alleviate vasomotor symptoms per se, maintaining high levels of physical activity throughout the MT clearly has protective effects, as it can offset many of the inevitable health consequences (adverse cardiovascular, metabolic, neuroendocrine changes) that occur during the this period.
(Sternfeld & Dugan, 2011). What is more, middle-aged women who are habitually active may have an advantage, as they are more likely to have a healthier profile entering the MT (e.g., lower BMI, decreased central adiposity)(Owens, Matthews, Wing, & Kuller, 1992; Sternfeld, Bhat, Wang, Sharp, & Quesenberry, 2005).

In addition, it is suggested one emphasis that can be placed when talking about the physical activity and symptom relation is on the more proximal, psychological outcomes (e.g., positive affective states, enhanced coping efficacy) that can result from engaging in physical activity, which are often overlooked. Moreover, it will be essential to provide information of how these immediate affective benefits can help in reducing symptom burden. To elaborate, if sustained on a regular daily basis, habitual physical activity may help a woman to add to her coping arsenal, which in turn can help her better manage her symptoms. Providing women with greater details about the treatment and adequate information in regards to her symptoms will enable them to make more accurate attributions about symptoms, possibly facilitating better adherence to physical activity (Towey, Bundy, & Cordingley, 2006). Notably, coupling physical activity interventions with symptom management skills targeted to the cognitive-behavioral level (e.g., components to improve coping ability) also has implications in that it may lead to additional gains, on top of what can be derived from activity in itself.

Fortunately, there are multiple routes (including engaging in physical activity) in which one can generate the resilient resources that were identified in the present study. Nonetheless, when designing interventions for symptom management, it will be essential to keep in mind the fact that there is no universal experience or treatment of the menopause (Avis et al., 2001). The challenge for the health care professional or researcher then will be to appropriately tailor these interventions towards the individual. While CBT and mindfulness was highlighted earlier as
potential treatment modalities, it can also be expected that it may not be a good fit for all women, despite the substantial evidence that is accumulating to support its effectiveness. Just as physical activity has person-specific effects on a woman’s symptom experiences (Elavsky et al., 2012b), the fit of the specific approach to the individual will be a key determinant of whether she can continue to engage in the behavior.

Of note, although much of the existing literature has placed emphasis on the examination of individual symptoms (especially hot flashes), there has been a gradual shift in the identification of symptom clusters (Cray, Woods, & Mitchell, 2010; Freeman, Sammel, & Lin, 2009; Greenblum et al., 2012; Thurston, Blumenthal, Babyak, & Sherwood, 2006). Indeed, researchers have begun to acknowledge the importance of examining how symptoms co-occur together, and possibly exacerbate one another as a means to capture the entirety of symptom experiences. The “interrelated nature” of menopausal symptoms was also brought to attention in Greenblum et al. (2012)’s study in which symptoms did not exclusively aggregate in a biological manner. Not only did their results provide support for the individualized experience of symptom experiences, it also conformed with the biopsychosocial model (Hanisch et al., 2008) in that symptom experiences were not exclusively biologically rooted. Additionally, evidence also indicates different types of mind-body therapies (e.g., exercise, yoga, relaxation therapies) vary in the impact it has on specific symptom types (Woods et al., 2013). In summary, this line of research indicates multiple-component interventions (e.g., including both cognitive and behavioral components) that offer a diverse range of symptom management components may have the flexibility to properly meet the individuals’ or subgroup of women’s’ needs.

Capturing the between- and within-person differences through EMA holds substantial value in elucidating the role of physical activity in the coping process. Additionally, knowledge
of individual differences in the effects of physical activity on symptom burden will open opportunities to tailor interventions using person-specific recommendations. With technological advancements, this is a time of great potential to administer and design ecological momentary interventions (EMI). That is, interventions that can be provided to women during “their everyday lives (i.e., in real time) and settings (real world)” (Heron & Smyth, 2010). The nature of these interventions may be particularly suitable for midlife women who need individualized and unique support for their menopausal symptoms. Moreover, physical activity can be incorporated into the EMI and specifically targeted to meet an individual’s needs. In order for the idiographic tailoring of EMI content and delivery however, more data are needed to delineate the dynamics of the physical activity-coping-symptom association.

Limitations and Future Directions

There are several limitations to the present study that warrant consideration and findings should be interpreted in light of these limitations. First, although the intensive daily surveys allowed for physical activity, affect, coping, and symptoms to be assessed in a more dynamic fashion, it will be worthwhile for future studies to collect even more intensive measurement occasions (i.e. multiple times throughout the day) to capture these constructs as close to their real time as possible. Whether the associations that were observed at the daily level holds or varies on a momentary basis will add to the understanding of how these processes unfold throughout the day, but can also assist in the design of EMI.

Second, the design of the present study employing concurrent (i.e., same day) analysis precludes any definitive conclusions to be drawn about temporal causality. Future work should consider the incorporation of lagged models to elucidate the direction of these findings. In addition, although in this work, coping flexibility was shown to predict more symptom burden at
the within-person level, obtaining more intensive, momentary data and applying lagged models may offer one route to better grasp this association. As the present study was observational in nature however, the mechanisms identified should be put to test in future intervention studies that address the physical activity and symptom association. Indeed, a particularly promising methodological approach that can be employed lies in the time-varying effect model (TVEM), which allows for the intensive examination of how this association may (or may not) shift with time throughout the intervention period (Tan, Shiyko, Li, Li, & Dierker, 2012).

To elaborate, in the majority of previous randomized controlled trials, the capacity for physical activity to reduce hot flash bother and frequency has only been collected at arbitrary time points (e.g., pre, mid, post) during the intervention period. Although some studies have collected daily hot flash reports (Carmody et al., 2011; Newton et al., 2013), these reports have been aggregated to smooth out day-to-day variability for the computation of weekly scores. Furthermore, secondary outcomes such as psychosocial measures of stress and affect have not been obtained intensively throughout the study duration. Findings from the present work however, could be rigorously put to test, if these secondary measures are also obtained concurrently and intensively with symptom bother and frequency throughout the intervention. Using TVEM, it becomes possible to explore whether physical activity alleviates symptoms at a certain time window, or exerts stronger effects during a specific point during the intervention. Alternatively, it is also a possibility that physical activity may not directly alleviate symptoms, but that the psychosocial factors are the time-varying changes that are occurring during the intervention, which helps a woman to cope with her symptoms on a daily basis.

Third, another methodological limitation that should be noted lies in the multilevel meditational approach that was employed. Specifically, it has been noted MLM fails to separate
variability in time-varying predictors (i.e., both the X and M in the 1-1-1 model) into daily and individual levels, which creates confounding as it cannot fully separate between- and within-person effects without introducing bias. Further, the MLM approach can only be employed with a limited portion of possible meditational questions. Using the recommendations put forth by Zhang et al. (2009), the issues with confounding that occurs at the between- and within-person level was addressed. However, a recently developed analytic approach, the multilevel structural equation modeling (MSEM) approach (Preacher et al., 2010) has been recognized to be a more flexible tool that can overcome the shortcomings inherent with the MLM meditational approach. Thus, MSEM may be a more advantageous analytical approach that could be considered for future work examining mediation processes in studies with intensive assessments.

Lastly, the women in the present sample were predominantly white, highly educated, high-income community-dwelling women who were fairly active, reporting low to moderate symptoms. It is of importance therefore, to examine whether the associations would differ in a more diverse sample and, or specifically in a sample of high symptomatic women. Notwithstanding, the use of accelerometers is a notable strength of this work which was able to overcome the lack of precision with self-assessments of physical activity. Additionally, despite the fact that another asset of the present study was its emphasis on the positive, and in particular, the identification of resilient resources for symptom management, the approach taken in this work should not be interpreted as a proposal to neglect or to ignore the negative aspects that have been identified with symptom experiences and the MT. Indeed, negative emotions also serve important functions, and can contribute to a complete and meaningful life (Forgas, 2007; Oishi & Kurtz, 2011). Future work should aim to integrate both the positive and negative aspects of symptom experiences.
Conclusions

The MT represents a normative and inevitable part of a woman’s lifespan. While some women make a smooth transition into old age, others go through profound changes during this period that influence quality of life, with negative spillover effects occurring to family and work domains (Geukes, van Aalst, Nauta, & Oosterhof, 2012; Woods & Mitchell, 2011). Indeed, the emergence of menopausal symptoms during the transition can be a source of unwanted disruption for an otherwise healthy lifestyle. Although varying with the frequency and severity of symptoms, many women will be bothered by symptom experiences at some point during the MT, with approximately 60% of women seeking medical attention for their relief (Williams et al., 2007). With the progressive increases in the aging population, the economic, societal, and psychological burden from these symptoms (both directly and indirectly) are a substantial concern for women and the healthcare system overall (Kleinman et al., 2013; Utian, 2005). Clearly, there is a high priority to identify comprehensive therapies that are cost-effective and safe, have the potential to reduce vasomotor and other menopausal symptoms, and can also encourage long-term compliance.

As the optimal course to follow for symptom management has yet to be identified however, the projected 25 million women transitioning menopause in the next decade will face uncertainty in regards to the wide array of treatment options that are presented. While collectively, research has placed emphasis on the physiological aspects of the MT, the etiology and mechanisms of hot flashes has yet to be identified (Kronenberg, 2010). Nonetheless, as indicated by the biopsychosocial model of hot flashes (Hanisch et al., 2008), incorporation of intervention components addressing the psychological aspects of symptom management is an arena that holds great promise. The present study was able to illuminate opportunities and
pathways for intervening through a cognitive behavioral route, and specifically depict how physical activity can work to assist a woman in coping with her menopausal symptoms in the context of her daily life. In order to advance the current understanding of the physical activity and menopausal symptom association however, more research is warranted with focus on the exploration of underlying biopsychosocial processes and mechanisms that are involved in the complex of symptoms. Unveiling and bringing awareness to the multiple aspects (physiological, cognitive, behavioral, and affective) of symptom experiences will assist in the development of an integrative and holistic approach to symptom management.

Promoting a physically active lifestyle during the MT is particularly relevant as participation rates are of great concern in this subpopulation (Troiano et al., 2008). Furthermore, the MT represents a period of accelerated physiological and neuroendocrine aging, which puts women at greater risk for a constellation of adverse health consequences. Hence, regardless of the ambiguity in the capacity of physical activity to directly alleviate or treat vasomotor symptoms, physical activity holds its ground as a compelling tool for health promotion and prevention, ensuring women a healthy progression through the transition. Notably, individuals or groups may be more receptive to health behavior (e.g., physical activity) change during transition periods, which makes the MT an opportune time for intervening (Hirvensalo & Lintunen, 2011).

In the short-term, physical activity may assist a woman to successfully adapt to the MT by improving a woman’s coping abilities (i.e., through the generation of resilient resources), which has potential in reducing the everyday burden that can be experienced from one’s menopausal symptoms. More importantly however, if women are able to develop a positive relationship with physical activity during this transition period, it will also help to establish an active lifestyle that continues into old age. With increases in life expectancy, the majority of
women will live about one third of their lives past the menopause. Physical activity holds great promise in directing a woman’s health and wellbeing to a more optimal trajectory.
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APPENDIX

TABLES AND FIGURES
Table 1  
**Participant Demographics**

<table>
<thead>
<tr>
<th>Participant characteristic</th>
<th>M (SD) or N%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>52.6 (4.7)</td>
</tr>
<tr>
<td>Premenopausal</td>
<td>14.6%</td>
</tr>
<tr>
<td>Perimenopausal</td>
<td>25.2%</td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>52.4%</td>
</tr>
<tr>
<td>Surgical</td>
<td>7.8%</td>
</tr>
<tr>
<td>Education</td>
<td>73.8% college graduate</td>
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<tr>
<td>Income</td>
<td>60.2% earning above $75,000</td>
</tr>
<tr>
<td>Marital status</td>
<td>84.5% married</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>94.2% White (non-Hispanic)</td>
</tr>
<tr>
<td>Height</td>
<td>163.8 (6.8) cm</td>
</tr>
<tr>
<td>Weight</td>
<td>69.9 (15.9) kg</td>
</tr>
<tr>
<td>BMI</td>
<td>26.0 (5.4)</td>
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<tr>
<td>Systolic BP</td>
<td>114.36 (14.84)</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>78.44 (10.18)</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>83.85 (12.33)</td>
</tr>
<tr>
<td>Waist to Hip Ratio</td>
<td>.80 (.06)</td>
</tr>
<tr>
<td>Depression (CES-D 10)</td>
<td>6.37 (4.19)</td>
</tr>
<tr>
<td>Symptom Burden (GCS)</td>
<td>14.06 (6.38)</td>
</tr>
<tr>
<td>Psychological Symptoms</td>
<td>7.82 (4.05)</td>
</tr>
<tr>
<td>Vasomotor Symptoms</td>
<td>1.72 (1.37)</td>
</tr>
<tr>
<td>Somatic Symptoms</td>
<td>3.59 (2.46)</td>
</tr>
</tbody>
</table>

*Note. BMI= Body Mass Index, BP= Blood Pressure; CES-D = Center for Epidemiologic Studies Depression Scale; GCS= Green Climacteric Scale. Scores on the GCS reflect baseline values assessed with the original response scale.*
Table 2  
*Descriptives, Intraclass Correlation, and Correlations of Predictors and Symptom Burden*

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>ICC</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom Burden</td>
<td>24.14</td>
<td>10.88</td>
<td>0.48</td>
<td>--</td>
<td>0.12</td>
<td>-0.12</td>
<td>0.09</td>
<td>-0.18*</td>
</tr>
<tr>
<td>2</td>
<td>Physical Activity</td>
<td>334.47</td>
<td>133.76</td>
<td>0.51</td>
<td>0.06*</td>
<td>--</td>
<td>0.25*</td>
<td>0.02</td>
<td>0.19</td>
</tr>
<tr>
<td>3</td>
<td>Positive Affect</td>
<td>40.20</td>
<td>16.89</td>
<td>0.66</td>
<td>-0.09*</td>
<td>0.23*</td>
<td>--</td>
<td>0.22*</td>
<td>0.55*</td>
</tr>
<tr>
<td>4</td>
<td>Coping Flexibility</td>
<td>1.87</td>
<td>1.55</td>
<td>0.58</td>
<td>0.05*</td>
<td>0.06*</td>
<td>0.18*</td>
<td>--</td>
<td>0.29*</td>
</tr>
<tr>
<td>5</td>
<td>Coping Efficacy</td>
<td>45.62</td>
<td>26.54</td>
<td>0.64</td>
<td>-0.15*</td>
<td>0.17*</td>
<td>0.46*</td>
<td>0.27*</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>Trait Resilience</td>
<td>45.27</td>
<td>4.72</td>
<td>--</td>
<td>-0.009</td>
<td>0.11*</td>
<td>0.21*</td>
<td>0.03</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*Note. Means and standard deviations represent person-level descriptives. ICC= Intraclass correlation. Coefficients above the diagonal represent between-person correlations, and coefficients below the diagonal reflect within-person, across-day correlations. *p < 0.05*
<table>
<thead>
<tr>
<th></th>
<th>Empty</th>
<th>All Predictors</th>
<th>Random Positive Affect</th>
<th>Random Coping Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>4.63*(0.11)</td>
<td>3.45*(1.73)</td>
<td>3.50*(1.73)</td>
<td>3.53*(1.72)</td>
</tr>
<tr>
<td>Overall physical activity, $\gamma_{01}$</td>
<td>1.14 (0.71)</td>
<td>1.12 (0.70)</td>
<td>1.11 (0.70)</td>
<td></td>
</tr>
<tr>
<td>Daily physical activity, $\gamma_{10}$</td>
<td>0.15 (0.18)</td>
<td>0.17 (0.18)</td>
<td>0.26 (0.18)</td>
<td></td>
</tr>
<tr>
<td>Overall positive affect, $\gamma_{02}$</td>
<td>-0.05 (0.09)</td>
<td>-0.05 (0.09)</td>
<td>-0.05 (0.09)</td>
<td></td>
</tr>
<tr>
<td>Daily positive affect, $\gamma_{20}$</td>
<td>-0.11*(0.03)</td>
<td>-0.11*(0.04)</td>
<td>-0.10*(0.04)</td>
<td></td>
</tr>
<tr>
<td>Overall coping flexibility, $\gamma_{03}$</td>
<td>0.12 (0.08)</td>
<td>0.12 (0.08)</td>
<td>0.12 (0.08)</td>
<td></td>
</tr>
<tr>
<td>Daily coping flexibility, $\gamma_{30}$</td>
<td>0.05*(0.02)</td>
<td>0.05*(0.02)</td>
<td>0.06*(0.02)</td>
<td></td>
</tr>
<tr>
<td>Overall coping efficacy, $\gamma_{04}$</td>
<td>-0.96 (0.54)</td>
<td>-0.97 (0.54)</td>
<td>-0.97 (0.53)</td>
<td></td>
</tr>
<tr>
<td>Daily coping efficacy, $\gamma_{40}$</td>
<td>-0.67*(0.15)</td>
<td>-0.63*(0.15)</td>
<td>-0.62*(0.21)</td>
<td></td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\sigma^2_u$</td>
<td>1.27*(0.19)</td>
<td>1.22*(0.19)</td>
<td>1.22*(0.19)</td>
<td>1.22*(0.19)</td>
</tr>
<tr>
<td>Positive affect slope, $\sigma^2_{u1}$</td>
<td>0.07*(0.02)</td>
<td>0.08*(0.02)</td>
<td></td>
<td>1.66*(0.53)</td>
</tr>
<tr>
<td>Coping efficacy slope, $\sigma^2_{u2}$</td>
<td>1.22*(0.04)</td>
<td>1.16*(0.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual variance, $\sigma^2_e$</td>
<td>6444</td>
<td>6081</td>
<td>6046</td>
<td>6011</td>
</tr>
<tr>
<td>$-2LL$</td>
<td>6448</td>
<td>6085</td>
<td>6052</td>
<td>6019</td>
</tr>
<tr>
<td>$AIC$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** Unstandardized estimates and standard errors. The inclusion of a random slope for positive affect improved model fit according to a log likelihood ratio test ($X^2(1)=35.1, p < 0.05$). The random slope for coping efficacy also improved model fit ($X^2(1)=34.8, p < 0.05$). Transformed scores were used to estimate parameters. $-2LL = -2$ Log Likelihood, $AIC$ = Akaike Information Criterion. *$p < 0.05$
Table 4

Additional Analyses of Multilevel Models of Symptom Burden

<table>
<thead>
<tr>
<th>Estimates</th>
<th>MVPA</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>6.02* (0.76)</td>
<td>3.25 (1.72)</td>
</tr>
<tr>
<td>Overall physical activity, $\gamma_{01}$</td>
<td>0.05 (0.38)</td>
<td>1.13 (0.70)</td>
</tr>
<tr>
<td>Daily physical activity, $\gamma_{10}$</td>
<td>0.09 (0.08)</td>
<td>0.23 (0.18)</td>
</tr>
<tr>
<td>Overall positive affect, $\gamma_{02}$</td>
<td>-0.02 (0.10)</td>
<td>-0.05 (0.10)</td>
</tr>
<tr>
<td>Daily positive affect, $\gamma_{20}$</td>
<td>-0.10* (0.04)</td>
<td>-0.08* (0.04)</td>
</tr>
<tr>
<td>Overall coping flexibility, $\gamma_{03}$</td>
<td>0.11 (0.08)</td>
<td>0.12 (0.12)</td>
</tr>
<tr>
<td>Daily coping flexibility, $\gamma_{30}$</td>
<td>0.05* (0.02)</td>
<td>0.08* (0.02)</td>
</tr>
<tr>
<td>Overall coping efficacy, $\gamma_{04}$</td>
<td>-0.92 (0.54)</td>
<td>-0.98 (0.53)</td>
</tr>
<tr>
<td>Daily coping efficacy, $\gamma_{40}$</td>
<td>-0.64* (0.21)</td>
<td>-0.64* (0.21)</td>
</tr>
<tr>
<td>Monday, $\gamma_{50}$</td>
<td></td>
<td>-0.11 (0.09)</td>
</tr>
<tr>
<td>Tuesday, $\gamma_{60}$</td>
<td></td>
<td>-0.06 (0.09)</td>
</tr>
<tr>
<td>Thursday, $\gamma_{70}$</td>
<td></td>
<td>-0.09 (0.09)</td>
</tr>
<tr>
<td>Friday, $\gamma_{80}$</td>
<td></td>
<td>-0.06 (0.09)</td>
</tr>
<tr>
<td>Saturday, $\gamma_{90}$</td>
<td></td>
<td>-0.005 (0.1)</td>
</tr>
<tr>
<td>Sunday, $\gamma_{100}$</td>
<td></td>
<td>-0.11 (0.1)</td>
</tr>
<tr>
<td>Day in Study, $\gamma_{110}$</td>
<td></td>
<td>0.03* (0.004)</td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\sigma^2_{u0}$</td>
<td>1.25* (0.19)</td>
<td>1.21* (0.18)</td>
</tr>
<tr>
<td>Positive affect slope, $\sigma^2_{u1}$</td>
<td>0.08* (0.02)</td>
<td>0.07* (0.02)</td>
</tr>
<tr>
<td>Coping efficacy slope, $\sigma^2_{u2}$</td>
<td>1.72* (0.55)</td>
<td>1.69* (0.54)</td>
</tr>
<tr>
<td>Residual variance, $\sigma^2_{e}$</td>
<td>1.16* (0.04)</td>
<td>1.14* (0.04)</td>
</tr>
<tr>
<td>$-2LL$</td>
<td>5958</td>
<td>6002</td>
</tr>
<tr>
<td>$AIC$</td>
<td>5966</td>
<td>6010</td>
</tr>
</tbody>
</table>

*Note. Unstandardized estimates and standard errors. Transformed scores were used to estimate parameters. $-2LL = -2$ Log Likelihood, $AIC = Akaike$ Information Criterion. *$p < 0.05$
### Table 5
*Exploratory Analysis with Trait Resilience as a Moderator*

<table>
<thead>
<tr>
<th></th>
<th>Interactions</th>
<th>Interaction, coping efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>5.86*(0.76)</td>
<td>5.88*(0.75)</td>
</tr>
<tr>
<td>Overall positive affect, $\gamma_{01}$</td>
<td>0.005 (0.10)</td>
<td>0.007 (0.10)</td>
</tr>
<tr>
<td>Daily positive affect, $\gamma_{10}$</td>
<td>-0.11*(0.03)</td>
<td>-0.11*(0.04)</td>
</tr>
<tr>
<td>Overall coping efficacy, $\gamma_{02}$</td>
<td>-0.77 (0.53)</td>
<td>-0.79 (0.53)</td>
</tr>
<tr>
<td>Daily coping efficacy, $\gamma_{20}$</td>
<td>-0.65*(0.14)</td>
<td>-0.60*(0.14)</td>
</tr>
<tr>
<td>Trait resilience, $\gamma_{30}$</td>
<td>-0.007 (0.03)</td>
<td>-0.008 (0.03)</td>
</tr>
<tr>
<td>Trait resilience x daily positive affect, $\gamma_{11}$</td>
<td>0.004 (0.006)</td>
<td></td>
</tr>
<tr>
<td>Trait resilience x daily coping efficacy, $\gamma_{21}$</td>
<td>-0.11*(0.03)</td>
<td>-0.10*(0.03)</td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, $\sigma^2_{u0}$</td>
<td>1.27*(0.19)</td>
<td>1.27*(0.19)</td>
</tr>
<tr>
<td>Positive affect slope, $\sigma^2_{u1}$</td>
<td>.07*(0.02)</td>
<td></td>
</tr>
<tr>
<td>Residual variance, $\sigma^2_{e}$</td>
<td>1.31*(0.04)</td>
<td>1.24*(0.04)</td>
</tr>
<tr>
<td>-2LL</td>
<td>6246</td>
<td>6206</td>
</tr>
<tr>
<td>AIC</td>
<td>6250</td>
<td>6212</td>
</tr>
</tbody>
</table>

*Note.* Unstandardized estimates and standard errors. Transformed scores were used to estimate Parameters. -2LL = -2 Log Likelihood, AIC = Akaike Information Criterion. *p < 0.05
### Table 6

**Multilevel Mediation Model with Positive Affect as a Mediator**

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Path a To positive affect</th>
<th>Path b and c’ To symptom burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept ($\gamma_{00}$, $\gamma_{00DSB}$)</td>
<td>0.90 (2.0)</td>
<td>2.79 (1.70)</td>
</tr>
<tr>
<td>Daily physical activity ($\gamma_{10}$, $\gamma_{11}$)</td>
<td>1.47*(0.15)</td>
<td>0.18 (0.18)</td>
</tr>
<tr>
<td>Daily positive affect ($\gamma_{21}$)</td>
<td>-</td>
<td>-0.14*(0.03)</td>
</tr>
<tr>
<td>Overall physical activity ($\gamma_{01}$, $\gamma_{02}$)</td>
<td>2.11*(0.82)</td>
<td>1.10 (0.71)</td>
</tr>
<tr>
<td>Overall positive affect ($\gamma_{03}$)</td>
<td>-</td>
<td>-0.11 (0.08)</td>
</tr>
</tbody>
</table>

**Random Effects**

| Intercept ($\sigma^2_{u0}$, $\sigma^2_{u0DSB}$) | 1.82*(0.26) | 1.26*(0.19) |
| Positive affect slope ($\sigma^2_{u1}$) | 0.08*(0.02) | |
| Residual variance ($\sigma^2_{e}$, $\sigma^2_{eDSB}$) | 1.10*(0.04) | 1.25*(0.19) |

*Note. Unstandardized estimates and standard errors. Transformed scores were used to estimate parameters. *p < 0.05*
Table 7

Multilevel Mediation Model with Coping Efficacy as a Mediator

<table>
<thead>
<tr>
<th></th>
<th>Path a To coping efficacy</th>
<th>Path b and c’ To symptom burden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept ($\gamma_{00}, \gamma_{00DSB}$)</td>
<td>0.88*(0.37)</td>
<td>3.53*(1.73)</td>
</tr>
<tr>
<td>Daily physical activity ($\gamma_{10}, \gamma_{11}$)</td>
<td>0.13*(0.03)</td>
<td>0.04 (0.18)</td>
</tr>
<tr>
<td>Daily coping efficacy ($\gamma_{21}$)</td>
<td></td>
<td>-0.79*(0.14)</td>
</tr>
<tr>
<td>Overall physical activity ($\gamma_{01}, \gamma_{02}$)</td>
<td>0.31*(0.15)</td>
<td>1.04 (0.70)</td>
</tr>
<tr>
<td>Overall coping efficacy ($\gamma_{03}$)</td>
<td>-</td>
<td>-0.91*(0.45)</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance intercept ($\sigma^2_{u0}, \sigma^2_{u0DSB}$)</td>
<td>0.06*(0.01)</td>
<td>1.23*(0.19)</td>
</tr>
<tr>
<td>Coping efficacy slope ($\sigma^2_{u1}$)</td>
<td></td>
<td>1.84*(0.57)</td>
</tr>
<tr>
<td>Residual variance ($\sigma^2_{e}, \sigma^2_{eDSB}$)</td>
<td>0.04*(0.001)</td>
<td>1.24*(0.04)</td>
</tr>
</tbody>
</table>

*Note.* Unstandardized estimates and standard errors. Transformed scores were used to estimate parameters. *p < 0.05*
Figure 1. A conceptual model adapted from Hersch et al. (2008)’s biopsychosocial model of hot flashes
Figure 2. Illustration of single-level (top panel) and 1-1-1 multilevel mediation (bottom panel) models

Level 2

Level 1
Figure 3. Daily variability in symptom burden as reported by a random subset (50%) of the participants across the 21 consecutive study days. Different colors represent individual lines.
Figure 4. Daily variability in positive affect as reported by a random subset (50%) of the participants across the 21 consecutive study days. Different colors represent individual lines.
Figure 5. Daily variability in coping flexibility as reported by a random subset (50%) of the participants across the 21 consecutive study days. From the figure, it can be seen that many women reported low to moderate use of coping strategies throughout the duration of the study. Different colors represent individual lines.
Figure 6. Daily variability in coping efficacy as reported by a random subset (50%) of the participants across the 21 consecutive study days. Different colors represent individual lines.
Figure 7. Physical activity levels of study participants (COPA) in comparison to a nationally-representative NHANES sample.
Figure 8. Interaction of trait resilience and daily coping efficacy on daily symptom burden. High trait-resilience denotes one standard deviation above the within-person mean, low trait-resilience denotes one standard deviation below the within-person mean. Note. Symptom burden scores reflect transformed values.
Figure 9. 1-1-1 multilevel model framework including both between- and within-person levels with positive affect as mediator. Only fixed effects are depicted in the figure. Random effects variances are omitted to avoid cluttering the figure.
Figure 10. Simplified cross sectional diagrams of 1-1-1 multilevel mediation.

Indirect effect = -0.21, [-0.33, -0.10], \( p < 0.05 \)

Indirect effect = -0.11, [-0.19, -0.04], \( p < 0.05 \)